Dr. Babasaheb Ambedkar Technological University (Established a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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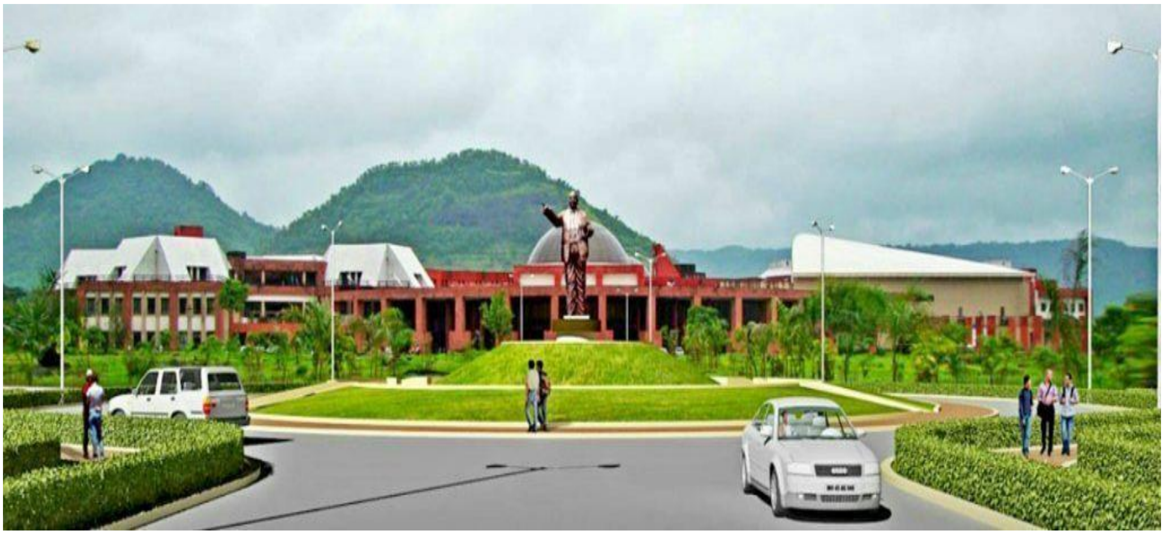
PROPOSED DRAFT FOR CURRICULUM

UNDER GRADUATE PROGRAMME

B. TECH

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

WITH EFFECT FROM THE ACADEMIC YEAR
SY: 2021-2022



Rules and Regulations

1. The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end- semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme: A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the

following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination

(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

(c) Paid all required advance payments of the Institute and hostel for the current semester;

(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2020-21, starting from I year B. Tech.

Percentage of Marks	Letter Grade	Grade Point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awarded based on CGPA of all eight semester of B. Tech Program.

CGPA for pass is minimum 5.0	
CGPA upto < 5.50	Pass class
CGPA ≥ 5.50 & $<$ 6.00	Second Class
CGPA ≥ 6.00 & $<$ 7.50	First Class
CGPA $\geq$ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

1	Mid Semester Exam (MSE) Marks	20
2	Continuous Assessment Marks	20
3	End Semester Examination (ESE) Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assessment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100,

with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B. Tech starting from Academic Year 2020-21.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.

EE Grade: The 'EE' grade stands for minimum passing grade.

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only. If any of the student remain **absent** for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

6.1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$\textbf{SGPA} \quad - \quad \frac{\text{CREDIT INDEX}}{\sum \text{CREDITS for a Semester}}$$

Where

'n' is the number of subjects for the semester,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.

-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$\textbf{CGPA} \quad - \quad \left. \frac{\sum \text{CREDIT INDEX of all Previous Semester}}{\sum \text{CREDITS of all Previous Semester}} \right|_{\text{upto a Semester}}$$

Where

'm' is the total number of subjects from the first semester onwards up to and including the semester S,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

#CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B. Tech level is introduced ,to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. <u>Eligibility Criteria for Majors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B. Tech (Honors) Degree.

B. <u>Eligibility Criteria for Minors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B. Tech Degree in -------Engineering with Minor in-- Engineering.
(For e.g.: B. Tech in Artificial Intelligence & Data Science with Minor in Computer Engineering).

For applying for Honors and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (e.g. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like Medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   a) If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

b) The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

c) In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/ Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i. e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

Different Categories of Courses and Credits for Degree Requirements

a) Humanities and Social Science including Management Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTHM104	Communication Skills	(2-0-0) 2
2	BTHM109L	Communication Skills Laboratory	(0-0-2) 1
3	BTHM403	Basic Human Rights	(3-0-0) 3
4	BTAIHM503	(A) Economics and Management (B) Business Communication (c) Knowledge Reasoning and AI Ethics.	(3-0-0) 3
5	BTAIHM605	(A) Development Engineering (B) Employability and Skills Development (C) Consumer Behavior	(3-0-0) 3
6	BTAIHM706	(A) Foreign Language Studies (B) Universal Human Value & Ethics (C) Intellectual Property Rights	(0-0-4)Audit
		TOTAL	**12**

b) Basic Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTBS101	Engineering Mathematics – I	(3-1-0) 4
2	BTBS102	Engineering Physics	(3-1-0) 4
3	BTBS107L	Engineering Physics Laboratory	(0-0-2) 1
4	BTBS201	Engineering Mathematics-II	(3-1-0) 4
5	BTBS202	Engineering Chemistry	(3-1-0) 4
6	BTBS207L	Engineering Chemistry Laboratory	(0-0-2) 1
7	BTES301	Engineering Mathematics-III	(3-1-0) 4
8	BTBS404	Probability Theory and Random Processes	(3-0-0) 3
		TOTAL	**25**

c) Engineering Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES103	Engineering Graphics	(2-0-0) 2
2	BTES105	Energy and Environment Engineering	(2-0-0) 2
3	BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
4	BTES108L	Engineering Graphics Laboratory	(0-0-4) 2
5	BTES203	Engineering Mechanics	(2-1-0) 3
6	BTES204	Computer Programming	(2-0-0) 2
7	BTES205	Workshop Practices	(0-0-4) 2
8	BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
9	BTES208L	Engineering Mechanics Laboratory	(0-0-2) 1
10	BTES209L	Basic Computer Programming Laboratory	(0-0-2) 1
11	BTESC304	Computer Architecture & Operating Systems	(3-0-0) 3
12	BTESC305	Digital Logic & Signal Processing	(3-0-0) 3
		TOTAL	**21**

d) Professional Core Course

Sr. No.	Cours eCode	Course Name	(L-T-P) Credits
1	BTAIC302	An Introduction to Artificial Intelligence	(3-1-0) 4
2	BTAIC303	Data Structure and Algorithm using Python	(3-1-0) 4
3	BTAIC401	Data Analysis	(3-1-0) 4
4	BTAIC402	Database Management System	(3-1-0) 4
5	BTAIC501	Computer Network and Cloud Computing	(3-1-0) 4
6	BTAIC502	Machine Learning	(3-0-0) 3
7	BTAIC601	Deep Learning	(3-1-0) 4
8	BTAIC602	Advanced Machine Learning	(3-0-0) 3
9	BTAIC701	Natural Language Processing	(3-1-0) 4
10	BTAIC702	AIOPS	(3-0-0) 3
11	BTAIC703	Data Visualization and its tools	(3-1-0) 4
12	BTAIL306	Artificial Intelligence Lab and Programming, Data Structure and Algorithm using Python Lab	(0-0-4) 2
13	BTAIL406	Data Analysis Lab and Database Management System Lab	(0-0-4) 2
14	BTAIL506	Machine Learning Lab and Competitive Programming Lab	(0-0-4) 2
15	BTAIL606	Deep Learning Lab and Advanced Machine Learning Lab	(0-0-4) 2
16	BTAIL707	Natural Language Processing Lab & AIOPS Lab	(0-0-4) 2
		TOTAL	**51**

e) Professional Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTAIPE405	Professional Elective Courses –I 1. Numerical Methods and Computer Programming 2. Image Processing & Computer Vision 3. Internet of Things & Embedded System 4. Programming in JAVA	(3-1-0) 4
2	BTAIPE504	Professional Elective Course (PEC) -II 1. Advanced Data base Systems 2. Soft Computing 3. Sensors & Robotics Technology 4. Advanced Java	(3-1-0) 4
3	BTAIPE603	Professional Elective Course (PEC) -III 1. Geographical Information Systems 2. Recommender System 3. Industry 4.0 & Automation 4. Web Development	(3-1-0) 4
4	BTAIPE704	Professional Elective Course (PEC) -IV 1. GPU Computing 2. Advanced Computer Vision 3. Autonomous Vehicle 4. Android Development	(3-1-0) 4
		TOTAL	**16**

f) Open Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTAIOE505	Open Elective Course (OEC) - I 1. Data Mining and Warehousing 2. Digital Communication & Information Theory 3. Software Engineering and Testing 4. Virtual Reality	(3-1-0) 4
2	BTAIOE604	Open Elective Course (OEC) - III 1. Big Data Analytics 2. Cryptography & Network Security 3. Agile Methodology 4. Augmented Reality	(3-1-0) 4
3	BTAIOE705	Open Elective Course (OEC) -IV 1. DevOPS 2. Blockchain 3. GPU Computing 4. IOS Development	(3-1-0) 4
		TOTAL	**12**

g) Seminar / Mini Project / Internship

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES210S	Seminar	(0-0-2) 1
2	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	Audit
3	BTAIP408	Internship -II	Audit
4	BTAIP508	Internship –II (Evaluation)	Audit
5	BTAIP608	Internship -III	Audit
6	BTAIP709	Internship –III (Evaluation)	Audit
7	BTAIS307	Seminar-I	(0-0-4) 2
8	BTAIS407	Seminar-II	(0-0-4) 2
9	BTAIM507	Mini Project-I	(0-0-4) 2
10	BTAIM607	Mini Project-II	(0-0-4) 2
11	BTAIM708	Project Work	(0-0-4) 2
12	BTAIF801	Project Work / Internship	(0-0-24) 12
		TOTAL	**23**

Category – wise total number of credits

Sr. No	Category	Suggested Breakup of Credits by AICTE	Credits awarded to First year	Credits awarded to Second year to Final Year	Total
1	Humanities and Social Sciences including Management courses	**12***	3	9	**12**
2	Basic Science courses	**25***	18	7	**25**
3	Engineering Science courses including workshop, drawing, basics of electrical / mechanical / computer etc.	**24***	15	6	**21**
4	Professional core courses	**48***	0	51	**51**
5	Professional Elective courses relevant to chosen specialization/branch	**18***	0	16	**16**
6	Open subjects – Electives from other technical and /or emerging subjects	**18***	0	12	**12**
7	Project work, seminar and internship in industry or elsewhere	**15***	1	22	**23**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	**NC**	--	--	**--**
	Total	**160***	**37**	**123**	**160**

**Minor variation is allowed as per need of the respective disciplines.*

Suggested Plan of Study

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTES301	BTAIC401	BTAIC501	BTAIC601	BTAIC701	BTAIP801 (Project / Internship)
2	BTBS102	BTBS202	BTAIC302	BTAIC402	BTAIC502	BTAIC602	BTAIC702	--
3	BTES103	BTES203	BTAIC303	BTHM403	BTAIHM503	BTAIPE603 **(Elective)**	BTAIC703	--
4	BTHM104	BTES204	BTESC304	BTBS404	BTAIPE504 **(Elective)**	BTAIOE604 **(Elective)**	BTAIPE704 **(Elective)**	--
5	BTES105	BTES205	BTESC305	BTAIPE405 **(Elective)**	BTAIOE505 **(Elective)**	BTAIHM605 **(Elective)**	BTAIOE705 **(Elective)**	--
6	BTES106	BTES206	BTAIL306	BTAIL406	BTAIL506	BTAIL606	BTAIHM706 **(Elective)**	--
7	BTBS107L	BTBS207L	BTAIS307	BTAIS407	BTAIM507	BTAIM607	BTAIL707	--
8	BTES108L	BTES208L	BTES211P (Internship –1 Evaluation)	BTAIP408 (Internship –2)	BTAIP508 (Internship –2 Evaluation)	BTAIP608 (Internship –3)	BTAIP708	--
9	BTHM109L	BTES209S	--	--	--	--	BTAIP709 (Internship –3 Evaluation)	--
10	--	BTES211P (Internship -1)	--	--	--	--	--	--

Programme Educational Objectives (PEO)

Name of Programme: Bachelor of Technology (Artificial Intelligence and Data Science). A graduate in the discipline of Artificial Intelligence and Data Science is generally expected to have three kinds of knowledge. First, the graduate should have conceptual knowledge of the core topics of Computer Science. Second, she/he should have knowledge of mathematical formalism underlying various programming concepts. Third, graduates in the discipline of Artificial Intelligence and Data Science should have the knowledge of the state of the technologies and tools so that he/she can apply the principles of Artificial Intelligence and Data Science to solve real-life problems from diverse application domains. The programme of B.Tech in Artificial Intelligence and Data Science at Dr. Babasaheb Ambedkar Technological University (DBATU) essentially aims to meet these broad expectations. At the same time, the program intends to comply with the courses and syllabus available at National Program on Technology Enhanced Learning (NPTEL) and SWAYAM. The following specific educational objective aims to achieve these global and regional expectations**.**

Objective Identifier	Objectives
PEO1	To equip graduates with a strong foundation in engineering sciences and Artificial Intelligence and Data Science Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
PEO2	Perceive the limitation and impact of engineering solutions in social, legal, environmental, economic and multidisciplinary contexts.
PEO3	Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness

Programme Outcomes (PO)

After undergoing the learning process of four years, students of B.Tech. (Artificial Intelligence and Data Science) at Dr. Babasaheb Ambedkar Technological University will have an ability to build information systems and provide computer based solutions to real life problems. The graduates of this programme will demonstrate following abilities and skill sets.

Outcome Identifier	Outcomes
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Outcome Identifier	**Outcomes**
PSO1	Apply the fundamentals of science, mathematics and engineering knowledge to design, development, formulates and investigate complex engineering problems related to application area in Artificial Intelligence and Data Science.
PSO2	Provide exposure to latest tools and technologies and aware of the impact of professional engineering solution in environmental, societal, professional ethics and able to communicate effectively.
PSO3	To publish research paper and think, innovates in artificial intelligence, machine Learning and Data Science domain

Graduate Attributes / ABET's Criteria

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

(a) Engineering knowledge: An ability to apply knowledge of mathematics, science and engineering.

(b) Problem analysis: An ability to design and conduct experiments as well as to analyze and interpret data.

(c) Design / development of solutions: An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(d) Individual and team work: An ability to function on multidisciplinary teams.

(e) Problem Solving: An ability to identify, formulate and solve engineering problems.

(f) Ethics: An understanding of professional and ethical responsibility.

(g) Communication: An ability to communicate effectively.

(h) Environment and sustainability: The broad education necessary to understand the impact of engineeringsolutions in a global, economic, environmental and social context.

(i) Life-long learning: Recognition of the need for and an ability to engage in life-long learning.

(j) A knowledge of technology: Acknowledge of contemporary issues, and state of art technology

(k) Modern tool usage: An ability to use the techniques, skills, and modern engineering tools necessary forengineering practice.

(l) Project management and finance: Demonstrate knowledge and understanding of the engineering andmanagement principles and apply in multidisciplinary environments.

Mapping of Programme Outcomes with Graduate Attributes / ABET's Criteria

	A	B	C	D	E	F	G	H	I	J	K	L
PO1	X									X		
PO2		X			X							
PO3			X		X							
PO4			X		X							
PO5											X	
PO6					X					X		
PO7								X				
PO8						X						
PO9				X								
PO10							X					
PO11												X
PO12									X			

Course Structure for Second Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester III (Term 3)											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC7	BTES301	Engineering Mathematics-III	3	1	-	20	20	60	100	4
PCC1	BTAIC302	An Introduction to Artificial Intelligence	3	1	-	20	20	60	100	4
PCC2	BTAIC303	Data Structure and Algorithm using Python	3	1	-	20	20	60	100	4
ESC11	BTESC304	Computer Architecture & Operating Systems	3	-	-	20	20	60	100	3
ESC12	BTESC305	Digital Logic & Signal Processing	3	-	-	20	20	60	100	3
LC1	BTAIL306	Artificial Intelligence Lab & Data Structure and Algorithm using Python Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS307	Seminar-I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship –I (Evaluation)	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Course Structure for Second Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester IV (Term 4)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC3	BTAIC401	Data Analysis	3	1	-	20	20	60	100	4
PCC4	BTAIC402	Database Management System	3	1	-	20	20	60	100	4
HSSM C3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC8	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC-1	BTAIPE405	Professional Elective Courses –I	3	1	-	20	20	60	100	4
	BTAIPE405A	1. Numerical Methods and Computer Programming								
	BTAIPE405B	2. Image Processing & Computer Vision								
	BTAIPE405C	3. Internet of Things & Embedded System								
	BTAIPE405D	4. Programming in JAVA								
LC2	BTAIL406	Data Analysis Lab and Database Management System Lab	-	-	4	60	-	40	100	2
Seminar	BTAIS407	Seminar - II	-	-	4	60	-	40	100	2
Internship	BTAIP408	Internship -II	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Course Structure for Third Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester V (Term 5)											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					
			L	T	P	CA	MSE	ESE	Total	Credit
PCC5	BTAIC501	Computer Network and Cloud Computing	3	1	-	20	20	60	100	4
PCC6	BTAIC502	Machine Learning	3	-	-	20	20	60	100	3
HSSMC4	BTAIHM503	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM503A	1. Economics and Management								
	BTAIHM503B	2. Business Communication								
	BTAIHM503C	3. Knowledge Reasoning and AI Ethics.								
PEC-2	BTAIPE504	Professional Elective Course (PEC) -II	3	1	-	20	20	60	100	4
	BTAIPE504A	1. Advanced Database System								
	BTAIPE504B	2. Soft Computing								
	BTAIPE504C	3. Sensors & Robotics Technology								
	BTAIPE504D	4. Advanced Java								
OEC-1	BTAIOE505	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE505A	1. Data Mining and Warehousing								
	BTAIOE505B	2. Digital Communication & Information Theory								
	BTAIOE505C	3. Software Engineering and Testing								
	BTAIOE505D	4. Virtual Reality								
LC3	BTAIL506	Machine Learning Lab and Competitive Programming Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM507	Mini Project I	-	-	4	60	-	40	100	2
Internship	BTAIP508	Internship –II (Evaluation)	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

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Course Structure for Third Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester VI (Term 6)											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					
			L	T	P	CA	MSE	ESE	Total	Credit
PCC7	BTAIC601	Deep Learning	3	1	-	20	20	60	100	4
PCC8	BTAIC602	Advanced Machine Learning	3	-	-	20	20	60	100	3
PEC-3	BTAIPE603	Professional Elective Course (PEC) -III	3	1	-	20	20	60	100	4
	BTAIPE603A	1. Geographical Information Systems								
	BTAIPE603B	2. Recommender System								
	BTAIPE603C	3. Industry 4.0 & Automation								
	BTAIPE603D	4. Web Development								
OEC-2	BTAIOE604	Open Elective Course (OEC) -I	3	1	-	20	20	60	100	4
	BTAIOE604A	1. Big Data Analytics								
	BTAIOE604B	2. Cryptography & Network Security								
	BTAIOE604C	3. Agile Methodology								
	BTAIOE604D	4. Augmented Reality								
HSSMEC-5	BTAIHM605	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM605A	1. Development Engineering								
	BTAIHM605B	2. Employability and Skills Development								
	BTAIHM605C	3. Consumer Behavior								
LC4	BTAIL606	Deep Learning Lab and Advanced Machine Learning Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM607	Mini Project II	-	-	4	60	-	40	100	2
Internship	BTAIP608	Internship –III	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

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Course Structure for Final Year

B. Tech in Artificial Intelligence & Data Science / B. Tech. in Artificial Intelligence & Data Science

Semester VII (Term 7)										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC9	BTAIC701	Natural Language Processing	3	1	-	20	20	60	100	4
PCC10	BTAIC702	AIOPS (AI Deployment and Operations)	3	-	-	20	20	60	100	3
PCC11	BTAIC703	Data Visualization and its tools	3	1	-	20	20	60	100	4
PEC-4	BTAIPE704	Professional Elective Course (PEC) -IV	3	1	-	20	20	60	100	4
	BTAIPE704A	1. Time series Forecasting								
	BTAIPE704B	2. Advanced Computer Vision								
	BTAIPE704C	3. Autonomous Vehicle								
	BTAIPE704D	4. Android Development								
OEC-3	BTAIOE705	Open Elective Course (OEC) - III	3	1	-	20	20	60	100	4
	BTAIOE705A	1.DevOPS								
	BTAIOE705B	2. Block chain Technology								
	BTAIOE705C	3. GPU Computing								
	BTAIOE705D	4. IOS Development								
HSSMEC -6	BTAIHM706	Humanities and Social Sciences including Management Elective Course (HSSMEC) - II	-	-	4	-	-	-	-	Audit
	BTAIOE706A	1. Foreign Language Studies								
	BTAIOE706B	2. Universal Human Value & Ethics								
	BTAIOE706C	3. Intellectual Property Rights								
LC5	BTAIL707	Natural Language Processing & AIOPS Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM708	Project Work	-	-	4	60	-	40	100	2
Internship	BTAIP709	Internship –III (Evaluation)	-	-	-	-	-	-	-	Audit
			15	**4**	**12**	**220**	**100**	**380**	**700**	**23**

Semester VIII (Term 8)										
Course Category	Couse Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
Project/ Internship	BTAIF801	Project Work/ Internship	-	-	24	60	-	40	100	12
			-	**-**	**24**	**60**	**-**	**40**	**100**	**12**

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Second Year (Semester –III)

Engineering Mathematics-III

BTES301	**Engineering Mathematics-III**	**BSC7**	**3L- 1T -0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To study the concepts of transformations, used in various field of artificial intelligence and data science.
2. To study partial differential equations to apply it in computer and electronics engineering.
3. To use complex variables.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the concept of LT & ILT.
CO2	Solve problems related to Fourier transform to Deep Learning, Signal & Image processing.
CO3	Understand the concepts of linear algebra and apply Linear Programming, Computer Graphics and Cryptography.
CO4	Understand the concepts of PDE and apply it in data analysis.
CO5	Analyze function of complex variables.

Course Contents:

Unit 1: Laplace Transform **[09 Hours]**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform **[09 Hours]**

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform **[09 Hours]**

Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals ; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications **[09 Hours]**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and one dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables **[09 Hours]**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy . Knowledgeware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Second Year (Semester –III)

An Introduction to Artificial Intelligence

BTAIC302	An Introduction to Artificial Intelligence	PCC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of Artificial Intelligence.
2. Demonstrate awareness and fundamental understanding of various applications of AI techniques.
3. Apply Artificial Intelligence techniques for problem solving.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Discuss Meaning, Scope and Stages of Artificial Intelligence
CO2	Understand and Implement Problem Space and Search Strategies for Solving problems.
CO3	Discuss the Search Techniques and Knowledge Representation.
CO4	Apply search for solving Constraint Satisfaction Problems and Game-playing.
CO5	Discover the Application of Artificial Intelligence and Analyze Impact of AI on Society

Course Contents:

Unit No 1: Introduction: [7 Hours]

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. Introduction: Philosophy of AI, Definitions, AI Future. Stages of AI. (ANI, AGI ASI with examples).

Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit No 2: Search Methods [8 Hours]

State Space Search

Generate and test, simple search, Depth first search (DFS), Breadth First search (BFS), Comparison, Quality of Solution, Depth Bounded DFS, Depth First Iterative Deepening.

Heuristic Search:

Heuristic Functions, Search Techniques: Best-first search, Hill climbing, Local Maxima, Solution Space Search, Variable Neighbourhood Descent, Beam Search, Tabu Search, Peak to peak method.

Unit No 3: Randomized Search: [7 Hours]

Population Based Methods: Escaping Local Optima, Iterated Hill Climbing, Simulated Annealing, Genetic Algorithms, Neural Network, Emergent Systems, Ant Colony Optimization.

Unit No 4: Optimal Path Finding [7 Hours]

Brute Force, Branch & Bound, Refinement Search, Dijkstra Algorithm, Algorithm A*, Admissible A*, Iterative Deepening A*, Recursive Best First Search, Pruning the CLOSED List, Pruning the OPEN List, Conquer Beam Stack Search.

Unit No 5: Constraint Satisfaction [7 Hours]

N Queens, Constraint Propagation, Scene labelling, Higher order consistency, Algorithm backtracking, Look-head strategies, Strategic retreat.

Text Books

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw-Hill Education, 2013.
2. Eugene, Charniak, Drew Mcdermott, "Introduction to artificial intelligence", Addison Wesley, 1985.
3. Elaine Rich, Kevin Knight, Shivashankar B Nair:Artificial Intelligence, Tata CGraw Hill 3rd edition. 2013.
4. Stuart Russel, Peter Norvig: Artificial Intelligence A Modern Approach, Pearson 3rd edition 2013.

Reference Books

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Herbert A. Simon, "The Sciences of the Artificial ", MIT Press, 3rd Edition (2nd Printing), 1995. 3. Tim Jones, "Artificial Intelligence Application Programming", Dreamtech Publication.
3. George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.
4. Prolog Programming for A.I. by Bratko, TMH

Semester –III

Data Structure and Algorithm Using Python

BTAIC303	Data Structure and Algorithm Using Python	PCC2	3L-1T-0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Introduce the fundamental concept of Python programming to the students
2. Understand various data structures in Python and write algorithms and programs using them
3. Compare alternative implementations of data structures with respect to performance
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Write programs using basic concepts of Python Programming
CO2	Implement algorithms for arrays, linked structures, stacks, queues, trees, and graphs
CO3	Write programs that use arrays, linked structures, stacks, queues, trees, and graphs
CO4	Compare and contrast the benefits of dynamic and static data structures implementation
CO5	Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Contents:

Unit 1: Introduction to Programming **[07 Hours]**

Introduction to Programming, Why Programming, What is a Program? Problem Solving, Algorithms and Data Structure

Introduction to Programming, Variables, Data Types, Input-Output Statements, Indentation, Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Control Flow- if, if-elif-else, for, while break, continue, pass

Collections- String, Lists, Tuples, Dictionaries, Sets, Map

Unit 2: Functions & Object Oriented Programming using Python [07 Hours]

Functions- Built-in and User defined functions, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables, Recursions

Need for OOP, Classes and Objects, OOP Concepts, Constructor, Class Diagram, Encapsulation, Statics, Relationship, Inheritance, and Abstract Classes, Exception Handling

Unit 3: Data Structures in Python [07 Hours]

ADT- Defining the ADT, Using the ADT, Pre conditions and post conditions

Introduction to Data Structures, Types of Data Structures, Arrays- Need for array, Array ADT, Implementing array, 2-D arrays,

Linked Structures- Singly Linked List & Operations with algorithms, Application- Polynomials, Doubly Linked Lists, Circular Linked List

Stacks- Stack ADT, Implementing the stack- using Python List and using a linked list, Stack Applications- Evaluating Postfix expressions

Queues- Queue ADT, Implementing the queue- using Python List and using a linked list, Priority Queue, Applications of Queues

Unit 4: Non-Linear Data Structures in Python [07 Hours]

Binary Trees- Tree Structure, Properties, Implementation, Tree Traversals, Heaps-Definition, Implementation, Heap Sort

Binary Search Trees- Operations and Algorithms (searching, insertion, deletion, min, max), Hash Tables- Hashing techniques, Hash functions, Applications

Unit 5: Searching & Sorting Algorithms and Analysis [08 Hours]

Search Algorithms- Linear Search Algorithm, Binary Search Algorithm,

Comparison Sort Algorithms- Introduction, Selection Sort, Insertion Sort, Bubble Sort, Merge Sort, Quick Sort

Algorithmic Techniques-Algorithm Technique- Greedy Approach, Dynamic Programming, Complexity Analysis of Algorithms- Introduction, Analysis of Algorithms, Big-O Notation, Evaluating the Python List.

Text Books / Reference Books

1. Data Structures and Algorithms Using Python, Rance D. Necaise
2. Python for Everybody, Exploring Data Using Python 3, Dr. Charles R. Severance
3. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.

Semester –III

Computer Architecture and Operation Systems

BTESC304	Computer Architecture and Operation Systems	ESC11	3L-0T-0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To understand the structure, function and characteristics of computer systems
2. To identify the elements of modern instructions sets and their impact on processor design
3. To understand the services provided by and the design of an operating system.
4. Understand the structure, organization memory management.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Understand the theory and architecture of central processing unit & Analyze some of the design issues in terms of speed, technology, cost, performance
CO2	Use appropriate tools to design verify and test the CPU architecture & Learn the concepts of parallel processing, pipelining and inter processor communication.
CO3	Understand the architecture and functionality of central processing unit & Exemplify in a better way the I/O and memory organization, Memory management systems, Virtual Memory
CO4	Describe and explain the fundamental components of a computer operating system
CO5	Define, restate, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Contents:

Unit 1: Introduction, Arithmetic and Instruction Sets [07 Hours]

Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

Computer Arithmetic: The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

Instruction Sets: Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

Unit 2: Memory Organization and Management [8 Hours]

Memory Organization: Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and

compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.
Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Unit 3: Control Unit & Input/ Output Organization: [07 Hours]

Control Unit: Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming.
Input/ Output Organization: External devices, I/O module, Programmed I/O, Interrupt driven I/ O, Direct memory access, I/O channels and processors, External interface. Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Unit 4: Introduction OS & Processes and CPU Scheduling: [07 Hours]

Introduction and Operating system structures: Definition, Types of Operating system, Real Time operating system, System Components- System Services, Systems Calls, System Programs, System structure. Virtual Machines, System Design and Implementation, System Generations.

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Cooperating processes. Threads, Inter-process Communication, Scheduling criteria, scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Scheduling Algorithms and performance evaluation.

Unit 5: Process Synchronization & Deadlocks [07 Hours]

Process Synchronization: The critical-section problem, Critical regions, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Synchronizations in Solaris.
Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

Note: Hands-on practice of Linux OS should cover under Tutorial slots.

Text Books

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.
2. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
3. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011
4. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.

Reference Books

1. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
2. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition, 2007.
3. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.

Semester –III

Digital Logic & Signal Processing

BTESC305	Digital Logic & Signal Processing	ESC12	3L-0T-0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To classify signals and systems into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal and image processing, computer vision, Machine Learning and Deep Learning.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Use the basic logic gates and various reduction techniques of digital logic circuit in detail
CO2	Understand mathematical description and representation of various signals and systems.
CO3	Develop input output relationship for linear shift invariant system and understand the convolution operator for discrete time system.
CO4	Understand use of different transforms and analyze the discrete time signals and systems.
CO5	Understand the concept of correlation, regression and spectral density.

Course Contents:

Unit 1: Number System and Boolean Algebra [07 Hours]

Digital Signal, Digital logic circuits: AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR.

Boolean algebra and theorems.

Number System: Binary, Octal, Decimal, and Hexadecimal. Binary Arithmetic (addition, subtraction, multiplication, division), 1's & 2's compliment.

Codes: Binary, Gray, BCD, Excess-3, Octal, Hexadecimal code.

Unit 2: Introduction to Signals and Systems [8 Hours]

Signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding. Sampling Process.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

Unit 3: Discrete Fourier Transform [07 Hours]

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, Convolution: circular convolution, linear convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm.

Unit 4: Z transform [07 Hours]

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Unit 5: Correlation and Spectral Density [07 Hours]

Introduction of correlation and correlogram, the correlation function: analogy between correlation and convolution, auto-correlation, properties of auto-correlation, Cross-correlation: properties of cross correlation

Introduction of Spectral density, ESD, Properties of ESD, PSD, Properties of PSD.

Text Books

1. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
2. Nagoor Kanni “Signals and Systems”, 2nd edition, McGrawHill.

Reference Books

1. R. P. Jain, Modern digital electronics. 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. Alan V. Oppenheim. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
3. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
4. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
5. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
6. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.

Semester –III

An Introduction to Artificial Intelligence Lab and Data Structure and Algorithm Using Python Lab

BTAIL306	**Artificial Intelligence Lab and Data Structure and Algorithm Using Python Lab**	**LC1**	**0L-0T-4P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

A) Artificial Intelligence Lab

List of Practical/Tutorial

Software Tools: Programming languages, namely Java, Python, C++, Lisp, and Prolog, is highly recommended for students to use when completing their assignments and/or practical’s for this course.

1. Study of Java/Python/C++/ Lisp/ PROLOG.
2. Existing AI Application (e.g. Recommendation system, Carpooling, OTT channels etc.)
3. Solve any problem using depth first search.
4. Solve any problem using breadth first search.
5. Solve 8-puzzle problem using best first search.
6. Write a program to solve Tic-Tac-Toe using Min-Max search.
7. Solve traveling salesman problem.
8. Write a program for Alpha–Beta Pruning.
9. Write a program to solve 8 queens problem.
10. Write a program to solve map coloring problem using CSP.

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Software Tools: Programming languages Python and Opens Source tools must and highly recommended for students to use when completing their assignments and/or practical’s for this course.

B) Data Structure and Algorithm Using Python Lab

List of Practical

Downloading and installing Python gcd in Python as start of lab for hands on laboratory

1) Write code and understand the concept Variable, Data Type and Data Object in python.
2) Write code and understand the concept List, Tuple, and Array in python.
3) Write code and understand the concept Loop and Function in python.
4) Write code and understand the concept Classes and Objects in python.
5) Write code and understand the concept Constructor and Relationship
6) Write code and understand the concept Inheritance and Exception Handling in python.
7) Write code and understand the concept List in data Structure
8) Write code and understand the concept Queue in data Structure
9) Write code and understand the concept Array in data Structure
10) Write code and understand the concept Graphs, Trees in data Structure
11) Write code and understand the concept Hashing, Hast Tables in data Structure
12) Write code and understand the concept Search Algorithms (Any two)
13) Write code and understand the concept Sorting Algorithms (Any two)
14) Write code and understand the concept Algorithm Technique on Greedy Approach

Note:

1. Open Source tools and technology use for programs
2. Lab should be in scope of hands of experience and practice related program must
3. Add case study and Live project experience if any related contents

Semester –III

Seminar-I

BTAIS307	**SEMINAR- I**	**Seminar**	**0L-0T-4P**	**2 Credits**

Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –III

Internship - I

BTES211P	**Field Training / Internship / Industrial Training**	**Internship**	**Audit**

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student’s work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students’ performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

Semester –IV

Data Analysis

BTAIC401	**Data Analysis**	**PCC3**	**3L - 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basics of Linear Algebra, Introduction, Probability and Statistics.

Course Objectives:

After completion of the course, students will learn:-

1. To obtain a Comprehensive knowledge of various tools and techniques for Data transformation and visualization
2. To learn the probability and probabilistic models of data science
3. To learn the basic statistics and testing hypothesis for specific problems
4. To learn about the prediction models
5. To give a hands-on experience with real-world data analysis

Course Outcomes:

On completion of this course, the student should be able to

CO1	Apply preprocessing techniques to convert raw data so as to enable further analysis
CO2	Apply exploratory data analysis and create insightful visualizations to identify patterns
CO3	Understand how to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions
CO4	Understand the statistical foundations of data science and analyze the degree of certainty of predictions using statistical test and models
CO5	Introduce machine learning algorithms for prediction and to derive insights

Course Contents:

Unit 1: Statistical data and Concepts **[07 Hours]**

The statistical Methods, Misuse, Misinterpretation and bias, Sampling and sampling size, Data preparation and cleaning, Missing data and data errors, Exploratory Data Analysis, Statistical error, Statistical Modeling, Computational Statistics, Inference, Bias, Cofounding, Hypothesis testing, Types of error, Statistical significance, Confidence Interval, Power and robustness, Degrees of freedom, Non parametric analysis.

Unit 2: Descriptive Statistics **[07 Hours]**

Counts and specific values, Measure of central tendency, Measure of spread, Measure of distribution shape, Statistical indices, Moments, Key functions, Measures of complexity and model selection.

Unit 3: Data transformation and standardization **[07 Hours]**

Box-Cox and power transforms, Freeman-Tukey (square root and arcsine) transforms, Log and Exponential transforms, Logit transforms, Normal transform.

Unit 4: Classical Tests and Contingency Tables **[7 Hours]**

Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors;

Z- test: test of single mean, standard deviation known, Test of the difference between two means, standard deviation known, test for proportions, P;

T-tests: test of single mean, standard deviation not known, Test of the difference between two means, standard deviation not known, test of regression coefficients;

Unit 5: Analysis of Variance and Covariance **[08 Hours]**

Variance test: Chi square test of single variable, F-test of two variables, test of homogeneity; Wilcoxon rank-sum/Mann-Whitney U test; Sign test.

Contingency Tables: Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test.

ANOVA: Single factor or one way ANOVA, Two factor or two-way and higher-way ANOVA, MANOVA, ANCOVA; Non Parametric ANOVA: Kruskal Wallis ANOVA, Friedam ANOVA test, Mood’s median

Text Books

1. Dr. Michael J de Smith, Statistical Analysis Handbook, A Comprehensive guide to statistical concepts methods and tools, The Winchelsea Press, Drumlin Security Ltd, Edinburgh 2018 edition. https://www.statsref.com/HTML/index.html
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013
3. Dr.J.Ravichandran, Probability And Statistics For Engineers, First Edition, Wiley, 2010 Scientists

Reference Books

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online)
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
4. Cathy O’Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O’Reilly. 2014.

Semester –IV

Database Management System

BTAIC402	**Database Management System**	**PCC4**	**3L-1T-0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fundamentals of Database Management Systems and types of DBMS used in data analysis
2. Understand various ways to organize, maintain and retrieve - efficiently, and effectively – information from different DBMS
3. Design and maintenance of the database systems
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Master the basic concepts of relational DBMS and its types.
CO2	Perform various types of operations on relational databases using DDL, DML, DCL in SQL
CO3	Understand the concept of how non-relational databases differ from relational databases from a practical perspective.
CO4	Master the basic concepts of designing NoSQL database management system.
CO5	Able to Identify what type of NoSQL database to implement based on business requirements

Course Contents:

Unit 1: Introduction to Databases **[06 Hours]**

Introduction to Data and Database, Significance of Database Management System, Various Types of DBMS- relational & non-relational, Data Independence - The Three Levels Of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema

Unit 2: Relational Database Management System [07 Hours]

Data Models & Types, ER to Relational Mapping , Structure Of Relational Databases, Creation and Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)
Normalization –Anomalies- Functional Dependency, Normal forms- 1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit 3: Non-Relational Database Management System [07 Hours]

NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, CAP theorem, Types of NoSQL Databases,
Key-value database-Key values database, More elements of key values database, Properties of Key-value store, Redis implementation (Basic CRUD operation)

Unit 4: Columnar & Document Databases [8 Hours]

Columnar Databases with Apache Cassandra- Characteristics of a columnar database, Concepts of columnar databases, Cassandra Introduction and its use-cases, implement a columnar database using Apache Cassandra
Introduction to Document databases, Document databases with MongoDB - Implement a document database with MongoDB

Unit 5: Graph and Future databases [8 Hours]

Graph Databases - Graph databases, graph traversal and graph problems, graph data structures edge list, adjacency matrix, properties of graph model.
Implementation and systems - Reliable, maintainable and scalable, Different information systems, NEO4J implementation (Basic CRUD operation), Introduction to Advance Databases- PostgreSQL

Text Books

1. Abraham Silberchatz, Henry K.Forth, Sudharshan, “Database system Concepts” – (6th edition), McGraw Hill, 2010.

2. Guy Harrison, “Next Generation Databases”, Apress, 2015.

3. Eric Redmond, Jim R Wilson, “Seven Databases in Seven Weeks”, LLC. 2012

Reference Books

1. K. Pakhira, “Database Management System”, Phi Learning Pvt. Ltd., 2012

2. MongoDB: The Definitive Guide, 2nd Edition , Powerful and Scalable Data Storage, By Kristina Chodorow, Publisher: O'Reilly Media

3. MongoDB Basics - EelDavid Hows,Peter Membrey,coPlugge, Publisher Apress - Ebook(free) https://it-ebooks.info/book/4527/

Semester –IV

Basic Human Rights

BTHM403	**Basic Human Rights**	**HSSMC3**	**3L- 0T -0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

On completion of the course, students will be able to:

CO1	Students will be able to understand the history of human rights.
CO2	Students will learn to respect others caste, religion, region and culture.
CO3	Students will be aware of their rights as Indian citizen.
CO4	Students will be able to understand the importance of groups and communities in the society.
CO5	Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Course Contents:

UNIT 1: The Basic Concepts: **[08 Hours]**

Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people.

UNIT 2 Fundamental rights and economic programme: [07 Hours]

Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT 3: Migrant workers: [07 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT 4: Human rights in Indian constitution and law [07 Hours]

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT 5: Universal declaration: [07 Hours]

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission

Text / Reference Books

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005

2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives(Law in India), Oxford India

Semester –IV

Probability Theory and Random Processes

BTBS404	**Probability Theory and Random Processes**	**BSC8**	**3L- 0T -0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To develop basic of statistics, probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon
CO2	Understand the basic concepts of one and two dimensional random variables and apply in engineering applications
CO3	Apply the concept random processes in engineering disciplines
CO4	Understand and apply the concept of correlation and spectral densities
CO5	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems

Course Contents:

UNIT 1: Probability Theory [07 Hours]

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

UNIT 2: Random Variable and Mathematical Expectation [07 Hours]

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

UNIT 3: Correlation **[07 Hours]**

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman‘s rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman‘s rank correlation coefficient, Probable errors.

UNIT 4: Linear Regression Analysis **[07 Hours]**

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

UNIT 5: Estimation and Hypothesis **[07 Hours]**

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Books

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.

Reference Books

1. 1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications,2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines,4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer ScienceApplications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability And Statistics, Wiley Publication, 2nd Edition, 2001.
8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition,Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics forengineers & scientists, 9th edition, Prentice Hall.

Semester –IV

Numerical Methods and Computer Programming

BTAIPE405A	**Numerical Methods and Computer Programming**	**PEC1**	**3L- 1T -0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:
On completion of the course, students will be able to:

CO1	Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem
CO2	Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques
CO3	Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values
CO4	Prepare them to solve Integration and Differentiation
CO5	Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.

Course Contents:

UNIT 1: Introduction to Computational Methods and Errors: **[07 Hours]**

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques.

Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT 2: Solution of Transcendental / Polynomial Equations and System of Linear Equation: [07 Hours]

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT 3: Interpolation and Polynomial Approximation: [07 Hours]

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange sinterpolation polynomials, Spline interpolation, Least square approximation.

UNIT 4: Numerical Integration and Differentiation [07 Hours]

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, Runge Kutta 2ndand 4th order, Stability analysis of above methods.

UNIT 5: Object Oriented Programming: [07 Hours]

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors..

Note: OOPS hands-on should cover under Tutorial slots.

Text / Reference Books

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rdedition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rdEdition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi,1996.
4. D. Ravichandran, "Programming with C++",TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2ndEdition
6. YeshwantKanetkar, "Let us C++, BPB Pub.", Delhi, 2002,4thEdition.
7. StroupstrupBjarne, "C++ Programming Language", Addison Wesley, 1997, 3rdEdition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai,1998.

Semester –IV
Image Processing and Computer Vision

BTAIPE405B	Image Processing and Computer Vision	PEC1	3L-1T-0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Prerequisites: Digital Signal Processing

Course Objectives:

1. To let the students learn the fundamental principles on the aspects of interdisciplinary research including acquiring, processing, analyzing, understanding and utilizing high-dimensional visual data from the real world;
2. To equip the students with the knowledge of how to develop artificial intelligent systems which automate tasks that the human visual system can do;
3. To guide the students to understand the relevant state of art technologies and gain experience throughout a variety of case studies.

Course Outcomes:

On completion of the course, students will be able to:

CO1	To implement fundamental image processing techniques required for computer vision
CO2	Understand Image formation process
CO3	To perform morphological operations on image.
CO4	Extract features form Images and do analysis of Images
CO5	To develop applications using computer vision techniques

Course Contents:

Unit 1: Introduction to Digital Image Processing [07 Hours]

Motivation & Perspective, Applications, Types of images, image file formats, Fundamentals Steps in Image Processing, Components of Image Processing System, Image digitization, Some basic relationships, Distance Measures between pixels, Image basic operation, Special Operations.

Unit 2: Image Enhancement and Transformation [08 Hours]

Image Enhancement: Introduction, Methods, Basic Intensity Transformation: Image Negatives, Log transformation, Power law Transformation, piecewise linear transformation functions, Histogram processing, Histogram Equalization and Matching.

Basics of Spatial Filters, 2D Convolution & 2D Correlation, Smoothening (LPF) (Linear: Box, Gaussian & Non Linear: Median) and Sharpening (HPF): Laplacian operators, Unsharp Masking and Highboost Filtering, Combining Spatial Enhancement Methods.

Image Transforms: Discrete Fourier transform (DFT): Definition and properties, FFT, DCT.

Unit 3: Morphological operations **[06 Hours]**

Introduction, erosion, dilation, opening, closing, Hit or Miss, boundary extraction, hole filling, connected components, the convex hull, thinning, thickening, skeletonization, and pruning.

Unit 4: Segmentation and Feature Extraction **[08 Hours]**

Segmentation: Fundamentals; Point, Line and Edge Detection; Basics of edge detection: Image gradient and operators, Thresholding: Intensity Thresholding, Global thresholding, Segmentation by region growing, region splitting and merging.

Feature Extraction: Boundary Preprocessing: Boundary Following (Tracing), Chain Codes (freeman & slope), Polygonal approximation, Signature, Boundary description: Shape number, Fourier Descriptor, Statistical Moments, Region Feature Descriptors: Topological feature, Texture.

Unit 5: Pattern Recognition **[07 Hours]**

Pattern and pattern classes, pattern classification by prototype matching (Minimum-Distance Classifier & using correlation for 2-D prototype matching), matching by structural prototype.

Introduction to Bayes statistical classifiers, Introduction to Neural Network and Deep Learning.

Note: Hands-on practice of Image Processing using openCV should cover under Tutorial slots.

Text Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
3. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
4. Dhananjay K. Theckedath, Image Processing using MATLAB codes, Nandu Printers and Publishers Pvt. Ltd, Third edition.

Reference Books:

1. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
2. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
6. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

Semester –IV

Internet of Things & Embedded System

BTAIPE405C	**Internet of Things & Embedded System**	**PEC1**	**3L-1T-0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Prerequisites: Basics if microprocessor, microcontroller, C language

Course Objectives:

1. To get the understanding of the concepts of Internet of Things
2. To enable the students to build IoT applications.
3. To understand the various protocols in IoT and Networking.
4. To develop the essential programming skill required

Course Outcomes:

On completion of the course, students will be able to:

CO1	The use of concepts of IoT and its areas.
CO2	Understand the basics of C and NodeMCU
CO3	Understand the basics of Python & Raspberry Pi
CO4	Interacting with Web Services and IoT protocol
CO5	Apply the IoT in various applications.

Course Contents:

Unit-1: Introduction to IoT **[07 Hours]**

Definition, characteristics of IoT, logical design of IoT, IoT communication models, IoT communication APIs: REST, Websocket, IoT Enabling Technologies: Wireless sensor networks, Cloud computing, Big data analytics, communication protocols, Embedded systems, IoT vs M2M.

Unit-2: Introduction to C and Node Mcu **[07 Hours]**

C: Introduction, Data types, variable, operator, branches, loops, functions, Debugging and Optimization of C programs.

NodeMCU: 8266 Wi-Fimodule, hardware and pin diagram, Interface with Arduino IDE. Interfacing of analog and digital sensors.

Unit-3: Introduction to Python and Raspberry Pi **[08 Hours]**

Python: Python IDE, Data types, variable, operator, branches, loops, functions, List, Dictionary, Writing to a File, Reading from a File, handling exceptions.

Raspberry Pi: Models of Raspberry pi, R Pi 3 hardware, GPIO pins, operating system for R pi3, Basic of Linux commands, configuring R pi3, Interfacing of Digital and Analog sensors.

Unit-4: **Interacting with Web Services** **[07 Hours]**

Configuring NodeMCU to connecting to server, NodeMCU interfacing with web services, configuring R pi 3 Wi-Fi and Ethernet, publishing and subscribing data from web using R pi3, interfacing R Pi 3 with twitter and whatsapp.

Unit-5: IoT Protocols **[07 Hours]**

UART, Wi-Fi, Ethernet, Bluetooth Low Energy (BLE), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Service (DDS), Advanced Message Queuing Protocol (AMQP).

Note: Hands-on practice of Internet of Things should cover under Tutorial slots.

Text Books:

1. Get Started With ESP8266 Programming NodeMCU Using Arduino, Up skill Learning.
2. Internet of Things with Raspberry Pi 3, ManeeshRao, pack
3. Internet of Things with ESP8266, Marco Schwartz
4. Internet of Things with Arduino Cookbook, Marco Schwartz

Reference Books:

1. Internet of Things: A Hands-On Approach- Arsheep Bahga,Vijay Madisetti
2. Raspberry Pi Cookbook for Python Programmers by Tim Cox
3. Learning Internet of Things, Peter Waher

Semester –IV

Programming in JAVA

BTAIPE405D	**Programming in JAVA**	**PEC1**	**3L-1T-0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam:20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basics of programming languages and Concepts of Object Oriented Programming languages.

Course Objectives:

After completion of the course, the students will be able to:
1. Apply object oriented features to real time entities.
2. Handle exceptions & implement multithreaded programs.
3. Implement database programming.
4. Design & implement GUI with event handling
5. Develop I/O & networking programs.

Course Outcomes:

On completion of the course, students will be able to:

CO1	To understand basics of JAVA
CO2	To use Packages & interfaces
CO3	To apply Exception Handling & Multithreaded Programming
CO4	To acquire Java Database Connectivity
CO5	To recognize Applet, Event Handling and AWT

Course Contents:

Unit 1: Introduction, Packages & interfaces **[8 Hours]**

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java. Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.

Unit 2: Exception Handling & Multithreaded Programming [07 Hours]

Exception handling fundamentals, Exception Types, Using try-catch, Multiple try-catch clauses, Nested try statements, throw, throws, finally, Built-in Exceptions, creating your own exception subclasses, The Java Thread Model, The Main Thread, Creating a Thread , Creating Multiple Threads, Using isAlive( ) and join( ), Thread Priorities, synchronization, Suspending, Resuming, and Stopping Threads

Unit 3: Applet, Event Handling and AWT [07 Hours]

Applet: Applet Basics, An Applet Skeleton, Simple Applet Display Methods, Using the Status, Window, The HTML APPLET Tag, Passing Parameters to Applets, Event Handling: The Delegation Event Model, Event Classes, Sources of Events, Event, Listener Interfaces, Handling Mouse and Keyboard Events, Adapter Classes, Introduction to AWT , AWT classes, Window, Creating a Frame Window in an Applet, Working with Graphics, swing.

Unit 4: Input /Output & Networking [07 Hours]

Input /Output: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, The Stream Classes, The Byte Streams, The Character Streams, Object Serialization & deserialization, Networking: Networking Basics, The Networking Classes and Interfaces, TCP/IP Client, Sockets, TCP/IP Server Sockets, Datagrams

Unit 5: Java Database Connectivity [07 Hours]

Introduction, Types of JDBC Drivers, Driver interface & DriverManager class, Connection Interface, Statement Interface, PreparedStatement , ResultSet, JDBC Program for executing Statements & processing ResultSet, Using PreparedStatement.

Note: Hands-on practice of Programming in Java should cover under Tutorial slots.

Text / Reference Books:

1. Herbert Schildt, The Complete Reference- Java2, (Seventh Edition), Tata Mc Graw Hill.
2. Steven Holzner, Java 2 Black Book, Dream Tech Press.
3. Deitel & Deitel, Java: How to Program, PHI.
4. Bert Bates, Kathy Sierra, Head First Java, O'Reilly Media, Inc.
5. E Balagurusamy, Programming with Java, Tata Mc Graw Hill.

Semester –IV

Data Analysis Lab and Database Management System Lab

BTAIL406	**Data Analysis Lab and Database Management System Lab**	**LC2**	**0L-0T-4P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Data Analysis Lab

List of practicals:

1. Installing R and R Studio
2. Data types, mathematical operators and functions in R.
3. Vectors, Factors, Lists, Matrix, Data Frames in R.
4. Measurement of Central Tendency Mean, Median and Mode.
5. Measurement of Variation - Range, IQR and Standard Deviation.
6. Descriptive Statistics Using psych Package.
7. One & two Sample z Test Using R
8. One & two Sample t Test Using R
9. Goodness of Fit Test Using R
10. Contingency Table Using R
11. Analysis of Variance (ANOVA) Using R
12. Central Limit Theorem Demonstration Using R
13. R Functions for Normal Distribution - rnorm, pnorm, qnorm and dnorm
14. R Functions for Binomial Distribution - rbinom, pbinom, qbinom and dbinom
15. R Functions for Poisson Distribution - rpois, ppois, qpois and dpois

Database Management System Lab

List of practical:

1. Draw E-R diagram and convert entities and relationships to relation table for a college database.

2. Perform the following:
   a) Viewing all databases,
   b) Creating a Database,
   c) Viewing all Tables in a Database,
   d) Creating Tables (With and Without Constraints),
   e) Inserting/Updating/Deleting Records in a Table,

3. Perform the following:
   a) Altering a Table,
   b) Dropping/Truncating/Renaming Tables,
   c) Backing up / restoring a Database.

4. For a given set of relation schemes, create tables and perform the following-
   a) Simple Queries,
   b) Simple Queries with Aggregate functions,
   c) Queries with Aggregate functions (group by and having clause),

5. Perform queries with Date functions and String Functions

6. Perform queries with Math Functions, Join Queries- Inner Join, Outer Join and Subqueries- With IN clause, With EXISTS clause

7. Implement a columnar database using Apache Cassandra

8. Implement a document database with MongoDB

9. Design and Implement any 5 query using MongoDB

10. Write a case study for various types of NoSQL databases.

Note:

1. Lab should be in scope of hands of experience and practice related program must
2. Add case study and Live project experience if any related contents

Semester –IV
Seminar-II

BTAIS407	SEMINAR-II	Seminar	0L-0T-4P	2 Credits

Guidelines for Seminar

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher. The students shall prepare his report and deliver talk on the topic for other students of his class in the presence of his guide and internal examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and presentation of the talk on the subject and will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –IV
Internship - II

BTAIP408	Field Training / Internship / Industrial Training	Internship	Audit

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student’s work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students’ performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Engineering Mathematics -III	BTBS301	III	Linear Algebra https://nptel.ac.in/courses/111/ 106/111106051/	IIT, Madras	90%	12 weeks
2	An Introduction to Artificial Intelligence	BTAIC302	III	Artificial Intelligence : Search Methods For Problem solving	IIT Madras	90%	12 weeks
				An Introduction to Artificial Intelligence	IIT Delhi	90%	12 weeks
3	Data Structure and Algorithm using Python	BTAIC303	III	Programming, Data Structures And Algorithms Using Python https://onlinecourses.nptel.ac.in/noc21_cs67/preview	Chennai Mathematical Institute	90%	8 week
4	Computer Architecture & Operating System	BTAIC304	III	Computer architecture and organization https://onlinecourses.nptel.ac.in/noc21_cs61/preview	IIT KHARAGPUR	100 %	12Weeks
5	Digital Logic & Signal Processing	BTESC305	III	Principles Of Signals And Systems https://nptel.ac.in/courses/108/104/108104100/	IIT KANPUR	60%	12Weeks
				Digital Signal Processing https://nptel.ac.in/courses/117/102/117102060/	IIT Delhi	60%	12Weeks
6	Data Analysis	BTAI401	IV	Data Science for Engineers https://onlinecourses.nptel.ac.in/noc21_cs69/preview	IIT Madras	60%	8 week
7	Database Management System	BTAI402	IV	Database Management System https://onlinecourses.nptel.ac.in/noc19_cs46/preview	IIT Kharagpur	50%	8 week
8	Basic Human Rights	BTHM403	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT KANPUR	50%	8 week
9	Probability Theory and Random Processes	BTBS404	IV	Introduction to Probability Theory and Stochastic Processes https://onlinecourses.nptel.ac.in/noc21_ma66/preview	IIT Delhi	90%	12 weeks
10	Numerical Methods and Computer Programming	BTSE405A	IV	Numerical methods and programing https://nptel.ac.in/courses/122/106/122106033/	IIT Madras	70%	12 week
11	Image Processing & Computer Vision	BTSE405B	IV	Computer Vision and Image Processing - Fundamentals and Applications https://onlinecourses.nptel.ac.in/noc21_ee23/preview	IIT Guwahati	80%	12 week
12	Internet of Things & Embedded System	BTSE405C	IV	Introduction To Internet Of Things https://nptel.ac.in/courses/106/105/106105166/	IIT Kharagpur	70%	12 Weeks
				Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Banglore	40%	8Weeks
13	Programming In Java		IV	https://onlinecourses.nptel.ac.in/noc19_cs84/preview	IIT Kharagpur	100 %	12 Weeks
14	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing https://onlinecourses.nptel.ac.in/noc22_cs87/preview Computer Networks and Internet Protocol https://onlinecourses.nptel.ac.in/noc22_cs19/preview	IIT Kharagpur	60%	12 weeks
15	Machine Learning	BTAIC502	V	Introduction to machine learning https://onlinecourses.nptel.ac.in/noc22_cs97/preview	IIT Kharagpur	80%	8 weeks
16	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning https://nptel.ac.in/courses/106106140	IIT Madras	60%	12 weeks
17	Virtual Reality	BTAIPE504A	V	Virtual reality engineering https://nptel.ac.in/courses/121106013	IIT Madras	70%	12Weeks
18	Soft computing	BTAIPE504B	V	Introduction to soft computing https://onlinecourses.nptel.ac.in/noc22_cs54/preview	IIT Kharagpur	40%	8 Weeks
19				Neural networks and applications https://archive.nptel.ac.in/courses/117/105/117105084/	IIT Kharagpur	40%	37 lectures
20	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics https://onlinecourses.nptel.ac.in/noc22_de11/preview	IIT Madras	70%	12 weeks

				Introduction to robotics https://archive.nptel.ac.in/courses/107/106/107106090/			
21	Advanced Java	BTAIPE504D	V	Programming in Java https://onlinecourses.nptel.ac.in/noc22_cs47/preview	IIT Kharagpur	50%	12 weeks
22	Data mining and warehousing	BTAIOE505A	V	Data mining https://onlinecourses.swayam2.ac.in/cec19_cs01/preview		60%	12 weeks
23				Data mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview	IIT Kharagpur	40%	8 weeks
24	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory https://onlinecourses.nptel.ac.in/noc22_ee108/preview	IIT Kanpur	80%	12 weeks
25				Principles of Digital communication https://nptel.ac.in/courses/108101113	IIT Bombay	90%	12 weeks
26	Software engineering and testing	BTAIOE505C	V	Software engineering https://onlinecourses.nptel.ac.in/noc22_cs106/preview	IIT Kharagpur	60%	12 weeks
27				Software testing https://onlinecourses.nptel.ac.in/noc19_cs71/preview	IIT Bangalore	60%	12 weeks
28				Software testing https://onlinecourses.nptel.ac.in/noc20_cs19/preview	IIT Kharagpur	40%	4 weeks
29	Deep learning	BTAIC601	VI	Deep learning https://onlinecourses.nptel.ac.in/noc20_cs62/preview	IIT Kharagpur	80%	12 week
30				Deep learning https://onlinecourses.nptel.ac.in/noc22_cs124/preview	IIT Ropar	70%	12 weeks
31	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application https://onlinecourses.nptel.ac.in/noc19_cs82/preview	IIT Madras	50%	12 Weeks
32	Augmented reality	BTAIPE603A	VI	-			
33	Recommender system	BTAIPE603B	VI	-			
34	Industry 4.0 & automation	BTAIPE603C	VI	Introduction to industry 4.0 and industrial internet of things https://onlinecourses.nptel.ac.in/noc22_cs95/preview	IIT Kharagpur	50%	12 weeks
35	Web Development	BTAIPE603D	VI	Modern application development https://nptel.ac.in/courses/106106156	IIT Madras	40%	8 weeks
36	Big Data Analytics	BTAIOE604A	VI	-			
37	Cryptography and network security	BTAIOE604B	VI	Cryptography and network security https://onlinecourses.nptel.ac.in/noc22_cs90/preview	IIT Kharagpur	60%	12 weeks
38	Agile Methodology	BTAIOE604C	VI	-			
39	Development Engineering	BTAIHM605A	VI	Developing soft skill and personality https://archive.nptel.ac.in/courses/109/104/109104107/ Educational leadership https://archive.nptel.ac.in/courses/109/105/109105122/	IIT Kharagpur & Kanpur	40%	8 weeks
40	Employability and Skills Development	BTAIHM605B	VI	Soft skills https://onlinecourses.nptel.ac.in/noc21_hs76/preview	IIT Roorkee	70%	12 weeks
41	Consumer Behavior	BTAIHM605C	VI	Introduction to consumer behavior https://nptel.ac.in/courses/110105029	IIT Kharagpur	50%	8 weeks
42	Economics and management	BTAIHM605D	VI	Economics / Management / Entrepreneurship https://nptel.ac.in/courses/110105067	IIT Kharagpur	60%	12 weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Engineering Mathematics- III	BTBS301	III	Mathematics for Machine Learning: Linear Algebra	Imperial College Landon	25%	5 week
2	An Introduction to Artificial Intelligence	BTAIC 302	III	AI For Everyone	DeepLearning.AI	50%	4 week
3	Programming, Data Structure and Algorithm using Python	BTAIC 303	III	Python Data Structures https://www.coursera.org/learn/python-data	University of Michigan	70%	7 weeks
4	Computer Architecture& Operating System	BTAIC 304	III	Computer Architecture	Princeton University, US	25	4 Weeks
6	Data Analysis	BTAI401	IV	Statistics with R Specialization	Duke University	50%	5 Weeks
7	Database Management System	BTAI402	IV	Database Management Essentials https://www.coursera.org/learn/database-management	University of Colorado	40%	4 weeks
9	Probability Theory and Random Processes	BTBS404	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
11	Image Processing & Computer Vision	BTSE405B	IV	1) Fundamentals of Digital Image and Video Processing 2)Computer Vision Basics	1)Northwestern University 2) University at Buffalo The State University of New York	1)25 2)25	1)4 Weeks 2)4 Weeks
12	Internet of Things & Embedded System	BTSE405C	IV	Hands-on Internet of Things Specialization(4 courses included in it)	University of Illinois at Urbana-Champaign	70	4 week per course
13	Programming in JAVA	BTSE405D	IV	Core Java Specialization https://www.coursera.org/specializations/core-java#courses	Learn Quest	70%	6 week
14	Computer Network and Cloud Computing	BTAIC501	V	The Bits and Bytes of Computer Networking https://www.coursera.org/learn/computer-networking	Google Career Certificate	80%	6 Weeks

15				Introduction to Cloud Computing https://www.coursera.org/learn/introduction-to-cloud	IBM Cloud	75%	5 Weeks
16	Machine Learning	BTAIC502	V	Machine Learning for All https://www.coursera.org/learn/uol-machine-learning-for-all	University of London	90%	4 Weeks
17	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial Intelligence Ethics in Action https://www.coursera.org/learn/ai-ethics-analysis	LearnQuest	75%	3 Weeks
18	Virtual Reality	BTAIPE504A	V	Intro to AR/VR/MR/XR: Technologies, Applications & Issues https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues	University of Michigan	78%	4 Weeks
19	Soft computing	BTAIPE504B	V	Neural Networks and Deep Learning https://www.coursera.org/learn/neural-networks-deep-learning	DeepLearning.AI	65%	4 Weeks
20	Sensors and Robotics Technology	BTAIPE504C	V	AI For Everyone https://www.coursera.org/learn/ai-for-everyone	DeepLearning.AI	65%	4 Weeks
21	Advanced Java	BTAIPE504D	V	Object Oriented Programming in Java https://www.coursera.org/learn/object-oriented-java	UC San Diego	75%	6 Weeks
22	Data mining and warehousing	BTAIOE505A	V	Data Mining Pipeline https://www.coursera.org/learn/data-mining-pipeline	University of Colorado Boulder	85%	4 Weeks
23				Fundamentals of Data Warehousing https://www.coursera.org/learn/fundamentals-of-data-warehousing	LearnQuest	80%	3 Weeks
24	Digital communication and information theory	BTAIOE505B	V	Fundamentals of Network Communication https://www.coursera.org/learn/fundamentals-network-communications	University of Colorado	76%	5 Weeks
25				Cryptography and Information Theory https://www.coursera.org/learn/crypto-info-theory	University of Colorado	80%	4 Weeks
26	Software engineering and testing	BTAIOE505C	V	Software Engineering: Implementation and Testing https://www.coursera.org/learn/software-engineering-implementation-and-testing	The Hong Kong University of Science and Technology	90%	7 Weeks
27	Deep learning	BTAIC601	VI	Neural Networks and Deep Learning https://www.coursera.org/learn/neural-networks-deep-learning	DeepLearning.AI	80%	4 Weeks
28	Advanced Machine Learning	BTAIC602	VI	Advanced Machine Learning and Signal Processing https://www.coursera.org/learn/advanced-machine-learning-signal-processing	IBM Skills Network	80%	4 Weeks
29	Augmented reality	BTAIPE603A	VI	Introduction to Augmented Reality and ARCore https://www.coursera.org/learn/ar	Daydream	85%	4 Weeks
30	Recommender system	BTAIPE603B	VI	Basic Recommender Systems https://www.coursera.org/learn/basic-recommender-systems	EIT Digital	70%	4 Weeks

31	Industry 4.0 & automation	BTAIPE 603C	VI	Industrial Internet of Things (IIoT) https://www.coursera.org/learn/industrial-internet-of-things	University of Michigan	80%	4 Weeks
32	Web Development	BTAIPE 603D	VI	Web Application Development: Basic Concepts https://www.coursera.org/learn/web-app	University of New Mexico	80%	5 Weeks
33	Big Data Analytics	BTAIOE 604A	VI	Fundamentals of Software Architecture for Big Data https://www.coursera.org/learn/software-architecture-for-big-data-fundamentals	University of Colorado Boulder	75%	4 Weeks
34	Cryptography and network security	BTAIOE 604B	VI	Cryptography and Hashing Overview https://www.coursera.org/learn/crypto-hashing	University of California, Irvine	75%	4 Weeks
35	Agile Methodology	BTAIOE 604C	VI	Combining Scrum with Other Agile Methodologies https://www.coursera.org/learn/combining-scrum-with-other-methodologies	LearnQuest	85%	2 Weeks
36	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIH M605	VI	People and Soft Skills Assessment https://www.coursera.org/learn/people-soft-skills-assessment	IBM	65%	1 Week
37	Development Engineering	BTAIH M605A	VI	Developing a Systems Mindset https://www.coursera.org/learn/systems-mindset	University of Colorado Boulder	60%	3 Weeks
38	Employability and Skills Development	BTAIH M605B	VI	Learning How to Learn: Powerful mental tools to help you master tough subjects https://www.coursera.org/learn/learning-how-to-learn	Deep Teaching Solutions	65%	4 Weeks
39	Consumer Behavior	BTAIH M605C	VI	Market Research and Consumer Behavior https://www.coursera.org/learn/market-research	IE Business School	70%	4 Weeks
40	Economics and management	BTAIH M605D	VI	The Strategist's Challenge https://www.coursera.org/learn/strategists-challenge	University of Virginia Darden School Foundation	75%	4 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	Name of Subject as per Curriculum	Course Code	Semester	Edx Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	An Introduction to Artificial Intelligence	BTAI C302	III	Artificial Intelligence (AI)	Colambia University	80%	12 Week
2	Data Structure and Algorithm using Python	BTAI C303	III	1) Foundations of Data Structures	1) IIT Bombay	1) 70%	1) 6 Weeks
				2) Algorithms and Data Structures	2) UCSan Diego	2) 60%	2) 4 Weeks
3	Computer Architecture& Operating System	BTAI C304	III	1. Computer Organization	1. MITx	1. 20%	10 Weeks
				2. Computer Architecture	2. MITx	2. 20%	
4	Data Analysis	BTAI401	IV	StaStatistics and Data	MITx	60%	1 Year
5	Database Management System	BTAI402	IV	Databases: SQL	Stanford Online	50	8 Weeks
6	Probability Theory and Random Processes	BTBS 404	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Image Processing & Computer Vision			Image Processing and Analysis for Life Scientists	EPFLx	50	7 Weeks
8	Internet of Things & Embedded System	BTSE405B	IV	Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/	IISc Banglore	40	8Weeks
				IoT: from hardware to practice	ITMOx University	40	17 Weeks
9	Programming in JAVA	BTSE405D	IV	Introduction to Object-Oriented Programming with Java II: Object-Oriented Programming and Algorithms https://www.edx.org/course/introduction-to-java-programming-ii-object-oriented-programming	Georgia Institute of Technology	100 %	6 week
	Programming in JAVA	BTSE405D	IV	Introduction to Object-Oriented Programming with Java III: Exceptions, Data Structures, Recursion, and GUIs https://www.edx.org/course/introduction-to-java-programming-iii-interfaces-polymorphism-and-complexity			6 week
	Programming in JAVA	BTSE405D	IV	Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics			6 week
10	Computer Network and Cloud Computing	BTAIC501	V	Cloud computing https://onlinecourses.nptel.ac.in/noc22_cs87/preview	IIT Kharagpur	40%	12 weeks

				11Computer Networks and Internet Protocol https://onlinecourses.nptel.ac.in/noc22_cs19/preview			
11	Machine Learning	BTAIC502	V	Introduction to machine learning https://onlinecourses.nptel.ac.in/noc22_cs97/preview	IIT Kharagpur	80%	8 weeks
12	Knowledge reasoning and AI ethics	BTAIHM503	V	Artificial intelligence: knowledge representation and reasoning https://nptel.ac.in/courses/106106140	IIT Madras	60%	12 weeks
13	Virtual Reality	BTAIPE504A	V	Virtual reality engineering https://nptel.ac.in/courses/121106013	IIT Madras	70%	12Weeks
14	Soft computing	BTAIPE504B	V	Introduction to soft computing https://onlinecourses.nptel.ac.in/noc22_cs54/preview	IIT Kharagpur	40%	8 Weeks
				Neural networks and applications https://archive.nptel.ac.in/courses/117/105/117105084/	IIT Kharagpur	40%	37 lectures
15	Sensors and Robotics Technology	BTAIPE504C	V	Introduction to robotics https://onlinecourses.nptel.ac.in/noc22_de11/preview Introduction to robotics https://archive.nptel.ac.in/courses/107/106/107106090/	IIT Madras	70%	12 weeks
16	Advanced Java	BTAIPE504D	V	Programming in Java https://onlinecourses.nptel.ac.in/noc22_cs47/preview	IIT Kharagpur	50%	12 weeks
17	Data mining and warehousing	BTAIOE505A	V	Data mining https://onlinecourses.swayam2.ac.in/cec19_cs01/preview		60%	12 weeks
				Data mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview	IIT Kharagpur	40%	8 weeks
18	Digital communication and information theory	BTAIOE505B	V	An introduction to coding theory https://onlinecourses.nptel.ac.in/noc22_ee108/preview	IIT Kanpur	80%	12 weeks
				Principles of Digital communication https://nptel.ac.in/courses/108101113	IIT Bombay	90%	12 weeks
17	Software engineering and testing	BTAIOE505C	V	Software engineering https://onlinecourses.nptel.ac.in/noc22_cs106/preview	IIT Kharagpur	60%	12 weeks
				Software testing https://onlinecourses.nptel.ac.in/noc19_cs71/preview	IIT Bangalore	60%	12 weeks
				Software testing https://onlinecourses.nptel.ac.in/noc20_cs19/preview	IIT Kharagpur	40%	4 weeks
18	Deep learning	BTAIC601	VI	Deep learning https://onlinecourses.nptel.ac.in/noc20_cs62/preview	IIT Kharagpur	80%	12 week
				Deep learning https://onlinecourses.nptel.ac.in/noc22_cs124/preview	IIT Ropar	70%	12 weeks
19	Advanced Machine Learning	BTAIC602	VI	Machine learning for engineering and science application https://onlinecourses.nptel.ac.in/noc19_cs82/preview	IIT Madras	50%	12 Weeks
20	Augmented reality	BTAIPE603A	VI	-			
22	Recommender system	BTAIPE603B	VI	-			
23	Industry 4.0 & automation	BTAIPE 603C	VI	Introduction to industry 4.0 and industrial internet of things https://onlinecourses.nptel.ac.in/noc22_cs95/preview	IIT Kharagpur	50%	12 weeks
24	Web Development	BTAIPE 603D	VI	Modern application development https://nptel.ac.in/courses/106106156	IIT Madras	40%	8 weeks

25	Big Data Analytics	BTAIOE 604A	VI	-			
26	Cryptography and network security	BTAIOE 604B	VI	Cryptography and network security https://onlinecourses.nptel.ac.in/noc22_cs90/preview	IIT Kharagpur	60%	12 weeks
27	Agile Methodology	BTAIOE 604C	VI	-			
28	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	BTAIH M605	VI	Developing soft skill and personality https://archive.nptel.ac.in/courses/109/104/109104107/ Educational leadership https://archive.nptel.ac.in/courses/109/105/109105122/	IIT Kharagpur & Kanpur	40%	8 weeks
29	Development Engineering	BTAIH M605A	VI	-			
30	Employability and Skills Development	BTAIH M605B	VI	Soft skills https://onlinecourses.nptel.ac.in/noc21_hs76/preview	IIT Roorkee	70%	12 weeks
31	Consumer Behavior	BTAIH M605C	VI	Introduction to consumer behavior https://nptel.ac.in/courses/110105029	IIT Kharagpur	50%	8 weeks
32	Economics and management	BTAIH M605D	VI	Economics / Management / Entrepreneurship https://nptel.ac.in/courses/110105067	IIT Kharagpur	60%	12 weeks

Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra

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www.dbatu.ac.in

Curriculum for Second year

Undergraduate Degree Programme

B. Tech. in Chemical Engineering

With effect from AY 2021-22

	Semester III									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	T	P	CA	MSE	ESE	Total	Credit
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC	BTCHC302	Fluid Flow Operations	3	1	-	20	20	60	100	4
PCC	BTCHC303	Process Calculations	3	1	-	20	20	60	100	4
PCC	BTCHC304	Mechanical Operations	3	-	-	20	20	60	100	3
PEC	BTCHE305	Professional Elective I	3	-	-	20	20	60	100	3
LC	BTCHL306	Fluid Flow Operations + Mechanical Operations Lab	-	-	3	60	-	40	100	2
Seminar	BTCHS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTCHI308	Internship – 1 (Evaluation)	-	-	-	-	-	-	-	Audit
		Total	**15**	**3**	**7**	**220**	**100**	**380**	**700**	**22**
	Semester IV									
PCC	BTCHC401	Chemical Engineering Thermodynamics	4	1	-	20	20	60	100	5
PCC	BTCHC402	Heat Transfer Operations	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic human rights	3	-	-	20	20	60	100	3
OEC	BTCHO404	Open Elective I	3	-	-	20	20	60	100	3
PEC	BTCHE405	Professional Elective – II	3	1	-	20	20	60	100	4
LC	BTCHL406	Heat Transfer Operations Lab	-	-	3	60	-	40	100	2
Seminar	BTCHS407	Seminar II	-	-	4	60	-	40	100	2
Internship		Field Training / Internship 2/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	**-**	**-**	**-**	-	-	-	-	Credit s To be evalua te d in V Sem.
		Total	**16**	**3**	**7**	**220**	**100**	**380**	**700**	**23**

**** As per the recent directives from the University, online courses on Artificial Intelligence(credit course) and Constitution of India are added in third semester as mandatory courses over and above the courses mentioned in course structure.**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course ,PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Course

List of Electives

1) Professional Elective I
   A. Green Technology
   B. Nanotechnology
   C. Energy Technology and Conversion
   D. Renewable Energy Sources
   E. Materials for Engineering applications
2) Professional Elective II
   A. Numerical methods
   B. Introduction to Bioprocess Engineering
   C. Strength of Materials
   D. Introduction to Polymer Science and Engineering
   E. Advanced Engineering Chemistry
3) Open Elective I
   A. NSS I
   B. Development Engineering

Semester: IIIrd

BTBS301 Engineering Mathematics – III **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
BSC	BTBS 301	Engineering Mathematics-III	3	1	-	20	20	60	100	4

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Laplace and inverse Laplace transforms and their derivatives for elementary functions
2. properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
3. definitions and properties of Fourier transforms
4. solutions of partial differential equations governing real-world problems

Course Outcomes:

At the end of the course, the student will be able to:

1. comprehend the fundamental knowledge of the Laplace and inverse Laplace transforms and their derivatives for elementary functions
2. apply the properties of Laplace and inverse Laplace transforms to solve simultaneous linear and linear differential equations with constant coefficients
3. conceptualize the definitions and properties of Fourier transforms, to solve boundary value problems using Fourier transforms
4. find the solutions of partial differential equations governing real-world problems
5. conceptualize limit, continuity, derivative and integration of complex functions, complex integrals useful in real-world problems

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	✓	-	-	✓		✓	-	-	-	-	-	-
CO2	✓	-	-	✓		✓	-	-	-	-	-	-
CO3	✓	-	-	✓		✓	-	-	-	-	-	-
CO4	✓	-	-	✓		✓	-	-	-	-	-	-
CO5	✓			✓		✓						

Detailed syllabus

Unit 1: Laplace Transform

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\text{i. e } \frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and one dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.

4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

BTCHC302 Fluid Flow Operations 4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC 302**	**Fluid Flow Operations**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Knowledge of dimensionless groups by dimensional analysis.
2. Manometers and decanters using the principles of fluid statics.
3. Pipe size / flow rate / power requirements under laminar / turbulent conditions
4. Motion of fluid, fluid – solid operations in packed and fluidized beds
5. Machinery for fluid transportation.

Course Outcomes: At the end of the course, the student will be able to:

1. Derive dimensionless groups by dimensional analysis.
2. Solve problems related to manometers and decanters using the principles of fluid statics.
3. Deter mine pipe size / flow rate / power requirements under laminar / turbulent conditions
4. Understand and solve Motion of fluid, fluid – solid operations in packed and fluidized beds
5. Select Machinery for fluid transportation.
6. Determine the flow rate of fluid passing through closed channels.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓							
CO6	✓	✓	✓	✓	✓							

Detailed syllabus

Unit I:

Continuity equation for compressible and incompressible fluids. Bernoulli equation, Euler equation.Equation of motion. Types of flow, steady and unsteady, laminar and turbulent flows, relationship between shear stress and pressure gradient, Hagen Poiseuille equation.

Unit II:

Prandtl mixing length theory and eddy diffusivity, losses in pipes and fittings. Darcy-Weisbach equation for frictional head loss, friction factor, Moody diagram. Velocity profile and boundary layer calculations for turbulent flow.

Unit III:

Flow through packed and fluidized beds. Introduction to non-Newtonian flow and two phase flow.

Unit IV:

Pumps and compressors for handling different fluids, valves, pipe fittings and their standards, power requirement for flow. Piping layout and economical pipe diameter. Vacuum producing devices.

Unit V:

Flow measuring devices: Orificemeter, Venturimeter, rotameter, Pitot tube, anemometer etc. Flow through constrictions such as notches, weirs, nozzles. Mixing and agitation, calculation of power numbers and mixing indices.Liquid-liquid and liquid solid mixing.

Texts / References:

1. W. L. McCabe and J. C. Smith, P. Harriot, Unit Operations of Chemical Engineering 4th ed. McGraw Hill 1985.
2. S. K. Gupta, Moment Transfer Operations, Tata McGraw Hill, 1979.
3. J. M. Coulson and J. F. Richardson, Chemical Engineering Vol. I.Pergamon Press, 1970.
4. S. Foust, L. A. Wenzel, C. W. Clump, L. B. Andersen. Principles of Unit Operations, 2nd ed. John Wiley, New York, 1980.

BTCHC303 Process Calculations **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC 303**	**Process Calculations**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Material and energy balances of chemical processes.
2. Material and energy balances on chemical processes/equipment
3. Chemical Engineering problems involving recycle, purge and bypass
4. Ideal and real behavior of gases, vapors and liquids.

Course Outcomes: At the end of the course, student will be able to:

1. Understand the material and energy balances of chemical processes.
2. Perform material and energy balances on chemical processes/equipment
3. Draw the flow diagram and solve the problems involving recycle, purge and bypass
4. Understand the ideal and real behavior of gases, vapors and liquids.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-

Detailed syllabus

Unit I:

Introduction to Chemical Engineering: Historical evolution of Chemical Engineering and Chemical Process Industries, Chemistry to Chemical Engineering, Revision of Units and Dimensions., Mathematical techniques, Introduction to use of calculators.Mole concept, composition relationships and stoichiometry.

Unit II:

Material Balances: Basic Material Balance Principles, Material balance problems without and with chemical reactions, Recycle, Bypass and Purge.

Unit III:

Gases, Vapours and Liquids: Ideal Gas Law, Real Gas relationships, Vapour pressure, Vapor-Liquid Equilibrium calculations, Partial saturation & Humidity, Humidity chart, Material balances involving condensation and vaporization.

Unit IV:

Energy Balances: Heat Capacity, Calculation of enthalpy changes, Energy balances without chemical reactions, Enthalpy changes of phase changes, Heat of solution and mixing, Energy balances accounting for chemical reactions - Standard heat of reaction, formation and combustion, Hess Law, Effect of temperature, Adiabatic flame temperature.

Unit V:

Un-steady state mass balances, with and without reactions.

Texts / References:

1. D.M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India, 1997.
2. B. I. Bhat and S. M. Vora, “Stoichiometry” Tata McGraw-Hill, New Delhi
3. V. Venkataramani, N. Anantharaman and K.M. MeeraSheriffa Begum, “Process Calculations” 2nd edition, Prentice Hall of India, 2015.

BTCHC304 Mechanical Operations **3 Credits**

Category	**Code**	**Subject Name**	**L**	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**Credit**
PCC	**BTCHC 304**	**Mechanical Operations**	**3**	**-**	**-**	**20**	**20**	**60**	**100**	**3**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Mechanical operations and their role in chemical engineering
2. Nature of solids, their characterization, handling, and the processes involving solids.
3. Performance of size reduction equipment and calculate the power requirements.
4. Solid-fluid separation equipment.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand mechanical operations and their role in chemical engineering
2. Understand nature of solids, their characterization, handling, and the processes involving solids.
3. Analyze the performance of size reduction equipment and calculate the power requirements.
4. Design solid-fluid separation equipment.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-

Detailed syllabus

Unit I:

Introduction: Unit operations and their role in chemical industries; Types of mechanical operations.Properties and handling of particulate solids: Characterization of solid particles, Properties of masses of particles, mixing of solids, Size reduction, ultrafine grinders.

Unit II:

Screening: Screening equipment, Screen capacity.

Unit III:

Cake filters: Centrifugal filters, Filter media, Principles of cake filtration, Washing filter cakes. Clarifying filters: Liquid clarification, Gas cleaning, Principles of clarification.

Unit IV:

Cross flow filtration: Types of membranes, Permeate flux for ultrafiltration, Concentration polarization, Applications of ultrafiltration, Dia-filtration, Microfiltration.

Unit V:

Sedimentation: Gravity sedimentation processes, Centrifugal sedimentation processes.

Text / Reference:

1. McCabe W. L., Jullian Smith C. and Peter Harriott - Unit operations of Chemical Engineering, 7th Edition, McGraw-Hill international edition, 2005.
2. Coulson J.M., Richardson J.F, Chemical Engineering, Vol. II, 4th Edition, Elsevier India, 2006.

BTCHE305 Professional Elective – I **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PEC	BTCHE305	Professional Elective I	3	-	-	20	20	60	100	3

A. Green Technology

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Principles and concepts of green chemistry
2. Manufacturing processes to reduce wastage and energy consumption
3. Technologies to reduce the level of emissions from buildings and core infrastructure
4. Effects of pollutants on the environment

Course Outcomes: At the end of the course, the student will be able to:

1. Understand principles and concepts of green chemistry
2. Develop manufacturing processes to reduce wastage and energy consumption
3. Design the technologies to reduce the level of emissions from buildings and core infrastructure
4. Analyze the effects of pollutants on the environment

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	

CO1	✓	✓	-	-	-	-	✓	-	-
CO2	✓	✓	✓	-	-	-	✓	-	-
CO3	✓	✓	✓	✓	✓	-	✓	-	-
CO4	✓	✓	-	✓	-	✓	✓	-	-

Detailed Syllabus

Unit 1: Principles and concepts of Green Chemistry: Introduction, Sustainable Development and Green Chemistry, Atom Economy, Atom Economic Reactions, Rearrangement Reactions, Addition Reactions, Atom Un-economic Reactions, Substitution Reactions, Elimination Reactions, Wittig Reactions, Reducing Toxicity, Measuring Toxicity.

Unit 2: Waste- Production, Problems and Prevention: Introduction, Some Problems Caused by Waste, Sources of Waste from the Chemical Industry, The Cost of Waste, Waste Minimization Techniques, The Team Approach to Waste Minimization, Process Design for Waste Minimization, Minimizing Waste from Existing Processes, On-site Waste Treatment, Physical Treatment, Chemical Treatment, Biotreatment Plants, Design for Degradation, Degradation and Surfactants, DDT, Polymers, Some Rules for Degradation, Polymer Recycling, Separation and Sorting, Incineration, Mechanical Recycling, Chemical Recycling to Monomers. Measuring and controlling environmental performance: The Importance of Measurement, Lactic Acid Production, Safer Gasoline, Introduction to Life Cycle Assessment, Green Process Metrics, Environmental Management Systems, The European Eco-management and Audit Scheme, Eco-labels, Legislation, Integrated Pollution Prevention and Control. Catalysis and green chemistry.

Unit 3: Organic solvents, Environmentally benign solutions: Organic Solvents and Volatile Organic Compounds, Solvent-free Systems, Supercritical Fluids, Supercritical Carbon Dioxide, Supercritical Water, Water as a Reaction Solvent, Water-based Coatings, Ionic Liquids, Ionic Liquids as Catalysts, Ionic Liquids as Solvents, Fluorous Biphase Solvents. Renewable resources: Biomass as a Renewable Resource, Energy, Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable Feed stocks, Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies, The Syngas Economy, The Bio-refinery, Chemicals from renewable feed stocks.

Unit 4: Emerging Greener technologies and Alternative energy solutions: Design for Energy Efficiency, Photochemical Reactions, Advantages of and Challenges Faced by Photochemical, Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves, Microwave Heating, Microwave-assisted Reactions, Sono-chemistry, Sono-chemistry and Green Chemistry, Electrochemical Synthesis, Examples of Electrochemical Synthesis. Designing greener processes: Conventional Reactors, Batch Reactors, Continuous Reactors, Inherently Safer Design, Minimization, Simplification, Substitution, Moderation, Limitation, Process Intensification, Some PI Equipment, Examples of Intensified Processes, In-process Monitoring, Near-infrared Spectroscopy.

Unit 5: Industrial case studies: A Brighter Shade of Green, Greening of Acetic Acid Manufacture, EPDM Rubbers, Vitamin C, Leather Manufacture, Tanning, Fatliquoring, Dyeing to be Green, Some Manufacturing and Products Improvements, Dye Application, Polyethene, Radical Process, Ziegler–Natta Catalysis, Metallocene Catalysis, Eco-friendly Pesticides, Insecticides. An integrated approach to a greener chemical industry: Society and Sustainability, Barriers and Drivers, The Role of Legislation, EU White Paper on Chemicals Policy, Green Chemical Supply Strategies.

Text / Reference:

1. Mike Lancaster, Green Chemistry, Royal Society of Chemistry, 2010.
2. Paul T. Anastas John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000.
3. Jay Warmke, Annie Warmke, Green Technology, Educational Technologies Group, 2009.

B. Nanotechnology

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Properties of nano-materials and their applications
2. Chemical engineering principles to nano-particles production and scale-up
3. Quantum confinement equations
4. Characterization of nano-materials.
5. Applications of nanotechnology in electronics and chemical industries.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the properties of nano-materials and their applications
2. Apply chemical engineering principles to nano-particles production and scale-up
3. Solve the quantum confinement equations
4. Characterize nano-materials.
5. State the applications of nanotechnology in electronics and chemical industries.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				-	-	-	-	-	-	-	-	-
CO2								-	-	-	-	-
CO3		-	-	-	-	-		-	-	-	-	-
CO4					-		-	-	-	-	-	-
CO5										✓	✓	-

Detailed Syllabus:

Unit I: Introduction to Nanotechnology: Introduction to nanotechnology and materials, Nanomaterials, Introduction to nano sizes and properties comparison with the bulk materials, different shapes and sizes and morphology.

Unit II: Fabrication of Nanomaterials: Top Down Approach, Grinding, Planetary milling and Comparison of particles, Bottom Up Approach, Wet Chemical Synthesis Methods, Micro emulsion Approach, Colloidal Nanoparticles Production, Sol Gel Methods, Sonochemical Approach, Microwave and Atomization, Gas phase Production Methods : Chemical Vapor Depositions.

Unit III: Kinetics at Nano-scale: Nucleation and growth of particles, Issues of Aggregation of Particles, Oswald Ripening, Stearic hindrance, Layers of surface Charges, Zeta Potential and pH. Carbon Nanomaterials: Synthesis of carbon buckyballs, List of stable carbon allotropes extended fullerenes, metal lofullerenes solid C60, bucky onions nano-tubes, nano-cones Difference between Chemical Engineering processes and nano-synthesis processes.

Unit IV: Characteristics of quantum dots, Synthesis of quantum dots, Semiconductor quantum dots, Introduction – Nano-clay Synthesis method, Applications of nano-clay. Nanomaterials characterization: Instrumentation Fractionation principles of Particle size measurements, Particle size and its distribution, XRD, Zeta potential

Microscopy's SEM, TEM, Atomic Forced Microscopy, Scanning and Tunneling Microscopy.

Unit V: Applications in Chemical Engineering: Self-assembly and molecular manufacturing : Surfactant based system Colloidal system applications, ZnO,TiO2, Silver Nanoparticles Functional materials Applications, Production Techniques of Nano-tubes, Carbon arc, bulk synthesis, commercial processes of synthesis of nano-materials, Nano-clay, Commercial case study of nano synthesis - applications in chemical engineering, Nano inroganic materials - CaCO3 synthesis, Hybrid wastewater treatment systems, Electronic Nano-devices, sensor applications.

Text / Reference:

1. Kulkarni Sulabha K., Nanotechnology: Principles and Practices, Capital Publishing Company, 2007.
2. Gabor L. Hornyak., H.F. Tibbals, JoydeepDutta, John J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press.
3. Robert Kelsall, Ian Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.
4. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009.
5. Davies, J. H. 'The Physics of Low Dimensional Semiconductors: An Introduction'

C. Energy Technology and Conservation

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Energy conversion processes for solid fuels.
2. Energy utilization systems for heat recovery.
3. Properties of fuel samples
4. Energy audit.

Course Outcomes: At the end of the course, the student will be able to:

1. Understand energy conversion processes for solid fuels.
2. Design energy utilization systems for heat recovery.
3. Estimate the properties of fuel samples

4. Perform energy audit.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	✓	-	-	-	-	-

Detailed syllabus

Unit I: Energy scenario: Introduction and classification of energy, renewable and non-renewable energy, Indian energy scenario, energy pricing in India, energy and environment. Solid fuels: Introduction, Biomass, Peat, Light and brown coal, Black Lignite, Bituminous coal, Semi anthracite , Anthracite, Natural coke/SLV fuel, Origin of coal, composition of coal, classification of coal, Sampling and analysis of solid fuels, oxidation of coal, Hydrogenation of coal, storage of coal.

Unit II: Carbonization and gasification processes: Introduction, carbonization of coal, the gasification of solid fuels, the gasification of oil and hydrocarbon gas reforming, carbureted water gas. Energy conversion with combustion: Introduction, Combustion, Burner design, Combustion plant, direct conversion of energy.

Unit III: Fuel testing: Introduction, Calorific value, tests on liquid fuels, Fuel and flue gas analysis. Energy auditing: Introduction, Energy conservation schemes Industrial energy use, energy conversion, energy index, energy costs. Energy sources: Energy consumption, world energy reserves, energy prices, fuel production and processing, energy policies, choice of fuels, cycle efficiency.

Unit IV: Heat transfer media: Water, Steam, Thermal fluids, Air-water vapor mixtures, Heat transfer equipment: Heat exchangers, Combustion and thermal efficiency, Steam plant, pressure hot water and thermal fluids plant, thermal fluids plant.

Unit V: Energy utilization and conversion systems: Furnaces, Hydraulic power systems, Compressed air, steam turbines, combined power and heating systems, Energy conversion, District heating, Heat recovery: Sources of waste heat and its applications, Heat recovery systems, Incinerators, Regenerators and recuperators, waste heat boilers.

Text / Reference:

1. Samir Sarkar, Fuels and Combustion, Universities Press, 2009.
2. Murphy W.R and Mckay G., Energy Management, Elsevier, 2007.
3. HarkerJ.H. and J.R. Backhurst, Fuel and Energy, Academic Press, London, 1981.

D. Renewable Energy Sources

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Challenges and problems associated with the use of energy sources.
2. Renewable energy resources and technologies
3. Conversion technologies for solar, wind, biomass and hydrogen energies
4. Performance of energy conversion technologies

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the challenges and problems associated with the use of energy sources.
2. List renewable energy resources and technologies
3. Design conversion technologies for solar, wind, biomass and hydrogen energies
4. Evaluate the performance of energy conversion technologies

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO2	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	✓	-	-	-	-	-

Detailed syllabus

Unit I: Sources of energy: Energy sources and their availability, renewable energy sources. Energy from

Unit II: Solar Energy: Sun and solar energy, solar radiation and its measurement, solar energy collectors, solar energy storage, Photovoltaic systems, Application of solar energy.

Unit III: Wind Energy: Wind as an Energy source, Basic principles of wind energy conversion, Types of Wind machines, Components of wind energy conversion system, Performance of wind machines, application of wind energy.

Unit IV: Energy from the Oceans: Introduction, Ocean Thermal Electric Conversion (OTEC), Energy from Tides, Ocean Waves

Unit V: Hydrogen energy: Introduction, Hydrogen production, Hydrogen storage, Hydrogen transportation. Chemical Energy Sources: Introduction, Fuel cells, Batteries.

Text / Reference:

1. Rai, G.D, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2010.
2. Rajesh Kumar Prasad, T.P. Ojha, Non-Conventional Energy Sources, Jain Brothers, 2012.
3. Sukhatme S.P and J. Nayak, Solar energy – Thermal Collection and storage, 3rd Edition, Tata McGraw Hill Education Pvt Ltd., 2008.
4. MM. EI – Wakil, Power Plant Technology, Tata McGraw Hill, NewYork, 1999.

E. Materials for Engineering Applications

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Processing, microstructure and properties of materials.
2. Behavior of materials under various conditions.
3. Modes of failure of engineering materials and design new materials with better properties and cost effective processes.
4. Suitable materials for engineering applications.

Course Outcomes: At the end of the course, the student will be able to:

1. Correlate processing, microstructure and properties of materials.
2. Understand behavior of materials under various conditions.
3. Characterize modes of failure of engineering materials and design new materials with better properties and cost effective processes.

4. Identify suitable materials for engineering applications.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	✓	-	✓		✓	-	-	-
CO2	-	✓	-	-	✓	-	✓		✓	-	-	-
CO3	-	✓	-	-	✓	-	✓		✓	-	-	-
CO4	-	✓	-	-	✓	-	✓		✓	-	-	-

Detailed Syllabus:

Unit I: Materials Science and Engineering Materials,Classification of Materials and Properties: Mechanical, Dielectric, Magnetic and Thermal.

Unit II: Metallurgical Aspects of Materials: Structure of Metals and Alloys, Nature of Metallic Bonding, Crystal Structures of Metals, Structure of Alloys, Imperfections in Crystals, Significance of micro structural features.

Unit III: Heat Treatment: effect of cooling and heating rates and ageing materials for mechanical load bearing applications; Corrosion Resistant Materials: Some important Metals, Alloys, Ceramics and Polymers.

Unit IV: Materials for Electrical Applications: Conductors, Dielectrics, insulators; Materials for Civil Engineering Applications.

Unit V: Materials for Biomedical applications: Steels, Ti and its alloys, Ni-Ti alloys, bioceramics, porous ceramics, bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products.

Text / Reference:

1. M.F. Ashby: Engineering Materials, 4th Edition, Elsevier, 2005.
2. M.F. Ashby: Materials Selection in Mechanical Design, B H, 2005.
3. ASM Publication Vol. 20, Materials Selection and Design, ASM, 1997
4. Pat L. Mangonon: The Principles of Materials Selection and Design, PHI, 1999.

BTCHL306 Fluid Flow Operations and Mechanical Operations Lab

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTCHL 306	Fluid Flow Operations and Mechanical Operations Lab	-	-	3	60	-	40	100	2

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Viscosity determination using Fenske or other viscometer
2. Laminar and turbulent flows.
3. Selection of manometric fluid for experiment.
4. Characteristics of packed & fluidized beds and centrifugal pumps
5. Ball, gate, globe, check valves, elbow, bend and T-joint
6. Screen effectiveness
7. Dry and wet screen analysis
8. Cyclone separator and froth flotation

Course Outcomes: At the end of the course, the student will be able to:

1. Determine viscosity using Fenske or other viscometer and terminal velocity
2. Distinguish laminar and turbulent flows.
3. Select manometric fluid for experiment.
4. Determine the characteristics of packed & fluidized beds and centrifugal pumps
5. Identify ball, gate, globe, check valves, elbow, bend and T-joint
6. Understand screen effectiveness
7. Understand dry screen analysis
8. Understand wet screen analysis
9. Understand cyclone separator and froth flotation

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓							

CO6	✓	✓	✓	✓	✓							
CO7	✓	✓	✓	✓	✓							
CO8	✓	✓	✓	✓	✓							
CO9	✓	✓	✓	✓	✓							

(Perform minimum 9 and maximum 11 of the experiments from the two sets, *viz.* Fluid Flow and mechanical Operations with at least 4 experiments from each set. This list is indicative. Colleges and departments can choose additional experiments as per availability subject to adherence with the syllabus.)

List of Experiments (Fluid Flow Operations):

1. Determination of flow regimes -Reynolds' apparatus
2. Verification of Bernoulli's equation
3. Determination of Fanning friction factor for smooth and rough pipes
4. Determination of equivalent length of pipe fittings
5. Determination of viscosity with capillary tube viscometer.
6. Determination of friction factor for flow through packed bed.
7. Determination of discharge coefficient for venturi meter
8. Centrifugal pump characteristics
9. Study of Rota meter

List of Experiments (Mechanical Operations):

1. Determination of screen effectiveness
2. Dry screen analysis
3. Wet screen analysis
4. Study of sedimentation
5. Study of air elutriation
6. Study of cyclone separator
7. Study of froth flotation

BTCHS307 Seminar I **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Seminar	**BTCHS307**	**Seminar - I**	**-**	**-**	**4**	**60**	**-**	**40**	**100**	**2**

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum.
2. Communicate with group of people on different topic
3. Collect and consolidate required information on a topic
4. Prepare a seminar report

Each student is expected to collect information on recent advances in Chemical Engineering by regularly referring to national and international journals and reference books. At the end of the semester he/she is required prepare a report as per the guide lines prescribed by the Department. Each student will be assigned a guide for this seminar course. Every student shall give a power point presentation on his Seminar topic before a panel of examiners.

BTCHI308 Internship - 1 (Evaluation)

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	**BTCHI308**	**Internship - 1 (Evaluation)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Audit**

BTCH308 Internship – I (Industrial Training)

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum on summer training.
2. Communicate with group of people on different topics of summer training.
3. Collect and consolidate required information on a topic of summer training.
4. Prepare a seminar report on summer training

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of IIndsemester (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc.

The student shall submit the report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Semester IVth

BTCHC401 Chemical Engineering Thermodynamics **5 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC401**	**Chemical Engineering Thermodynamics**	**4**	**1**	**-**	**20**	**20**	**60**	**100**	**5**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. First and second laws of thermodynamics to chemical processes and the properties of ideal and real mixtures.
2. Behavior of flow and non-flow processes using mass and energy balances
3. Heat and work requirements for industrial processes.
4. Efficiency of processes involving heat into work, refrigeration and liquefaction
5. Heat effects involved in industrial chemical processes
6. Thermodynamic properties of gaseous mixtures / solutions
7. Bubble-P & T, Dew-P & T for binary and multi-component systems
8. Vapor-liquid equilibrium (VLE) composition for ideal and non-ideal systems
9. Equilibrium constant and composition of product mixture at given temperature and pressure.

Course Outcomes: At the end of the course, the student will be able to:

1. Apply the first and second laws of thermodynamics to chemical processes.
   Compute the properties of ideal and real mixtures.
2. Analyze the behavior of flow and non-flow processes using mass and energy balances
3. Estimate heat and work requirements for industrial processes.
4. Determine the efficiency of processes involving heat into work, refrigeration and liquefaction
5. Calculate heat effects involved in industrial chemical processes
6. Determine thermodynamic properties of gaseous mixtures / solutions
7. Calculate Bubble-P & T, Dew-P & T for binary and multi-component systems
8. Calculate vapor-liquid equilibrium (VLE) composition for ideal and non-ideal systems
9. Determine equilibrium constant and composition of product mixture at given temperature and pressure.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO6	✓	✓	✓	✓			✓					
CO7	✓	✓	✓	✓			✓					
CO8	✓	✓	✓	✓			✓					
CO9	✓	✓	✓	✓			✓					

Detailed Syllabus :

Unit 1 : INTRODUCTION : The Scope of thermodynamics; Dimensions and units; Measures of Amount or size; Force; Temperature; Pressure; Work; Energy; Heat. **THE FIRST LAW OF THERMODYNAMICS:** Joule's Experiments; Internal Energy; The First Law of Thermodynamics; Energy balance for closed systems; Thermodynamic state and state functions; Equilibrium; The phase rule; The reversible process; Constant V and constant P processes; Enthalpy; Heat capacity; Mass and energy balances for open systems. **VOLUMETRIC PROPERTIES OF PURE FLUIDS :** PVT Behaviour of pure substances; the Virial Equation; The Ideal Gas; Application of the Virial Equation; Cubic Equations of State; Generalised Correlation's for gases; Generalised correlation's for Liquids**. HEAT EFFECTS:** Sensible Heat Effects, Heat Effects Accompanying Phase Changes of Pure Substances,The Standard Heat of Reaction, The Standard Heat of Formation, The Standard Heat of Combustion, Effect of Temperature on the standard Heat of Reaction**.**

Unit II: THE SECOND LAW OF THERMODYNAMICS : Statement of the Second law : The Heat Engine; Thermodynamic Temperature Scales; Entropy; Entropy changes of an ideal gas; Mathematical statement of the Second Law; Entropy balance for open systems; Calculation of ideal work; Lost work; The Third Law of Thermodynamics; Entropy from the Microscopic view point. **THERMODYNAMIC PROPERTIES OF FLUIDS:** Property Relations for Homogeneous phase; Residual Properties; Residual properties by equations of state; Two phase systems, Thermodynamic diagrams; Tables of Thermodynamic properties; Generalised property correlations for gases.

Unit III: APPLICATIONS OF THERMODYNAMICS TO FLOW PROCESSES: Duct flow of compressible fluids; Turbines (expanders); Compression processes. **REFRIGERATION AND LIQUEFACTION :** The Carnot Refrigerator; the vapour-compression cycle; The Choice of refrigerant; Absorption Refrigeration; The heat pump; Liquefaction Processes. **Vapour/Liquid Equilibrium Introduction**: The nature of equilibrium, the Phase Rule, Duhem's Theorem, VLE: Qualitative behaviour, Simple models for vapour/liquid equilibrium, VLE by modified Raoult's Law, VLE from K- value correlations.

Unit IV: Solution Thermodynamics: Theory: Fundamental property relation, The chemical potential and phase equilibria, Partial properties, Ideal gas mixtures, Fugacity and fugacity coefficient. Fugacity and fugacity coefficient: Species in the solution, Generalized correlations for the fugacity coefficient, The ideal solution, Excess properties.
Solution Thermodynamics: Applications: Liquid-phase properties from VLE data, Models for the excess Gibbs energy, Property changes of mixing, Heat Effects of mixing processes.

Unit V: Chemical Reaction Equilibria: The reaction coordinate, Application of equilibrium criteria to chemical reactions, The standard Gibbs energy change and equilibrium constant, Effect of temperature on the equilibrium constants. Relation of equilibrium constants to composition, Equilibrium conversions for single reactions, Phase rule and Duhem's theorem for reacting systems, Multi reaction equilibria, Fuel cells.

Text/Reference books:

1. J. M. Smith, H.C. Van Ness, and M.M. Abbott, Chemical Engineering Thermodynamics, 6thed, Tata McGraw Hill edition, 2003.
2. Y. V. C. Rao, "Chemical Engineering Thermodynamics", University Press 1997
3. S. I. Sandler. "Chemical Engineering Thermodynamics", Wiley, New York, 1999.

BTCHC402 Heat Transfer Operations **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC402**	**Heat Transfer Operations**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Different modes of heat transfer.
2. Heat transfer coefficients for forced and natural convection.
3. Heat transfer involving phase change.
4. Heat exchanger performance for co-current and counter-current flows.
5. Double pipe and shell & tube heat exchangers

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the modes of heat transfer.
2. Determine heat transfer coefficients for forced and natural convection.
3. Understand heat transfer involving phase change.

4. Analyze the heat exchanger performance for co-current and counter-current flows.
5. Design double pipe and shell & tube heat exchangers

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed syllabus

Unit I: **Conduction** through a single homogeneous solid, thermal conductivity of solids, liquids and gases. Conduction through several bodies in series. Contact resistances. Unsteady state heat conduction, lumped heat capacity system, transient heat flow in a semi-infinite solid. Concept of critical insulation thickness.

Unit II: **Heat transfer by Convection**: Forced convection, Laminar heat transfer on a flat plate Laminar and turbulent flow heat transfer inside and outside tubes. Film and overall heat transfer coefficients. Resistance concept, Coefficients for scale deposits, L.M.T.D. in heat exchangers with co and counter current flow. Heat exchanger design, Effectiveness – N T U method in finned tube heat exchangers. **Natural convection**: Heat transfer from plates and cylinders in verticals and horizontal configuration, natural convection to spheres. **Combined natural and forced convection:** Fluid flow and heat transfer across cylinders and spheres. Combined natural and forced convection heat transfer in horizontal circular conduits.

Unit III: **Heat transfer with phase change,** heat transfer in condensing vapour, types of condensation. Nusselt Theory. Heat transfer to Boiling liquid. Pool boiling. Evaporation , Single and multiple effect evaporators. Types of evaporators. Performance of evaporator. Calculations of single and multiple effect evaporator.

Unit IV: **Heat Transfer by Radiation:** Black and gray body radiations, emissivity, laws of radiation, view factor, luminous and non-luminous gases. Radiation between surfaces, Combined heat transfer, i.e. conduction, convection and radiation together. .

Unit V: **Introductory Concepts of Heat exchanger design:** Design of single and multi pass shell and tube type exchangers using LMTD and effectiveness – NTU methods. Spiral coil and plate type heat exchangers. Single and multi phase condenser. Design of

Reboilers, vapourisers, Kettle type and Thermosiphon reboilers, forced circulation vaporizers. Heat transfer in agitated vessels both, jacketed and with coil, Determination of overall heat transfer coefficient, transient heating or cooling. Heat transfer in packed and fluidized beds. Heat transfer in extended surfaces such as fins, conduction convection heat transfer, forced convection heat transfer in circular conduits with longitudinal fins. Heat transfer in non Newtonian fluids.

Texts / References:

1. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. 1 ELBS, Pergamon press, 1970

2. J. M. Coulson and J. F. Richardson, "Chemical Engineering" Vol. 2 ELBS, Pergamon press, 1970

3. W. L. McCabe J. C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", 4th ed. McGraw Hill 1985.

4. D. Q. Kern, "Process Heat Transfer", McGraw Hill, 1950.

BTHM403 Basic human rights **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSMC	**BTHM403**	**Basic human rights**	**3**	**-**	**-**	**20**	**20**	**60**	**100**	**3**

Course Objectives:

1) To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2) To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3) To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4) To develop sympathy in their minds for those who are denied rights.
5) To make the students aware of their rights as well as duties to the nation.

Course Outcomes:

1. Students will be able to understand the history of human rights.
2. Students will learn to respect others caste, religion, region and culture.
3. Students will be aware of their rights as Indian citizen.
4. Students will be able to understand the importance of groups and communities in the society.
5. Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

Detailed Syllabus

UNIT I:
The Basic Concepts: - Individual, group, civil society, state, equality, justice.
Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

UNIT II
Fundamental rights and economic programme.
Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT III
Migrant workers and human rights violations, human rights of mentally and physically challenged.
State, Individual liberty, Freedom and democracy.
NGOs and human rights in India: - Land, Water, Forest issues.

UNIT IV
Human rights in Indian constitution and law:-
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

UNIT V
Universal declaration of human rights and provisions of India. Constitution and law.
National human rights commission and state human rights commission.

Reference books:

Shastry, T. S. N., *India and Human rights: Reflections*, Concept Publishing Company India (P Ltd.), 2005
Nirmal, C.J., *Human Rights in India: Historical, Social and Political Perspectives(Law in India)*, Oxford India

BTCHO404 Open Elective I **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OEC	BTCHO404	Open Elective I	3	-	-	20	20	60	100	3

A. NSS-I

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Features of Indian constitution, fundamental rights and duties of citizens
2. Importance of Health, Hygiene & Sanitation
3. Yoga as a tool for healthy lifestyle
4. Environmental issues and organize its management
5. Disasters and youth role in its management

Course Outcomes: At the end of the course, students will be able to:

1. Understand features of Indian constitution, fundamental rights and duties of citizens
2. Explain importance of Health, Hygiene & Sanitation
3. Summarize yoga a tool for healthy lifestyle
4. Conclude environmental issues and organize its management
5. Classify the disasters and youth role in its management

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
CO1										
CO2										
CO3										
CO4										
CO5										

Detailed Syllabus

Unit I: Introduction and Basic Concepts of NSS: History, Philosophy, Aims & objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption village/slums, Methodology of conducting Survey

Unit II: Youth and Community Mobilization: Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism

Unit III: Importance and Role of Youth Leadership: Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership

Unit IV: Life Competencies and Skill; Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management

Unit V: Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building **Youth Development Programs in India:** National Youth Policy, Youth development programs at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations.

B. Development Engineering

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Importance of development
2. Different tools used in development
3. Methods and modalities of development engineering

Course Outcomes: At the end of the course, the student will be able to:

1. Understand importance of development
2. Use different tools used in development
3. Understand the methods and modalities of development engineering

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
CO1							✓			
CO2							✓			
CO3							✓			

Detailed Syllabus

Unit I: Introduction to Development Engineering: Introduction to development engineering; need of development engineering; core disciplines and concept; major issues in development, urban development; rural development; socioeconomic development; scientific social research, formulation of research problem, field work and data collection, report drafting.

Unit II: Design of Sustainable Communities: Concept and development of sustainable communities; Sustainable design principles, building regulations, codes and standards – ANSI,ASTM,ASHRAE, approval process; green buildings – green building techniques-energy solutions, site solutions, site solutions, exterior and interior solutions, Certification – BREEAM, GRIHA, NAHB, LEED,IGBC.

Unit III: Town / City Planning: Town Planning, history of town planning in India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum redevelopment; Smart city planning introduction to city planning, infrastructure elements of smart city planning, d imensions of smart cities global standards and performance benchmark; smart solutions e -governance, waste management, water management, energy management, urban mobility, citizen services, other services such as tele-medication and education, trade facilitation, skill development; GIS for Planning.

Unit IV: Planning and Development of Rural Areas: District administration, District Planning, introduction to various sectors of rural areas such as drinking water, Waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy; issues and challenges associated with these sectors; People's participation and role in development of rural areas; various schemes and policies floated by state and central government - phases in the schemes; life cycle costing of these schemes.

Unit V: Development aspects: Urban and Rural: Planning and designing of a model town / city and using Auto-CAD and / or GIS, Visit to a village or small town – The project will be carried out in groups. Problem faced by the villagers pertaining to various sectors or existing schemes; define the need, method, tools and techniques for development; deliver technology based solution.

Text Books:

1. Chand M. and Purr U.K. (1983), 'Regional Planning in India', Allied Publisher, New Delhi.
2. Kaiser E.J., et. al., 'Urbun Landuse Planning', 4th edition Urbana, University of Illinois Press.
3. Sundaram K.V., 'Geography Planning', Concept Publishing Co., New Delhi.

4. Ayyar C.P.V., 'Town Planning in Early South India', Mittal Publications, Delhi.
5. Reeder, Hoboken, 'Guideto green building rating systems', John Wiley& sons, Inc.
6. Longley, et.al, 'Geographic Information Systems and Science', John Wiley & Sons, New York.
7. Desai V., 'Rural Development of India', Himalaya Publishing house, Mumbai.
8. Rau S.K., 'Global Search for Rural Development', NIRD, Hyderabad.

Reference Books:

1. Institute of Town Planners, India, Ministry of Urban Affairs & Employment, Government of India, New Delhi, UDPFI Guidelines, 1996.
2. Miles R. Simon, 1970, 'Metropolitan Problems', Methuen Publications, Canada.
3. B.I.S., 1980, "National Building Code of India', ISI, New Delhi.
4. ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings.
5. **ASHRAE Standard 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings.**

BTCHE405 Professional Elective – II **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PEC	**BTCHE405**	**Professional Elective - II**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

A. Numerical Methods

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Common numerical methods and how they are used to obtain approximate solutions.
2. Numerical methods to obtain approximate solutions to mathematical problems
3. Numerical methods for various mathematical operations like interpolation, differentiation etc.
4. Accuracy of common numerical methods.

Course Outcomes: At the end of the course, the student will be able to:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
2. Apply numerical methods to obtain approximate solutions to mathematical problems
3. Derive numerical methods for various mathematical operations like interpolation, differentiation etc.
4. Analyse and evaluate the accuracy of common numerical methods.

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	-	-	✓	-	✓	-	-	-
CO2	✓	-	-	✓	-	✓	-	-	-
CO3	✓	-	-	✓	-	✓	-	-	-
CO4	✓	-	-	✓	-	✓	-	-	-

Detailed syllabus

Unit I: **Solutions of Linear Algebraic Equations -** Gauss elimination and LU decomposition, Gauss-Jordan Elimination, Guass-Seidel and relaxation methods.

Eigen values and Eigen Vectors of Matrices –Faddeev-Leverrier method, Power method, Householder's and Given's method

Unit II: **Nonlinear Algebraic Equations -** Fixed point method, Multivariable successive substitutions, Single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique.

Unit III: **Function Evaluation -** Least-squares curve fit, Newton's Interpolation formulae, Newton's divided difference interpolation polynomial, Langrangian interpolation, Pade approximations, Cubic spline approximations

Unit IV: **Ordinary Differential Equations (Initial value problems)** – RungeKutta Methods, Semi-implicit RungeKutta Techniques, Step size control and estimates of error **Ordinary Differential Equations (Boundary value problems) -** Finite difference technique, Orthogonal collocation technique, Orthogonal collocation on finite elements

Unit V: **Partial Differential Equations** – Introduction to finite difference technique

Texts / References:

S.K. Gupta, "Numerical Methods for Engineers", Wiley Eastern, 1995.
M.E. Davis, "Numerical Methods & Modeling for Chemical Engineers", Wiley, 1984.

B. Introduction to Bio-process Engineering

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Cell and enzyme kinetics
2. Basics of biology, structure of cells
3. Material and energy balances in bioprocesses
4. Kinetics and manufacture and application of enzyme-catalyzed reactions,
5. Design of bioreactors

Course Outcomes: At the end of the course, the student will be able to:

1. Understand cell and enzyme kinetics
2. Understand basics of biology, structure
3. Understand material and energy balances in bioprocesses
4. Understand kinetics and manufacture and application of enzyme-catalyzed reactions,
5. Study design of bioreactor

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					-	-	-	-	-	-	-	-
CO2					-	-	-	-	-	-	-	-
CO3					-	-	-	-	-	-	-	-
CO4					-		-	-	-	-	-	-
CO5					-	-	-	-	-	-	-	-

Detailed Syllabus:

Unit I: Bioprocess engineering and related fields, basics of biology, structure and function of microbial, plant and animal cells, introduction to chemicals of life such as lipids, carbohydrates, nucleic acids and proteins. Metabolism and central metabolic pathways, central dogma, transcription and translation processes, material and energy balances in bioprocesses with examples.

Unit II: Unstructured and structured growth models of bioprocesses, growth kinetics, estimation of process parameters, logistic equation, effect of substrate and product inhibition.

Unit III: Enzymes, kinetics of enzyme-catalyzed reactions, inhibited enzyme kinetics, immobilized enzymes, manufacture and application of enzymes.

Unit IV: Design of biological reactors, continuous, batch and fedbatch processes and their comparison, multistage chemostat systems, introduction to transport phenomena in bioprocesses.Non-ideal effects. Scale-up and scale-down criteria.

Unit V: Recovery and purification of bioprocesses, recent advances and applications of bioprocess engineering, genetic engineering and recombinant DNA technology, mixed cultures, application to biological wastewater treatment. Introduction to control strategies in bioprocesses.

References:

1. Shuler and Kargi, "Bioprocess Engineering : Basic Concepts" Prentice Hall of India,2002
2. J.E. Bailey & D.F. Ollis (eds) : `Biochemical Engineering Fundamentals', McGraw Hill Inc., 1986.
3.

C. Strength of Materials

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain
2. Materials in design considering engineering properties, sustainability, cost and weight.
3. Engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain
2. Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.

3. Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	✓	-	-	-	-	-	-	-
CO2	✓	✓	-	-	✓	-	-	-	-	-	-	-
CO3	✓	✓	-	-	✓	-	✓	-	-	-	-	-

Detailed syllabus

Unit I:
Stress and Strain:
Load and its effect, Types of stresses, Types of strain, Support and free body diagram, Types of structures, Equilibrium considerations, Thermal stresses and strains

Unit II:

Trusses: Stability of trusses on application of load, redundancy, Unstable trusses

Use of different methods for analysis of trusses, Condition for perfect trusses

Unit III:
Shear Force and Bending Moment: S. F. and B. M. diagram, Cantilever, Simply Supported Beams, Concentrated and Uniformly Distributed Loads **Torsion**: Concept of torsion, Basic Torsion equation, Slope and Deflection of Beams, Cantilevers etc.Macaulay's Method.

Unit IV:
Short and Long Columns (Struts): Basic Theory, Crippling loads and conditions thereof, Euler's and Rankine's Approach for the same.

Unit V:
Thick and Thin Cylinders: Radial and Longitudinal Stresses, Behavior of thin Cylinders, Problems on thin cylinders and Spherical shells, Behavior of thick cylinders

Texts and References:

1. Timoshenko & Young, "Strength of Materials."
2. V.N. Vazirani&Ratwani, "Analysis of Structures", Vol.I Khanna Publishers.
3. R.L. Bansal, "Strength of Materials", Luxmi Publishers.

4. Popov, “Strength of Materials”, Prentice Hall of India.

5. Ramamrutham, Strength of materials

D. Introduction to Polymer Science and Engineering

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Thermodynamics of polymer structures
2. Polymerization reactor for a polymer product.
3. Characterization of polymers.
4. Polymer additives, blends and composites.
5. Polymer Rheology

Course Outcomes: At the end of the course, the student will be able to:

1. Understand thermodynamics of polymer structures
2. Select polymerization reactor for a polymer product.
3. Characterize polymers.
4. State polymer additives, blends and composites.
5. Understand Polymer Rheology

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					-			-	-	-	-	-
CO2								-	-	-	-	-
CO3					-	-	-	-	-	-	-	-
CO4						-		-	-	-	-	-
CO5						-		-	-	-	-	-

Detailed Syllabus:

Unit I: **Introduction:** Basic concepts of Polymer Science, Various molecular forces in polymer, Various Molecular weights and their distribution.

Unit II: **Polymerization:** (i) Step growth: Mechanism, Kinetics, Polyfunctional Step growth polymerization. (ii) Radical polymerization: Mechanism, Kinetics, Effects of temperature, pressure. (iii) Ionic and Coordination Polymerization: Kinetics of Cationic and Anionic polymerization.

Unit III: **Polymerization Conditions:** Bulk, Solution, Suspension and Emulsion polymerization.

Unit IV: **Measurement of Molecular Weight:** End group analysis, Colligative property measurement, Gel Permeation Chromatography.

Unit V: **Polymer Processing:**Plastic technology: Molding, Extrusion, Additives and Compounding; **Fiber Technology:**Textile and Fabric properties, Spinning, Elastomer technology: Vulcanization, Reinforcement.

Text/References:

1. Text book of Polymer Science: Fred W. Billmeyer, Jr., Second Edition, 1994, John Wiley and Sons, Inc., Singapore.
2. Principals of Polymerization, George Odian, Third Edition, 2002, John Wiley and Sons, Inc., Singapore.
3. Fundamentals of Polymers, Anil Kumar and Gupta, R. K., McGraw Hill, 1998.

E. Advanced Engineering Chemistry

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Basic concepts in electrochemistry and corrosion science
2. Basic concepts in molecular interactions
3. Synthesis and analysis of modern materials
4. Concepts of organic chemistry for synthesis
5. Synthesis and applications of polymer science
6. Structure of organic molecules using photo chemistry and chemical spectroscopy

Course Outcomes: At the end of the course, the student will be able to:

1. Understand and apply the concepts in electrochemistry and corrosion science
2. Understand the concepts in molecular interactions
3. Understand the synthesis and analysis of modern materials
4. Apply the concepts of organic chemistry for synthesis
5. Understand the synthesis and applications of polymer science

6. Identify the structure of organic molecules using photo chemistry and chemical spectroscopy

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
CO2	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
CO3	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
CO4	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
CO5	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-
CO6	✓	✓	✓	-	✓	-	✓	-	✓	-	-	-

Detailed syllabus

Unit I: Corrosion and its Control: Introduction, Fundamental reason, Electrochemical Corrosion, Direct Chemical Corrosion, Factors affecting the rate of corrosion, types of corrosion-Galvanic, Pitting Corrosion, Microbiological corrosion, Stress corrosion, methods to minimize the corrosion- Proper design, Cathodic and Anodic protection. Study of Composite materials.

Unit II: Spectroscopy: Brief introduction to spectroscopy, UV – Visible Spectroscopy: Laws of absorption, types of transitions, instrumentation and application. FT-IR spectroscopy: introduction, theory, instrumentation and application. Brief discussion on NMR Spectroscopy and its Applications. Brief introduction of AAS (Atomic Absorption Spectroscopy)

Unit III: Instrumental Methods of Chemical Analysis: Introduction to Chromatography, Types of Chromatography (Adsorption and partition chromatography), Paper and Thin Layer Chromatography, Gas Chromatography – introduction, theory, instrumentation. Brief discussion of Thermo gravimetric analysis (TGA), Differential Scanning Colorimetry .

Unit IV: Organic reaction Mechanisms: Introduction, Electronic displacement effects in organic molecule, reactive intermediates (carbocation, carbanion and carbine), Brief introduction of Addition and Substitution and Elimination reaction with suitable examples. **Rearrangement:**introduction, Pinacole – Pinacolone rearrangement.

Unit V: Drugs and Dyes:

Drugs: Introduction, Study of the following drugs with reference to structure, occurrence, medicinal uses and side effects: Antipyretic:Paracetamol (synthesis), Anti Inflammatory drug: Ibuprofen, Antibiotic drugs, Anti-malarial drug: Quinine(Synthesis), Anti- Cancer drugs, Anti- hypertensive drugs.

Dyes: Introduction, Synthesis and uses of Synthetic dyes: Congo- red, Eriochrome black – T

Text books:

1. Bhal and Bhal Advance Organic Chemistry, S. Chand & Company, New Delhi, 1995.
2. Jain P.C & Jain Monica, Engineering Chemistry, DhanpatRai& Sons, Delhi, 1992.
3. Bhal&Tuli, Text book of Physical Chemistry (1995), S. Chand & Company, New Delhi.
4. Handbook of Drugs and Dyes, Himalaya Publications.

Reference books:

1. Finar I.L., Organic Chemistry (Vol. I & II), Longman Gr. Ltd & English Language Book Society, London.
2. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
3. ShikhaAgarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.
4. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
5. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.

Books on Drugs and Dyes, McGraw-Hill Publication, New Delhi

BTCHL406 Heat Transfer Operations Lab 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTCHL406	Heat Transfer Operations Lab	-	-	3	60	-	40	100	2

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Electrical analogy in relation to heat conduction
2. Emissivity of a given body.
3. Heat flow for resistances in series

4. Heat losses from cylindrical furnace
5. Temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment
6. Boiling Phenomena in liquids

Course Outcomes: At the end of the course, students will be able to:

1. Understand the Electrical analogy in relation to heat conduction
2. Determine Emissivity of a given body.
3. Determine heat flow for resistances in series

4. Determine heat losses from cylindrical furnace
5. Determine temperature profiles in rod-double pipe heat exchanger, helical coil, heat pipe demonstration experiment
6. Understand boiling Phenomena in liquids

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-
CO5	✓	✓	✓	✓	✓				
CO6	✓	✓	✓	✓	✓				

List of Experiments

1. To determine thermal conductivity of given metal rod
2. Study of Double Pipe Heat Exchanger
3. Study of Shell and Tube Heat Exchanger
4. Study of Study of emissivity of circular discs with and without black coating.
5. Study of Stefan-Boltzman's constant
6. To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.

BTCHS407 Seminar II **2 Credits**

Category	Code	Subject Name				CA	MSE	ESE	Total	Credit

Seminar	BTCHS 407	Seminar - II		-	4	**60**	**-**	**40**	**100**	**2**

Course Outcomes: At the end of the course, the student will be able to:

1. Prepare a seminar report on summer training
2. Communicate with group of people on different topic
3. Collect and consolidate required information on a topic
4. Prepare a seminar report

Each student is expected to collect information on recent advances in Chemical Engineering by regularly referring to national and international journals and reference books. At the end of the semester he/she is required prepare a report as per the guide lines prescribed by the Department. Each student will be assigned a guide for this seminar course.

Every student shall give a power point presentation on his Seminar topic before a panel of examiners.

BTCHI508 Internship - 2 **Audit**

Category	**Code**	**Subject Name**	**L**	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**Credit**
Internship	**BTCHI 508**	**Internship - 2**							**-**	**Audit**

Field Training / Internship 2 / Industrial Training (minimum of 4 weeks, which can be completed partially in third semester and fourth semester or at one time). Credits To be evaluated in V Sem.

Internship- II (Industrial Training)

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum on summer training.
2. Communicate with group of people on different topics of summer training.

3. Collect and consolidate required information on a topic of summer training.
4. Prepare a seminar report on summer training

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of IV^{rth} semester (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc. Student shall submit report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

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Curriculum for Third Year

Undergraduate Degree Programme

B. Tech. in Chemical Engineering

With effect from AY 2022-23

	Semester V										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**					
			L	T	P	CA	MSE	ESE	Total	Credit	
PCC	BTCHC501	Mass Transfer Operations - I	3	1	-	20	20	60	100	4	
PCC	BTCHC502	Chemical Reaction Engineering - I	3	1	-	20	20	60	100	4	
PCC	BTCHC503	Chemical Technology	3	-	-	20	20	60	100	3	
OEC	BTCHO504	Open Elective - II	3	-	-	20	20	60	100	3	
PEC	BTCHE505	Professional Elective – III	3	-	-	20	20	60	100	3	
LC	BTCHL506	Chemical Reaction Engineering Lab	-	-	3	60	-	40	100	2	
Project	BTCHM507	Mini Project - 1	-	-	4	60	-	40	100	2	
Internship	BTCHI508	Internship – 2 (Evaluation)	-	-	-	-	-	-	-	Audit	
		Total	**15**	**2**	**7**	**220**	**100**	**380**	**700**	**21**	
	Semester VI										
PCC	BTCHC601	Chemical Reaction Engineering - II	3	1	-	20	20	60	100	4	
PCC	BTCHC602	Mass Transfer Operations - II	3	1	-	20	20	60	100	4	
PCC	BTCHC603	Process Instrumentation and Control	4	1	-	20	20	60	100	5	
HSSMC	BTHM604	Engineering Economics and Project management	4	-	-	20	20	60	100	4	
OEC	BTCHO605	Open Elective - III	3	-	-	20	20	60	100	3	
LC	BTCHL606	Mass Transfer Operations Lab	-	-	3	60	-	40	100	2	
Project	BTCHM607	Mini Project - 2	-	-	4	60	-	40	100	2	
Internship		Field Training / Internship3/Industrial Training (minimum of 4 weeks which can be completed partially in fifth semester and sixth semester or in at one time).	**-**	**-**	**-**	-	-	-	-	Credits To be evalua-ted in VII Sem.	
		Total	**17**	**3**	**7**	**220**	**100**	**380**	**700**	**24**	

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Course

List of Electives

1) Professional Elective III
   A. Industrial Safety and Hazard Mitigation
   B. Optimization Techniques
   C. Petroleum refining and Petrochemicals
   D. Food technology
   E. Disaster Management in Chemical Industries
2) Open Elective II
   A. NSS II
   B. Pollution Control in Process Industries
3) Open Elective III
   A. Pharmaceuticals and fine Chemicals
   B. Heat Transfer Equipment Design

Semester: V

BTCHC501 Mass Transfer operations – I   4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC 501	Mass Transfer operations – I	3	1	-	20	20	60	100	4

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Diffusion in fluids and solids, mass transfer coefficients.
2. Material balances and co-current, countercurrent operation and concept of stage.
3. Gas absorption and stripping, number of transfer units in plate towers and packed bed towers.
4. Liquid liquid extraction and solid liquid extraction and calculation of amount of solvent needed and number of stages.
5. Adsorption and ion exchange, adsorption isotherms and their applications.
6. Equipments for majorly gas-liquid operations.

Course Outcomes:

On completion of course, students will be able to:

1. Understand Fick's law of diffusion
2. Determine diffusivity coefficient in gases and liquids
3. Determine mass transfer coefficients
4. Calculate rate of mass transfer in humidification
5. Select equipment for gas-liquid operations

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	-	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	-	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Unit I:
Diffusion in fluids - Fick's Law of diffusion equimolecular counter diffusion, diffusion in stationary gas. Maxwell's low of diffusion. Inter phase mass transfer - Mass transfer equilibrium, diffusion between two phases. Local mass transfer coefficient, Local and average overall mass transfer coefficients. Simultaneous heat and mass transfer.

Unit II:
Material balance – steady state co current and counter current processes stage wise and differential contacts. Number of theoretical stages. Stage efficiency Height of mass transfer units.

Unit III:
Gas Absorption - Equilibrium solubilities of gases. Material balance for transfer of one component. Counter current multistage operations for binary and multi component systems. Continuous contactors, absorption with chemical reaction.

Unit IV:
Liquid–liquid extraction - Calculations with and without reflux for immiscible and partially miscible system.
Leaching - Leaching single and multistage operations based on solvent free co ordinates.

Unit V:
Adsorption and ion-exchange**:** Types of adsorption; Nature of adsorption; Freundlich equation; Types of adsorption; Nature of adsorption; Freundlich equation; Stage wise and continuous adsorption. Stage wise and continuous adsorption.Theory of ion – exchange and its application to removal of ionic impurity.
Gas–Liquid operations - Sparged vessels (bubble columns), mechanically agitated vessels for a single phase and gas liquid contact.liquid dispersed scrubbers, venturi scrubbers, wetted towers packed towers. Mass transfer coefficients for packed towers co-current flow of gas and liquid end effect and axial mixing.

Texts / References:

1. R. E. Treybal, Mass transfer operations, 3ed ed. McGraw Hill, 1980.
2. A. S. Foust et al. Principles of Unit Operations
3. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. 1 ELBS, Pergaman press, 1970
4. J. M. Coulson and J. F. Richardson, "Chemical Engineering" Vol. 2 ELBS, Pergaman press, 1970

BTCHC502 Chemical Reaction Engineering – I **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC 502**	**Chemical Reaction Engineering – I**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Mole balances in chemical reactions, types of reactors and their performance equations along with rector sizing
2. Rate laws used in chemical kinetics and design equations
3. Reactor design in isothermal conditions and its applications to different types of reactors and problems.
4. Collection and analysis of data, integral and differential methods
5. Catalysts and catalysis , rate determining steps and applications

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand different types of chemical reactors.
CO2	Write rate law for chemical reactions of different orders.
CO3	Analyze the performance of different reactors to carry out isothermal processes
CO4	Analyze the reaction data by different analysis methods
CO5	Understand catalysis and analyze the rate determining step in catalytic reaction

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO5	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-

Unit I:

Mole Balances - Definition of the rate of reaction, General mole balance equation, Batch Reactors, Continuous-flow reactors, Industrial reactors

Conversion and Reactor Sizing - Definition of conversion, Design equations, Applications of the design equations for continuous-flow reactors, Reactors in series

Unit II:
Rate-Law and Stoichiometry - Basic definitions, Approach to reactor sizing and design, Stoichiometric table, expressing concentrations in terms other than conversion, Reactions with phase change

Unit III:
Isothermal Reactor Design - Design structure for isothermal reactors, Scale up of liquid-phase batch reactor data to the design of a CSTR, Tubular reactors, Recycle reactors

Unit IV:
Collection and Analysis of Rate Data - Batch reactor data, Method of initial rates, Method of half-life, Differential reactors, Least square analysis

Unit V:
Catalysis and Catalytic Reactors - Catalysts, Steps in a catalytic reaction, synthesizing a rate law, mechanism and rate-limiting step, Design of Reactors for gas-solid reactions, Heterogeneous data analysis for reactor design

Texts / References:

1. .H. S. Fogler, "Elements of Chemical Reaction Engineering", 3rd Ed, New Delhi-Prentice a Hall, 2001
2. O. Levenspiel," Chemical Reaction Engineering" Willey Eastern, 3rd Ed., 2000
3. J. M. Smith, "Chemical Engineering Kinetics", 3rd Ed., McGraw- Hill, 1988

BTCHC503 Chemical Technology **3 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC 503	Chemical Technology	3	-	-	20	20	60	100	3

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Chemical industries in general, chlor-alkali industries, phosphorous industries
2. Nitrogen and sulphuric acid industries
3. Soaps and detergents , starch production
4. Fermentation industries and polymerization industries
5. Petroleum processing and allied industries

Course Outcomes:

On completion of course, students will be able to:

1. Understand inorganic and organic chemical technologies.
2. Draw process flow diagrams.
3. Identify the effect of chemical technologies on the health, safety and environment.
4. Understand engineering problems in chemical processes and equipments.
5. List chemical reactions and their mechanism involved

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO3	✓	✓	✓	-	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus

Unit I:
Introduction: Chemical industries-facts and figures, Unit operation and unit process concepts, chemical processing and role of chemical engineers. Chloro-Alkali Industries: Soda ash, Solvay process, dual process, Natural soda ash from deposits, Electrolytic process, Caustic soda.Phosphorus Industries: Phosphoric acid, Wet process, Electric furnace process, Calcium phosphate, Ammonium phosphates, Nitrophosphates, Sodium phosphate. Potassium Industries: Potassium recovery from sea water.

Unit II:
Nitrogen Industries: Ammonia, Nitric acid, Urea from ammonium carbonate, Ammonium nitrate.Sulfur and Sulfuric Acid Industries: Elemental sulfur mining by Frasch process, Sulfur production by oxidation-reduction of H2S, Sulfur and sulfur dioxide from pyrites, Sulfuric acid. Contact process, Chamber process.

Unit III:
Soap and Detergents: Batch saponification production, Continuous hydrolysis and saponification process, Sulfated fatty alcohols, Alkyl-aryl sulfonates. Sugar and Starch Industries: Sucrose, Extraction of sugar cane to produce crystalline white sugar, Extraction of sugar cane to produce

sugar, Starch production from maize, Production of dextrin by starch hydrolysis in a fluidized bed.

Unit IV:

Fermentation Industries: Ethyl alcohol by fermentation, Fermentation products from petroleum. Pulp and Paper Industries: Sulfate pulp process, Chemical recovery from sulfate pulp digestion liquor, Types of paper products, Raw materials, Methods of production. Plastic Industries: Polymerization fundamentals, Polymer manufacturing processes, Ethenic polymer processes, Polycondensation processes, Polyurethanes.

Unit V:

Petroleum Processing: Production of crude petroleum, Petroleum refinery products, Types of refineries, Design of refinery, Choice of crude petroleum, Refinery processes, Pyrolysis and cracking, Reforming, Polymerization, Isomerization, Alkylation. Rubber: Elastomer polymerization processes, Rubber polymers, Butadiene-Styrene copolymer, Polymer oils and rubbers based on silicon.

Text / References:

1. Austin G.T., Shreve's Chemical Process Industries - International Student Edition, 5th Edition, McGraw Hill Inc., 1998.
2. Sittig M. and GopalaRao M., Dryden's Outlines of Chemical Technology for the 21st Century, 3rd Edition, WEP East West Press, 2010

BTCHO504 Open Elective -II 3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OEC	BTCH 504	Open Elective -II	3	-	-	20	20	60	100	3

A. NSS – II

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Citizenship and understanding constitution of india
2. Needs and scope of health , hygiene and sanitation
3. Philosophy and concept of Yoga
4. Environmental issues and waste management

5. Disaster management and role of youth
6. Sociological and psychological factors regarding youth and crime

Course Outcomes:

On completion of course, students will be able to:

1. Understand constitution of India and fundamental rights
2. Understand health, hygiene , sanitation and its importance
3. Have knowledge about Yoga and its philosophy
4. Know environmental issues, enrichment and sustainability
5. Understand disaster management and classification of disaster
6. Understand Sociological and psychological factors regarding youth and crime

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓
CO5							✓					✓
CO6												✓

Detailed Syllabus:

Unit I:
Citizenship: Basic Features of Constitution of India, Fundamental Rights and Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI.

Unit II:
Health, Hygiene & Sanitation: Definition, Needs and scope of health education , Food and Nutrition , Safe drinking water, Water borne diseases and sanitation, National Health Programme, Reproductive health , Healthy Lifestyles ,HIV AIDS, Drugs and Substance abuse, Home Nursing , First Aid.

Unit III:
Youth and Yoga: History, Philosophy and concept of Yoga , Myths and misconceptions about yoga , Different Yoga traditions and their Impacts, Yoga as a preventive, promotive and curative method, Yoga as a tool for healthy lifestyle.

Unit IV:
Environment Issues: Environment conservation, Enrichment and Sustainability, Climate change, Waste management, Natural resource management, Rain water harvesting, Energy conservation, Waste land development, Soil conservations and forestation.

Unit V:
Disaster Management: Introduction to Disaster Management, Classification disaster, Role of youth in Disaster Management. Youth and crime: Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crime, Awareness about anti-ragging, Cybercrime and its prevention, Juvenile justice.

B. Pollution Control in Process Industries

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Biosphere, hydrological cycle and air pollutants
2. Meteorological aspects of air pollutant dispersion
3. Air pollution control equipments
4. Control of sulphur oxides, nitrogen oxides etc.
5. Waste water sampling, analysis and treatment

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze the effects of pollutants on the environment
2. Understand meteorological aspects of air pollution
3. Understand air pollution control methods
4. Select treatment technologies for water/wastewater/solid waste
5. Design unit operations for pollution control

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO2	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO3	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO4	✓	✓	-	✓	✓	-	✓	-	-	-	-	-

CO5	✓	✓	✓	✓	-	-	✓	-	-	-	-	-

Detailed Syllabus

Unit I:

Introduction: Biosphere, Hydrological cycle, Nutrient cycle, Consequences of population growth, Pollution of air, Water and soil. Air pollution sources & effects: Classification and properties of air pollutants, Emission sources, Behavior and fate of air pollutants, Effect of air pollution.

Unit II:

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise. Air pollution sampling and measurement: Types of pollutant sampling and measurement, Ambient air sampling, Stack sampling, Analysis of air pollutants.

Unit III:

Air pollution control methods & equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector, Control of gaseous emissions, Design methods for control equipment.

Unit IV:

Control of specific gaseous pollutants: Control of sulphur dioxide emissions, Control of nitrogen oxides, Carbon monoxide control, Control of hydrocarbons and mobile sources. Water pollution: Water resources, Origin of wastewater, types of water pollutants and there effects.

Unit V:

Waste water sampling, analysis and treatment: Sampling, Methods of analysis, Determination of organic matter, Determination of inorganic substances, Physical characteristics, Bacteriological measurement, Basic processes of water treatment, Primary treatment, Secondary treatment, Advanced wastewater treatment, Recovery of materials from process effluents. Solid waste management: Sources and classification, Public health aspects, Methods of collection, Disposal Methods, Potential methods of disposal. Hazardous waste management: Definition and sources, Hazardous waste classification, Treatment methods, Disposal methods.

Text / References:

1. Rao C.S., Environmental Pollution Control Engineering, Wiley Eastern Limited, India, 1993.
2. Noel de Nevers, Air Pollution and Control Engineering, McGraw Hill, 2000.
3. Glynn Henry J. and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.

4. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
5. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.

BTCHE505 Professional Elective – III 3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PEC	BTCHE 505	Professional Elective – III	3	-	-	20	20	60	100	3

A. Industrial Safety and Hazard Mitigation

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Safety programs, engineering ethics and public perceptions
2. Fire and explosions with flammability characteristics
3. Prevention of fire and explosion
4. Operated reliefs in liquids, vapors, gases
5. Hazard identification, safety procedures and designs

Course Outcomes:

At the end of the course, the student will be able to:

1. Know Safety programs, engineering ethics and public perceptions
2. Understand the principles of fire and explosions , flammability characteristics
3. Know about the methods for prevention of fire and explosion
4. Know about Operated reliefs in liquids, vapors , gases
5. Know about process hazard checklist, how to do hazard surveys
6. Know safety procedures and best safety practices

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-

Detailed syllabus

Unit I:
Introduction: Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions, Nature of the Accident Process, Inherent Safety. Industrial Hygiene: Anticipation and Identification, Hygiene Evaluation, Hygiene Control.

Unit II:
Fires and Explosions: Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram

Unit III:
Concepts to Prevent Fires and Explosions: Inerting, Controlling Static Electricity, Explosion-Proof Equipment and Instruments, Ventilation, Sprinkler Systems. Introduction to Reliefs: Relief Concepts, Location of Reliefs, Relief Types, Relief Scenarios, Data for Sizing Reliefs, Relief Systems.

Unit IV:
Relief Sizing- Conventional Spring: Operated Reliefs in Liquid Service, Conventional Spring-Operated Reliefs in Vapor or Gas Service, Rupture Disc Reliefs in Liquid Service, Rupture Disc Reliefs in Vapor or Gas Service. Hazards Identification: Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews.

Unit V:
Safety Procedures and Designs: Process Safety Hierarchy, Managing Safety, Best Practices, Procedures—Operating, Procedures—Permits, Procedures—Safety Reviews and Accident Investigations, Designs for Process Safety.

Text / References:

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

B. Optimization Techniques

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Single variable optimization algorithms , optimality criteria
2. Multivariable optimization algorithms and different methods
3. Constrained optimization algorithms with Kuhn-Tucker conditions
4. Sensitivity analysis in optimization
5. Integer programming, geometric programming
6. Non-traditional optimization algorithms

Course Outcomes:

At the end of the course, the student will be able to:

1. Formulate single variable optimization algorithms and its solution
2. Know and formulate Multivariable optimization algorithms and its methods of solution
3. Understand Constrained optimization algorithms , Kuhn-Tucker conditions and solve using transformation methods
4. Do Sensitivity analysis in optimization
5. Solve optimization problems using Integer programming, geometric programming
6. Formulate Non-traditional optimization algorithms and their solution techniques

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	✓	✓	-	-	✓	-	-	-
CO2	-	-	-	-	✓	✓	-	-	✓	-	-	-
CO3	-	-	-	-	✓	✓	-	-	✓	-	-	-
CO4	-	-	-	-	✓	✓	-	-	✓	-	-	-
CO5					✓	✓			✓			
CO6					✓	✓			✓			

Detailed Syllabus:

UNIT I:
Single-variable optimization algorithms: Optimal problem formulation, Optimization algorithms, Optimality criteria, Bracketing methods, Region-elimination methods, Point-estimation method, Gradient based methods, Root finding using optimization techniques.

UNIT II:

Multi-variable optimization algorithms: Unidirectional search, Direct search methods, Gradient based methods.

UNIT III:
Constrained optimization algorithms: Kuhn-Tucker conditions, Transformation methods,

UNIT IV:
Sensitivity analysis, Direct search for constrained minimization, Linearized search techniques, Feasible direction method, Generalized reduced gradient method, Gradient projection method

UNIT V:
Specialized algorithms: Integer programming, Geometric programming.
Non-traditional optimization algorithms: Genetic algorithms, Simulated annealing, Global optimization.

Texts / References:

Deb K., Optimization for Engineering Design, Algorithms and Examples, Prentice Hall of India, New Delhi 1996

C. Petroleum Refining and Petrochemicals

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Petroleum basics, its origin , formation and composition
2. Fractionation of petroleum with different treatment techniques
3. Thermal and catalytic cracking and reforming
4. Different chemicals from C3, C4 and higher carbon atoms with applications

Course Outcomes:

At the end of the course, the student will be able to:

1. State the composition of petroleum.
2. Understand the unit operations and processes in petroleum refining
3. Understand the technologies for conversion of petroleum refining products to chemical products
4. Select feed stock for conversion to products

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-

CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-

DETAILED SYLLABUS:

Unit I:
ORIGIN, FORMATION AND COMPOSITION OF PETROLEUM: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry, composition of petroleum. PETROLEUM PROCESSING DATA: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

Unit II:
FRACTIONATION OF PETROLEUM: Dehydration and desalting of crudes, heating of crude-pipe still heaters, distillation of petroleum, blending of gasoline. TREATMENT TECHNIQUES: Fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

Unit III:

THERMAL AND CATALYTIC PROCESSES: Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylation processes, Petrochemical Industry – Feed stocks

Unit IV:
CHEMICALS FROM METHANE: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines. CHEMICALS FROM ETHANE-ETHYLENE-ACETYLENE: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, Vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

Unit V:
CHEMICALS FROM C3, C4 AND HIGHER CARBON ATOMS: Chemical from Propylene, manufacture of Isopropanol, manufacture of Acrylonitrile, production of Acrylic acid, polymers and copolymers of propylene, production of Phenol from cumene, production of Bisphenol-A, manufacture of maleic Anhydride, production of Acetic acid and production of Butadiene from Butane. SYNTHESIS GAS AND CHEMICALS: Steam reforming of hydrocarbons, production of synthesis gas, SNG from Naphtha, Synthesis gas via partial Oxidation.

TEXT BOOKS:

1. B.K. BhaskaraRao - Modern Petroleum Refining Processes - 3rd edition, Oxford & IBH Publishing Co. Pvt. Ltd., Jan. 1997.
2. B.K. BhaskaraRao - A Text of Petrochemicals - 2nd edition, Khanna Publications, 1998.

REFERENCE BOOK:

W.L. Nelson - Petroleum Refinery Engineering; McGraw Hill Book Company.

D. Food Technology

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. General aspects of food industry and constituents of food
2. Basic principle of food and its properties
3. Ambient temperature processing for food
4. Heat processing of food using various techniques
5. Post processing techniques of food

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand general aspects of food industry
2. Know Basic principles about properties of food , effect of heat on microorganisms
3. Understand Ambient temperature processing for food with raw material preparation, separation and concentration of food components
4. Understand Heat processing of food using steam, water , air , dielectric heating
5. Know Post processing techniques of food with its applications with types of packaging materials

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO4	✓	✓	-	✓	-	✓	✓	-	-	-	-	-

Detailed Syllabus

Unit 1:

Introduction: General aspects of food industry, World food demand and Indian scenario, Constituents of food, Quality and nutritive aspects, Product and Process development, engineering challenges in the Food Processing Industry.

Unit 2:

Basic principles: Properties of foods and processing theory, Heat transfer, Effect of heat on micro-organisms, Basic Food Biochemistry and Microbiology: Food Constituents; Food fortification, Water activity, Effects of processing on sensory characteristics of foods, Effects of processing on nutritional properties, Food safety, good manufacturing practice and quality Process Control in Food Processing.

Unit 3:

Ambient Temperature Processing: Raw material preparation, Size reduction, Mixing and forming, Separation and concentration of food components, Centrifugation, Membrane concentration, Fermentation and enzyme technology, Irradiation, Effect on micro-organisms, Processing using electric fields, high hydrostatic pressure, light or ultrasound.

Unit 4:

Heat processing using steam, water and air: Blanching, Pasteurization, Heat sterilization, Evaporation and distillation, Extrusion, Dehydration, Baking and roasting.

Heat processing by direct and radiated energy: Dielectric heating, Ohmic heating, Infrared heating.

Unit 5:

Post Processing Applications Packaging: Coating or enrobing, Theory and Types of packaging materials, Printing, Interactions between packaging and foods, Environmental considerations.

Text / Reference:

1. Fellows P., Food Processing Technology: Principles and Practice, 2nd Edition, Woodhead Publishing, 2000.
2. Toledo R, Fundamentals of Food Process Engineering, 3rd Edition, Springer, 2010.
3. Singh, R.P. &Heldman, D.R., Introduction to Food Engineering, 3rd Edition, Academic Press, UK, 2001.
4. Smith J.M., Chemical Engineering Kinetics, 3rd Edition, McGraw Hill, 1981

E. Disaster Management in Chemical Industries

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. General aspects of industrial disaster due to fire, explosion etc.
2. Classification of chemical hazards, occupational diseases

3. Hazard analysis and health management
4. Pressure vessels ,its storage and handling
5. Safety practices, protection devices

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze the effects of release of toxic substances
2. Select the methods of prevention of fires and explosions
3. Understand the methods of hazard identification and preventive measures
4. Assess the risks using fault tree diagram

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-

Unit 1:
General aspects of industrial disaster: Due to fire, explosion, toxicity and radiation; Chemical hazards.

Unit 2:
Classification of chemical hazards, Chemical as cause of occupational diseases – dust, fumes, gases and vapors.

Unit 3:
Hazard analysis and health management; Engineering control of chemical plant hazards – Plant layout, ventilation and lighting.

Unit 4:
Pressure vessels, Storage, Handling, Transportation, Electrical systems, Instrumentation.

Unit 5:
Emergency planning, Personal protective devices, Maintenance procedure; Emergency safety and laboratory safety; Legal aspects of safety. Management information system and its application in monitoring disaster, safety and health; Hazop Analysis.

Text Book:
1. H. H. Tawcatt & W S Wood, Safety and Accident Prevention in Chemical Operations.

Reference Books:

1. R. V. Betrabet and T. P. S. Rajan in CHEMTECH-I, Safety in Chemical Industry, Chemical
2. Engineering Development Centre, Madras, 1975.
3. Wells, Safety in Process Plant Design.
4. Less, P. Frank, Loss Prevention in Process Industries.
5. J. Lolb & S. Roy Sterm, Product Safety and Liability.

BTCHL506 Chemical Reaction Engineering Lab 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	**BTCHL 506**	**Chemical Reaction Engineering Lab**	**-**	**-**	**3**	**60**	**-**	**40**	**100**	**2**

Course Objectives

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Activation energy of acid catalyzed hydrolysis of methyl acetate.
2. Specific reaction rate of acid catalyzed hydrolysis of ethyl acetate
3. The reaction between potassium persulphate and iodide
4. Saponification of ethyl acetate.
5. Different types of reactors
6. RTD studies in reactors

Course Outcomes

At the end of the course, the student will be able to:

1. Find activation energy of acid catalyzed hydrolysis of methyl acetate.
2. Find Specific reaction rate of acid catalyzed hydrolysis of ethyl acetate
3. Study the reaction between potassium persulphate and iodide
4. Study saponification of ethyl acetate.
5. Study different types of reactors
6. **Study RTD studies in reactors**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓							
CO6	✓	✓	✓	✓	✓							

List of Practicals

1. Determine rate constant/activation energy of acid catalyzed hydrolysis of methyl acetate.
2. To study effect of concentration of reactant / temperature on the rate of reaction.
3. To determination of specific reaction rate of acid catalyzed hydrolysis of ethyl acetate
4. Determination of specific reaction rate of acid catalyzed hydrolysis of ethyl acetate by sodium hydroxide at 298 K.
5. To study the reaction between potassium persulphate and iodide.
6. Kinetics of hydrolysis of methyl acetate by strong acid.
7. To study saponification of ethyl acetate.
8. Study of Isothermal continuous stirred tank reactor.
9. Study of RTD in packed bed.
10. Study of RTD studies in continuous stirred tank reactor.
11. Study of non- catalytic homogenous reaction in a isothermal tubular flow reactor.
12. Study of non- catalytic homogenous reaction in a batch reactor.
13. Study of non- catalytic homogenous reaction in a continuous stirred tank reactor.
14. Study of non- catalytic homogenous reaction in plug flow reactor.
    (Minimum 12 experiments to be performed by all the students)

BTCHM507 Mini Project I **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Project	BTCHM 507	Mini Project – I	-	-	4	60	-	40	100	2

The purpose behind the mini project is that the student should be exposed to more hands-on rather than merely theory. It is expected that the student (or a small group say, not more than two in a group, to be confirmed) will undertake to make a working model, a program, etc. which he/she will benefit from since he /she will be doing it first-hand.

BTCHI508 Internship – 2 (Evaluation) Audit

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	**BTCHI508**	**Internship - 2 (Evaluation)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Audit**

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum on summer training.
2. Communicate with group of people on different topics of summer training.
3. Collect and consolidate required information on a topic of summer training.
4. Prepare a seminar report on summer training

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of fourth semester (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc.

The student shall submit the report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

SEMESTER VI

BTCHC601 Chemical Reaction Engineering - II 4 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC 601	Chemical Reaction Engineering - II	3	1	-	20	20	60	100	4

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Multiple reactions , their types and use of PFR, CSTR for multiple reactions
2. Different types of non-elementary reactions, their kinetics and applications
3. External diffusion effects on heterogeneous reactions with application of mass transfer to reaction
4. General characteristics of RTD in chemical reactors
5. Models for non-ideal reactors

Course Outcomes: At the end of the course, students will be able to :

1. Compare the performance of ideal and non-ideal reactors using E- and F-curves.
2. Determine the mean residence time and standard deviation using residence time distribution (RTD)
3. Analyze the performance of non-ideal reactors using segregation model, tanks-in series model and dispersion model
4. Understand the effect of velocity, particle size and fluid properties on rate of reactions controlled by mass transfer
5. Design fixed bed reactors involving chemical reactions with mass transfer
6. Determine internal and overall effectiveness factors

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	✓	-	-	-	-	-
CO6	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus:

UNIT I:
Multiple Reactions - Maximizing desired product in parallel reactions, Maximizing desired product in series reactions, Stoichiometric table using fractional conversion
Multiple reactions in PFR and CSTR – An alternative approach to using fractional conversion

UNIT II:
Nonelementary Reaction Kinetics - Fundamentals, Searching for a mechanism, polymerization, enzyme reaction fundamentals, Bioreactors

UNIT III:
External Diffusion Effects on Heterogeneous Reactions - Mass transfer fundamentals, Binary diffusion, External resistance to mass transfer, The shrinking core model

UNIT IV:
Distribution of Residence times for Chemical Reactors - General characteristics, Measurement of RTD, Characteristics of RTD, RTD in ideal reactors, Reactor modeling with RTD, Zero-parameter models

UNIT V:
Models for non-ideal reactors - One-parameter models; tank-in-series model, dispersion model

Texts / References:

1. H. S. Fogler, "Elements of Chemical Reaction Engineering", 3rd Ed, New Delhi-Prentice Hall, 2001
2. O. Levenspiel," Chemical Reaction Engineering" Willey Eastern, 3rd Ed., 2000
3. J. M. Smith, "Chemical Engineering Kinetics", 3rd Ed., McGraw- Hill, 1988

BTCHC602 Mass Transfer Operations – II **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	**BTCHC 602**	**Mass Transfer Operations – II**	**3**	**1**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Distillation, flash and differential distillation
2. McCabe Thiele method and Ponchon Savarit method to do calculations of distillation
3. Humidification operations and cooling tower design
4. Drying and different types of dryers
5. Crystallization basics and membrane separation processes

Course Outcomes: At the end of the course, the student will be able to:

1. Select solvent for absorption and extraction operations.
2. Determine number of stages in distillation, absorption and extraction operations.
3. Determine the height of packed column in absorption, distillation and extractioı
4. Calculate drying rates and moisture content for batch and continuous drying.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus:

UNIT I:
Distillation - Vapour liquid equilibria, flash vapourisation, batch distillation, differential distillation.

UNIT II:
Continuous fractionation - Binary systems, Mc-Cabe.Thiele and PonchonSavarit method calculations with multiple feeds and withdrawal

UNIT III:
Humidification - Vapour liquid equilibrium, enthalpy for pure substances, vapour gas contact operation. Psychrometric charts and measurement of humidity
Dehumidification and Cooling Tower Design **-** Adiabatic and non adiabatic operations evaporative cooling, cooling tower design and dehumidification methods.

UNIT IV:
Drying - Drying equilibrium and rate of drying, drying operation batch and continuous number of transfer units.

UNIT V:
Crystallisation - Theories of crystallisation nucleation and crystal growth. principles of supe saturation. different types of crystallisers.
Special topics in separation**:** Types of membranes for osmosis and dialysis; Mechanism of solute/solvent rejection in the process; Design of R.O. and dialysis units; applications.

Texts / References:

1. R. E. Treybal, Mass transfer operations, 3ed ed. McGraw Hill, 1980.
2. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. 1 ELBS, Pergamon press, 1970
3. J. M. Coulson and J. F. Richardson, "Chemical Engineering" Vol. 2 ELBS, Pergamon press, 1970.

BTCHC603 Process Instrumentation and Control **5 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
PCC	BTCHC 603	**Process Instrumentation and Control**	4	1	-	20	20	60	100	5

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Characteristics of measurement systems with pressure measurement
2. Temperature, flow and level measurement
3. Close loop and open loop systems, dynamics of first order systems
4. Transient response of control systems
5. Frequency response analysis and controller tuning

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the measurement techniques for Pressure and Temperature
2. Understand the measurement techniques for Flow and Level

3. Understand recording, indicating and signaling instruments
4. Analyze repeatability, precision and accuracy of instruments
5. Understand open-loop and closed loop systems
6. Understand transient response of control systems
7. Understand frequency response analysis

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	-	✓	✓	✓	-	-	-	-	-	-	-
CO2	✓	-	-	✓	✓	-	-	-	-	-	-	-
CO3	✓	-	-	✓	✓	-	-	-	-	-	-	-
CO4	✓	-	-	✓	✓	-	-	-	-	-	-	-
CO5	✓			✓	✓							
CO6	✓			✓	✓							
CO7	✓			✓	✓							

Detailed syllabus

Unit I

Characteristics of Measurement System -Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers. Pressure Measurement- Pressure, vacuum and head manometers, measuring elements for gage pressure and vacuum, measuring pressure in corrosive liquids, measuring of absolute pressure, static accuracy and response of pressure gages.

Unit II

Temperature Measurement–Industrial thermocouples, thermocouple wires, thermo couple wells and response of thermocouples. Flow Measurement- head flow meters, open channel meters, area flow meters, flow of dry materials, viscosity measurement. Level Measurement- direct measurement of liquid level, level measurement in pressure vessels, measurement of interface level, level of dry materials.

Instruments for Analysis - recording instruments, indicating and signaling instruments, instrumentation diagram.

UNIT III

Introduction Block diagrams, closed loop and open loop control systems, Basic control actions.
Open loop response of simple systems**:** Dynamics of first order systems using transfer functions; Various first order response such as, a thermometer bulb. General response to step, ramp, impulse, and sinusoidal inputs; Concentration and temperature responses of a stirred tank;
Linearization of liquid level systems; Response of a pressure system, second order systems, the manometer; Response of interacting and non interacting systems.

UNIT IV

Transient response of control systems: Servo and regulated operation, General equations for the transient response, proportional control of a signal capacity process; Integral control, Proportional-integral control and derivative action. Stability**:** Concept of stability, Stability criterion, Routh test for stability. Root locus analysis**:** Concept of root locus, Locus diagram.

UNIT V

Frequency response analysis: First order systems, Bode diagram, and Complex numbers to get frequency response. Controller selection and tuning, Control valve characteristics and sizing, cascade control, Feed forward control. Introduction of digital control principles.

Text / References:

1. Patranabis D, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 1999.
2. EckmanDonald P., Industrial Instrumentation, Wiley Eastern Ltd., 2004.
3. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, 1st Edition, Tata McGraw-Hill Education Private Limited, 2009.
4. D. R. Coughanowr, Process system analysis and control, 2nd ed, McGraw Hill, 1991.
5. P. Harriott, Process Control, Reprint of text, ed. Tata McGraw Hill, 1983.
6. G. Stephanopoulos, Chemical Process Control: An introduction to theory and practice, Prentice Hall, New Jersey, 1984.

BTHM604 Engineering Economics and Project management **4 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
HSSMC	**BTHM 604**	**Engineering Economics and Project management**	**4**	**-**	**-**	**20**	**20**	**60**	**100**	**4**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fixed and working capital investment , total product cost
2. Application of time value of money, interest and investment costs
3. Taxes and insurance , depreciation and depreciation methods
4. Profitability of projects
5. Optimum process design, CPM/PERT techniques

Course Outcomes:

On completion of course, students will be able to:

1. Analyze alternative processes and equipment for manufacturing a product
2. Design plant layout and engineering flow diagrams
3. Perform economic analysis related to process design
4. Evaluate project profitability

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	✓	-	✓	-	✓	-	✓	-
CO3	-	-	✓	✓	✓	-	-	✓	✓	-	-	-
CO4	-	-	✓	✓	✓	-	-	✓	-	-	-	-

Detailed Sullabus

UNIT I
Capital cost estimation in chemical industries, different methods of calculation of fixed costs. Capital Investment and working Capital.

UNIT II
Time value of money, types of interest, investment costs, annuities, perpetuity and capitalized costs, discounted cash flow analysis

UNIT III
Taxes and insurance, depreciation, amortization and obsolescence in chemical industries, types of depreciation methods, breakeven point analysis

UNIT IV
Discussion on projects , causes for time and cost overruns, project evaluation and assessment of project profitability, organization of project engineering.

UNIT V
Optimum process design with examples, project development and commercialization, plant location and layout, selection of plant capacity.
Project engineering management, project scheduling and its importance, use of CPM/PERT techniques.

Texts / References:

1. M. S. Peters and K. D. Timmerhaus, "Plant Design Economics for Chemical Engineers", 5th Ed., McGraw-Hill, New York - 2003.
2. V. W. Uhl and A. W. Hawkins, "Technical Economics for Chemical Engineers", AIChE - 1971.
3. J. Moder and Philips, "Project Engineering with CPM and PERT", Rein Hold.
4. Choudhary, "Project Management"
5. Jelen, "Cost and Optimization Engineering"

BTCHO605 Open Elective III 3 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
OEC	**BTCHO 605**	**Open Elective III**	**4**	**-**	**-**	**20**	**20**	**60**	**100**	**4**

A. Pharmaceuticals and Fine Chemicals

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Different grades of chemicals
2. Different methods of preparation of reagents and laboratory chemicals
3. Uses and testing of the pharmaceuticals and fine chemicals
4. Manufacture of Pharmaceuticals and fine chemicals with flow sheets
5. Study compressed tablet making and coating techniques
6. Study Preparation of capsules and extraction of crude drugs

Course Outcomes:

At the end of the course, the student will be able to:

1. Know different grades of chemicals
2. Understand different methods of preparation of reagents and laboratory chemicals
3. Know uses and testing of the pharmaceuticals , fine chemicals and their applications
4. Know the techniques for manufacture of Pharmaceuticals and fine chemicals with flow sheets and their applications
5. Tablet making and coating techniques

6. Know Industrial procedures of capsule formulation and methods of recovering the drugs formulated from the reaction mixture

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	-	-	-	-	-	-	-	-
CO2	✓	✓	-	-	-	-	-	-	-	-	-	-
CO3	✓	✓	-	-	-	-	-	-	-	-	-	-
CO4	✓	-	-	✓	-	-	-	-	-	-	-	-
CO5	✓	-	-	✓	-	✓	-	-	-	-	-	-
CO6	✓			✓		✓						

Detailed Syllabus

Unit 1:
A brief outline of different grades of chemicals – Reagent grade and Laboratory grade.
Outlines of preparation – Different methods of preparation of Reagent grade and Laboratory grade Chemicals.

Unit 2:
Uses and testing of the pharmaceuticals and fine chemicals – Applications of medicinal value Chemicals and their quality testing procedures.

Unit 3:
Properties, assays and manufacture of Pharmaceuticals and fine chemicals with flow sheets- Physical and Chemical properties, methods of assessing the quality and industrial methods of formulating the drugs and fine chemicals that have no medicinal value but are used as the intermediates.

Unit 4:
Compressed Tablet making and coating – Types of tablets and Methods of compressed tablet making and coating.

Unit 5:
Preparation of capsules and extraction of crude drugs – Industrial procedures of capsule formulation and methods of recovering the drugs formulated from the reaction mixture. Sterilization – Need for sterilization, Sterilization methods, batch and continuous sterilization.

Text / References:

1. Remington, Pharmaceutical Sciences, Mak. Publishing Co., 16th Edition, 1980.
2. William Lawrence Faith, Donald B. Keyes and Ronald L. Clark, Industrial Chemicals, 4th Edition, John Wiley & Sons, 1975.
3. Gurdeep R. Chatwal, Synthetic Drugs, Himalaya Publishing House, 2002.

B. Heat Transfer Equipment Design

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. process design of double pipe heat exchanger
2. process design of Shell and Tube heat Exchanger
3. process design of condenser and reboiler
4. process design of evaporator
5. process design of agitator

Course Outcomes: At the end of the course, the student will be able to:

1. Do process design of double pipe heat exchanger
2. Do process design of Shell and Tube heat Exchanger
3. Do process design of condenser and reboiler
4. Do process design of evaporator
5. Do process design of agitator

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	✓	-	✓	-	-	-	-	-
CO2	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO3	✓	✓	-	-	✓	-	✓	-	-	-	-	-
CO4	✓	✓	-	-	✓	-	✓	-	-	-	-	-
CO6	✓	✓			✓		✓					

Detailed Syllabus

Unit I:
Detailed Process Design of Double Pipe Heat Exchangers

Unit II:
Detailed Process Design of Shell and Tube heat exchanger

Unit III:
Detailed Process design of condenser and reboiler

Unit IV:
Detailed Process Design of Evaporator

Unit V:

Detailed process design of Agitator

Text/Reference books:

1. J. M. Coulson and J. F. Richardson, “Chemical Engineering” Vol. 2 ELBS, Pergamon press, 1970
2. D. Q. Kern, “Process Heat Transfer”, McGraw Hill, 1950.

Practicals

All above designs will be manually calculated and then verified using Aspen Plus software.

BTCHL606 Mass Transfer Operations Lab 2 Credits

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
LC	BTCHL 606	Mass Transfer Operations Lab	-	-	3	60	-	40	100	2

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Diffusivity of components in other components
2. Equilibrium solubility diagram
3. The overall plate efficiency of sieve plate distillation
4. Rayleigh's equation for batch and differential distillation
5. Liquid-liquid extraction
6. The critical moisture content in drying

Course Outcomes:

On completion of course, students will be able to:

1. Determine diffusivity of components

2. Draw equilibrium solubility diagram
3. Determine the overall plate efficiency of sieve plate distillation
4. Verify Rayleigh's equation for batch distillation
5. Study liquid-liquid extraction
6. Determine the critical moisture content in drying

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	✓							
CO6	✓	✓	✓	✓	✓							

LIST OF PRACTICALS:

1. To determine the diffusivity of acetone in air
2. To study liquid-liquid diffusion.
3. To study the absorption with/without chemical reaction.
4. To study single stage/multistage leaching operation for calcium carbonate, sodium hydroxide water system.
5. To draw equilibrium solubility diagram for an acetic acid, benzene/toluene, water.
6. To study counter-current single stage extraction process for water(A), acetic acid(B) and benzene(C)/Toluene(C) system
7. To study liquid-liquid extraction in packed bed for suitable ternary system (HTU/NTU)
8. T-x-y diagram for water-acetone system
9. To prove Rayleigh equation by carrying out simple distillation of methanol-water system
10. To study crystallization of given salt
11. To determine rate of drying of given sample and to plot (kg moisture content/ kg of dry solid) V/S time and rate of drying V/S time
12. To study Batch/Continuous crystallizer
13. Study of Rotary/fluidized bed dryer.
14. Study of steam distillation/Sieve plate distillation column
15. Study of Humidification/dehumidification system
16. Study of Cooling Tower

(About 12 Experiments are to be conducted)

BTCHM607 Mini Project – 2 **2 Credits**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Project	BTCHM 607	Mini Project – 2	-	-	4	60	-	40	100	2

The purpose behind the mini project is that the student should be exposed to more hands-on rather than merely theory. It is expected that the student (or a small group say, not more than two in a group, to be confirmed) will undertake to make a working model, a program, etc. which he will benefit from since he /she will be doing it firsthand.

BTCHI708 Internship - 3 **Audit**

Category	Code	Subject Name	L	T	P	CA	MSE	ESE	Total	Credit
Internship	BTCHI708	Internship - 3							-	Audit

Field Training / Internship 3 / Industrial Training (minimum of 4 weeks, which can be completed partially in fifth semester and sixth semester or at one time). Credits To be evaluated in VII Sem.

Course Outcomes: At the end of the course, the student will be able to:

1. Acquire knowledge on topics outside the scope of curriculum on summer training.
2. Communicate with group of people on different topics of summer training.
3. Collect and consolidate required information on a topic of summer training.
4. Prepare a seminar report on summer training

Each student is expected to spend Four weeks in any one factory/project/workshop at the end of VI semester (during summer vacation). Here he/she shall observe layout, working and use of various machinery, plants, design, instruments, process etc. under the general supervision of the foreman/artisan/engineer of the factory etc. Student shall submit report in a systematic technical format about the major field of the factory, particularly about the section/department where he/she has received the training giving details of equipment, machinery, materials, process etc. with their detailed specifications, use etc. The report shall be checked and evaluated by the concerned teacher and appropriate grade shall be awarded.

Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Chemical Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent

responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

Objective Identifier	Objectives
PEO1	To provide knowledge of sound mathematical principles underlying various concepts of Chemical Engineering.
PEO2	To develop an ability to understand complex issues in the analysis, design, implementation and operation of Chemical Engg. Systems.
PEO3	To provide knowledge of mechanisms for building large-scale Chemical-based systems.
PEO4	To develop an ability to provide Engineering-based solutions to the problems from other disciplines of science and engineering.
PEO5	To impart skills necessary for adapting rapid changes taking place in the industries.
PEO6	To provide knowledge of ethical issues arising due to deployment of new technologies in the society on large scale.

Program Outcomes

Program Outcome (POs)

Outcome Identifier	Outcomes
PO1	The graduates will possess the knowledge of various discrete mathematical structures and numerical techniques.
PO2	The graduate will demonstrate the use of Logic in representing and reasoning knowledge based systems.
PO3	The graduates will have an ability to apply mathematical formalisms of to analyze the problems.
PO4	The graduates will have knowledge of design software and concepts essential to implement these software.
PO5	The graduates will have an ability to analyze problem, specify most feasible solutions to them and to evaluate alternative solutions.
PO6	The graduates will have in-depth knowledge of core subjects of Chemical Engineering.
PO7	The graduate will have broad understanding of the impact of Chemical Engineering solutions in economic, environmental and social context.
PO8	The graduates will demonstrate use of analytical tools in gathering requirements to provide feasible solutions.
PO9	The graduates will have knowledge of design rules and patterns necessary to formulate concept based solutions.
PO10	The graduates will demonstrate the ability to build human centric interfaces to deign tools.
PO11	The graduates will possess skills necessary to communicate design engineering ideas. The skills set include verbal, written and listening skills.
PO12	The graduates will have an ability and attitude to address the ethical issues.

Program-Specific Outcomes (PSOs)

PSO 1	Make the students employable in engineering industries.
PSO 2	Motivate the students for higher studies and research.

Teaching and Evaluation Scheme Fourth Year B. Tech. (Chemical Engineering)

Sr. No.	Code	Course title	Weekly Teaching hours			Evaluation Scheme			Credit
			L	T	P	MSE	CA	ESE	
		Semester VII							
1	BTCHC 701	Process Dynamics and Control	3	1	-	20	20	60	4
2	BTCHC 702	Pollution Control in Process Industries	3	-	-	20	20	60	3
3	BTCHC 703	Transport Phenomena	3	1	-	20	20	60	4
4*	BTCHC 704	Process Equipment Design and Drawing	2	-	-	20	20	60	2
5	BTCHE 705	Elective IV A. Biochemical Engineering B. Advanced Separation Techniques C. Pharmaceuticals and Fine Chemicals D. Modeling and Simulation in Chemical Engineering E. Advanced Petroleum Refining	3	-	-	20	20	60	3
6	BTCHL 706	Process Instrumentation and Control Lab.	-	-	2	-	30	20	1
7	BTCHL 707	Process Equipment Design and Drawing Lab.	-	-	2	-	30	20	1
8	BTCHL 708	Process Design, Flow Sheeting & Simulation I Lab	-	-	2	-	30	20	1
9	BTCHP* 709	Project Work Stage – I**	-	-	4	-	20	30	2
10	BTCHF 710	Field Training / Internship/Industrial Training Evaluations (of sem. VI)	-	-	-	-	-	50	1
		Total **(750)**	14	2	10	100	210	440	22

***In case of students opting for Internship in the eighth semester, the Project must be industry-based.*

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCHC801A	(Self-Study Course)	Process Control ; Design, Analysis and assessment	2	1	--	20	20	60	100	3
BTCHC801B		Computational Fluid dynamics								
BTCHC801C		Optimization in Chemical Engineering								
BTCHC802A	(Self-Study Course)	Environmental Quality monitoring and analysis	2	1	--	20	20	60	100	3
BTCHC802B		Transport Processes-I: heat and mass transfer								
BTCHP803	Project	Project Stage-II or Internship*	--	--	30	50	--	100	150	15
		Total	4	2	30	90	40	220	350	21

** Six months of Internship in the industry*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

Semester - VII

1. Process Dynamics and Control

BTCHC 701	Process Dynamics And Control	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: mathematics and process instrument knowledge

Course Outcomes: At the end of the course, students will be able to:

CO 1	Understand the dynamic behavior of different processes
CO2	Analyze different components of a control loop
CO3	Analyze stability of feedback control system
CO4	Design controllers for first and second order processes
CO5	Analyze frequency response for controllers and processes

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus

UNIT I: Introduction Block diagrams, closed loop and open loop control systems, Basic control actions.

UNIT II: Open loop response of simple systems: Dynamics of first order systems using transfer functions; Various first order response such as, a thermometer bulb. General response to step, ramp, impulse, and sinusoidal inputs; Concentration and temperature responses of a stirred tank;

UNIT II: Linearization of liquid level systems; Response of a pressure system, second order systems, the manometer; Response of interacting and non interacting systems.

UNIT III: Transient response of control systems: **Servo and regulated operation,** General equations for the transient response, proportional control of a signal capacity process; Integral control, Proportional-integral control and derivative action.

UNIT IV: Stability: Concept of stability, Stability criterion, Routh test for stability.

UNIT V: Frequency response analysis: First order systems, Bode diagram, and Complex numbers to get frequency response.

UNIT VI: Controller selection and tuning, Control valve characteristics and sizing, cascade control, Feed forward control. Introduction of digital control principles.

Text / References:

1. D. R. Coughanowr, Process system analysis and control, 2nd ed, McGraw Hill, 1991.
2. P. Harriott, Process Control, Reprint of text, ed. Tata McGraw Hill, 1983.
3. G. Stephanopoulos, Chemical Process Control: An introduction to theory and practice, Prentice Hall, New Jersey, 1984.

2. Pollution Control in Process Industries

BTCHC 702		**Pollution Control in Process Industries**	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Basics of Chemical Process Industries

Course Outcomes: At the end of the course, students will be able to:

CO 1	Analyze the effects of pollutants on the environment
CO2	Understand meteorological aspects of air pollution
CO3	Understand air pollution control methods
CO4	Select treatment technologies for water/wastewater/solid waste
CO5	Design unit operations for pollution control

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO2	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO3	✓	✓	-	-	-	-	✓	-	-	-	-	-
CO4	✓	✓	-	✓	✓	-	✓	-	-	-	-	-
CO5	✓	✓	✓	✓	-	-	✓	-	-	-	-	-

Detailed Syllabus

Unit I: Introduction: Biosphere, Hydrological cycle, Nutrient cycle, Consequences of population growth, Pollution of air, Water and soil. Air pollution sources & effects: Classification and properties of air pollutants, Emission sources, Behavior and fate of air pollutants, Effect of air pollution.

Unit II: Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise. Air pollution sampling and measurement: Types of pollutant sampling and measurement, Ambient air sampling, Stack sampling, Analysis of air pollutants.

Unit III: Air pollution control methods & equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector, Control of gaseous emissions, Design methods for control equipment.

Unit IV: Control of specific gaseous pollutants: Control of sulphur dioxide emissions, Control of nitrogen oxides, Carbon monoxide control, Control of hydrocarbons and mobile sources. Water pollution: Water resources, Origin of wastewater, types of water pollutants and there effects.

Unit V: Waste water sampling, analysis and treatment: Sampling, Methods of analysis, Determination of organic matter, Determination of inorganic substances, Physical characteristics, Bacteriological measurement, Basic processes of water treatment, Primary treatment, Secondary treatment, Advanced wastewater treatment, Recovery of materials from process effluents.

Unit VI: Solid waste management: Sources and classification, Public health aspects, Methods of collection, Disposal Methods, Potential methods of disposal. Hazardous waste management: Definition and sources, Hazardous waste classification, Treatment methods, Disposal methods.

Text / References:

1. Rao C.S., Environmental Pollution Control Engineering, Wiley Eastern Limited, India, 1993.
2. Noel de Nevers, Air Pollution and Control Engineering, McGraw Hill, 2000.
3. Glynn Henry J. and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
4. Rao M.N. and Rao H.V.N - Air Pollution, Tata - McGraw Hill Publishing Ltd., 1993.

De A.K - Environmental Chemistry, Tata - McGraw Hill Publishing Ltd., 1999.

3. Transport Phenomena

BTCHC 703	**Transport Phenomena**	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Knowledge of Engineering Mathematics and fluid flow operations

Course Outcomes: At the end of the course, students will be able to:

CO 1	Understand the analogy among momentum, heat and mass transport
CO2	Formulate a mathematical representation of a flow/heat/mass transfer phenomena
CO3	Solve flow/heat/mass transfer problems either individually or coupled for simple geometries analytically
CO4	Identify the similarities among the correlations for flow, heat and mass transfer interfaces

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	✓	✓	-	-	-	-	-
CO2	✓	✓	✓	✓	-	✓	-	-	-	-	-	-
CO3	✓	-	✓	✓	-	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	-	✓	-	-	-	-	-	-

Detailed Syllabus

Unit 1

1. **VISCOSITY AND MECHANISM OF MOMENTUM TRANSPORT :** Newton's Law of Viscosity; Non-Newtonian fluids ; The Bingham model; The power law model; The Elli's model and the Reiner Philippoff model; Temperature and pressure dependents of viscosity.

2. **VELOCITY DISTRIBUTIONS IN LAMINAR FLOW :** Shell momentum balances; Boundary conditions ; Flow of a falling film; flow through a circular tube; flow through annulus.

Unit 2

3. **EQUATION OF CHANGE FOR ISOTHERMAL SYSTEMS :** Equations of continuity

and motion in Cartesian and curvilinear co-ordinates; Use of the equations of change to set-up steady flow problems. Tangential annular flow of Newtonian fluid; Shape of surface of a rotating liquid.

4. **VELOCITY DISTRIBUTIONS WITH MORE THAN ONE INDEPENDENT VARIABLE**:Unsteady viscous flow ; Flow near a wall suddenly set in motion.

Unit 3

5. **INTERPHASE TRANSPORT IN ISOTHERMAL SYSTEMS :** Definition of fraction factors; Friction factors for flow in tubes; for around spheres.

6. **THERMAL CONDUCTIVITY AND MECHANISM OF ENERGY TRANSPORT :** Fourier's law of heat conduction; temperature and pressure dependence of thermal conductivity in gases and liquids.

7. **TEMPERATURE DISTRIBUTIONS IN SOLIDS AND IN LAMINAR FLOW :** Shell energy balances; Boundary conditions; Heat conduction with an electrical heat source; with a viscous heat source.

Unit 4

8. **EQUATIONS OF CHANGE FOR NON-ISOTHERMAL SYSTEMS :** Use of equations of energy and equations of motion (for forced and free convection) in non-isothermal flow; Tangential flow in an annulus with viscous heat generation; steady flow of a non-isothermal film; Transpiration cooling.

9. **TEMPERATURE DISTRIBUTIONS WITH MORE THAN ONE INDEPENDENT VARIABLE :** Unsteady heat conduction in solids; Heating of a semi-infinite slab.

Unit 5

10. **INTERPHASE TRANSPORT IN NON-ISOTHERMAL SYSTEMS :** Definition of heat transfer coefficient; Heat transfer coefficients for forced convection in tubes; for forced convection around submerged objects.

11. **DIFFUSIVITY AND THE MECHANISM OF MASS TRANSPORT :** definition of concentrations; Velocity and mass fluxes; Fick's law of diffusion; Temperature and pressure dependence of mass diffusivity.

Unit 6

12. **CONCENTRATION DISTRIBUTION IN SOLIDS AND IN LAMINAR FLOW:** Shell mass balances; Boundary conditions; Diffusion through a stagnant gas film; Diffusion with heterogeneous chemical reaction.

13. **EQUATION OF CHANGE FOR MULTICOMPONENT SYSTEMS**:Equations of continuity for a binary mixture.

14. **INTERPHASE TRANSPORT IN MULTICOMPONENT SYSTEMS:** Definition of binary mass transfer coefficients in one phase. Correlations of binary mass transfer coefficient in one phase at low mass transfer rates.

TEXT BOOK:

1. Bird R.B., Stewart W.E. and Light Foot E.N. Transport Phenomena - John Wiley International - 2nd Edition, New York, (2002).

REFERENCE BOOKS:

Christie J. Geankoplis - Transport Processes and Unit Operations - Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

4. Process Equipment Design and Drawing

BTCHC 704	**Process Equipment Design and Drawing**	2-0-0	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Knowledge of chemical engineering Processes

Course Outcomes: At the end of the course, students will be able to:

CO 1	Identify equipment and instruments based on symbols
CO2	Draw process flow diagrams using symbols
CO3	Apply mechanical design aspects to process equipment
CO4	Design heat exchangers, evaporators, absorbers, distillation columns, reactors and filters.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	-	-	-	-	-	-	-	-
CO2	-	✓	-	-	✓	-	-	-	-	-	-	-
CO3	✓	-	✓	✓	✓	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	✓	✓	-	-	-	-	-	-

Detailed Syllabus

Unit I: Mechanical Design of Process Equipment: Introduction to mechanical aspects of chemical equipment design,

Unit II: Design Preliminaries, Design of cylindrical and spherical vessels under internal pressure, Design of heads and closers, Design of tall vessels.

Unit III and IV: Drawing: Drawing of process equipment symbols for fluid handling, heat transfer, mass transfer, Drawing of process equipment symbols for vessels, conveyers and feeders etc. Drawing of process equipment symbols for, separators, mixing & comminution etc. Drawing of process equipment symbols for distillation, driers, evaporators, scrubbers etc. Drawing of process equipment symbols for crystallizer, grinding, jigging, elutriation, magnetic separation, compressor etc. Drawing of basic instrumentation symbols for flow, temperature, level, pressure and combined instruments, Drawing of miscellaneous instrumentation symbols, Detailed drawing of equipment, Drawing of flow sheet.

Unit V and VI: Process Equipment Design: Design of a heat exchanger, Design of an absorber, Design of a distillation column, Design of evaporator, Design of condenser, Design of a chemical reactor.

Text / References:

1. Brownell L.E, Process Equipment Design - Vessel Design, Wiley Eastern Ltd., 1986.
2. Bhattacharya B.C., Introduction to Chemical Equipment Design - Mechanical Aspects, CBS Publishers and Distributors, 2003.
3. Towler, G. P. and R. K. Sinnott, Chemical Engineering Design, Principles, Practice and Economics of Plant and Process Design, 2nd Edition, Butterworth Heinemann, 2012.
4. Donald Kern, Process Heat Transfer, 1st Edition, Tata McGraw-Hill Education, 1950
5. Robert E. Treybal, Mass-Transfer Operations, 3rd Edition, McGraw-Hill Book Company, 1981.

5. Elective IV

BTCHC 705	A. Biochemical Engineering B. Advanced Separation Techniques C. Pharmaceuticals and Fine Chemicals D. Modeling and Simulation in Chemical Engineering E. Advanced Petroleum Refining	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

A. **Biochemical Engineering**

Course Outcomes: At the end of the course, students will be able to:

CO 1	Understand cell and enzyme kinetics
CO2	State methods of immobilization
CO3	Calculate volume of a bioreactor
CO4	State sterilization methods
CO5	Select downstream process to separate the products

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO2	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO3	✓	✓	✓	✓	-	-	-	-	-	-	-	-
CO4	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
	✓	✓	✓	✓	-	-	-	-	-	-	-	-

Detailed Syllabus

Unit I: Introduction: Biotechnology, Biochemical Engineering, Biological Process, Definition of Fermentation.

Unit II: Enzyme Kinetics: Introduction, Simple Enzyme Kinetics, Enzyme Reactor with Simple Kinetics, Inhibition of Enzyme Reactions, and Other Influences on Enzyme Activity. Immobilized Enzyme: Immobilization techniques and effect of mass transfer resistance.

Unit III: Industrial application of enzymes: Carbohydrates, starch conversion and
cellulose conversion. Cell Cultivation: Microbial cell cultivation, animal cell cultivation, plant cell cultivation, cell growth measurement and cell immobilization.

Unit IV: Cell Kinetics and Fermenter Design: Introduction, growth cycle for batch
cultivation, stirred tank fermenters, multiple fermenters connected series, cell recycling, alternate fermenters and structured model. Sterilization: Sterilization methods, thermal death kinetics, design criterion, batch sterilization, continuous sterilization and air sterilization.

Unit V: Agitation and Aeration: Introduction, basic mass transfer concepts, correlation for mass transfer co-efficient, measurement of interfacial area, correlations for 'a' and D32, gas-holdup, power consumption, determination of oxygen absorption rate, correlation for kLa, scale-up and shear sensitivity.

Unit VI: Downstream Processing: introduction, solid-liquid separation, cell rupture,
recovery and purification.

Text / Refernces:

2. Lee J.M., Biochemical Engineering, Ebook, version 2.32, 2009.
3. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, 2nd edition, McGraw Hill International, 1986.
3. Michael L. Shuler & Fikret Kargi, Bioprocess Engineering - Basic Concepts, 2nd edition, Prentice Hall of India, New Delhi, 2002.

B. Advanced Separation Techniques

Course Outcomes: At the end of the course, students will be able to:

CO 1	Classify the membranes
CO2	Differentiate various membrane processes
CO3	Understand the methods of membrane preparation
CO4	Compare membrane process with other methods of separation
CO5	Understand principles thermogravimetry and of differential thermal analyses.
CO6	Characterize chemical, inorganic and engineering materials using analytical techniques

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	✓	-	-	-	-	-	✓	-	-	-
CO2	-	-	✓	-	-	-	-	-	✓	-	-	-
CO3	-	-	✓	-	-	-	-	-	✓	-	-	-
CO4	-	-	✓	-	-	-	-	-	✓	-	-	-
CO5	-	-	✓	-	-	-	-	-	✓	-	-	-
CO6	-	-	✓	-	-	-	-	-	✓	-	-	-

Detailed Syllabus

Unit I and II: Solute transport parameters for membrane performance predictionin RO/UF systems involving aqueous and non aqueous solution. Physic - chemical. Polar, on- polar criteria governing RO separations - membrane transport mechanism.

Unit III and IV: Membrane fouling and compaction. TFC membrane development

RO/UF/Ed process design and module analysis. RO/F/ED and DD in acid and enzyme recovery from scarified hydrolytes.

Unit V and VI: Membrane techniques in reclamation of water and chemicals along with pollution control from industrial effluents. Cost benefits analysis in resources cycling and environmental quality improvement by MT. Industrial processing with membranes - membrane reactor concept in biotechnology concentration. Gas separation by RO.

Text / References:

1. S. Sourirajan and T. Matsuuura (Ed.), RO - UF: Principles and Applications, NRCC Publications, Ottawa, Canada (1986).
2. Munir Cheryan, UF Applications Handbook, Technique Publishing Co, Lancaster, USA (1986).

C. Pharmaceuticals and Fine Chemicals

Course Outcomes: At the end of the course, students will be able to:

CO 1	Know different grades of Chemicals
CO2	Understand different methods of preparation of reagents
CO3	Know uses and testing of pharmaceuticals
CO4	Know the techniques for manufacture of pharmaceuticals
CO5	Understand tablet making and coating techniques

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓		✓	
CO2								✓	✓		✓	
CO3									✓		✓	
CO4								✓	✓		✓	
CO5								✓	✓		✓	

Unit 1:
A brief outline of different grades of chemicals – Reagent grade and Laboratory grade. Outlines of preparation – Different methods of preparation of Reagent grade and Laboratory grade Chemicals.

Unit 2:
Uses and testing of the pharmaceuticals and fine chemicals – Applications of medicinal value Chemicals and their quality testing procedures.

Unit 3:
Properties, assays and manufacture of Pharmaceuticals and fine chemicals with flow sheets-Physical and Chemical properties, methods of assessing the quality and industrial methods of formulating the drugs and fine chemicals that have no medicinal value but are used as the intermediates.

Unit 4:
Compressed Tablet making and coating – Types of tablets and Methods of compressed tablet making and coating.

Unit 5 and 6 :

Preparation of capsules and extraction of crude drugs – Industrial procedures of capsule formulation and methods of recovering the drugs formulated from the reaction mixture. Sterilization – Need for sterilization, Sterilization methods, batch and continuous sterilization.

Text / References:

1. Remington, Pharmaceutical Sciences, Mak. Publishing Co., 16th Edition, 1980.
2. William Lawrence Faith, Donald B. Keyes and Ronald L. Clark, Industrial Chemicals, 4th Edition, John Wiley & Sons, 1975.
3. Gurdeep R. Chatwal, Synthetic Drugs, Himalaya Publishing House, 2002.

D.MODELING AND SIMULATION IN CHEMICAL ENGINEERING

Course Outcomes: At the end of the course, students will be able to:

CO 1	use mass balance, component balance, energy balance and momentum balance equations for mathematical model development.
CO2	to develop lumped parameter mathematical models of heat transfer, mass transfer equipments and reactors with heat transfer.
CO3	to develop distributed parameter models of mass transfer equipments, heat exchangers and plug flow reactors.
CO4	to use basic features of modern simulation software.

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓										✓	✓
CO2	✓	✓									✓	✓
CO3	✓	✓	✓		✓						✓	✓
CO4			✓		✓						✓	✓

Unit 1: Basic Modeling Introduction to modeling – Types of Models, Dependent & Independent Variables, Application and scope coverage, Modeling fundamentals, Chemical engineering modeling, Several aspects of the modeling approach, General modeling procedure

Unit 2: Formulation of dynamic models Mass balance equation - Balancing procedure, Case studies: CSTR, Tubular reactor , Coffee percolator, Total mass balance, Case Studies: Tank drainage, Component balances Case Studies: Waste holding tank, Continuous heating in an agitated tank, Heating in a filling tank, Parallel reaction in a semi continuous reactor with large temperature difference, Momentum balances – Dimensionless model equations, CSTR, Gas liquid mass transfer in a continuous reactor, Multistage Evaporator

Unit 3: Modeling of stage wise processes Introduction, Stirred tank reactor, Reactor Configurations, Generalized model description, Heat transfer to and from reactors, Steam heating in jacket, Dynamics of the metal jacket walls, Batch reactor – Constant volume, Semi - Batch reactor, CSTR - Constant volume CSTR, CSTR cascade, Reactor stability, Reactor Control, Bioreactors, Trickle bed reactor

Unit 4: Mass transfer process models Liquid-liquid extraction, Binary batch distillation, Continuous binary distillation, Multi-component separation, Multi-component steam distillation, Absorber- stage wise absorption, steady state gas absorption with heat effects.

Unit 5: Modeling of distributed system Plug flow tubular reactor, Liquid phase tubular flow reactor, Gas phase tubular flow reactor contactors, Dynamic simulation of the Plug-Flow tubular reactor , Dynamic modeling of plug-flow contactors: liquid–liquid extraction column dynamics, Steady-state tubular flow with heat loss, Steady state counter-current heat exchanger, Heat exchanger dynamics

Unit 6: Process Simulation Scope of process simulation, Formulation of problem, Step for steady state simulation, Process simulation approaches for steady state simulation, Strategies, Process simulator, Structure of process simulator, Integral process simulation, Demonstration of process simulator

Text / References:

1. W. L. Luyben, ―Process Modeling, Simulation and Control for Chemical Engineering, McGraw Hill Book co., 1973.

2. John Ingham, Irving, J. Dunn, Elmar, Heinzle Jiri, E. Prenosil, ―Chemical Engineering Dynamics, VCH Publishers Inc., New York, 1974.

3. Amiya K. Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 2nd Edition, 2011.

E. Advanced Petroleum Refining

Course Outcomes: At the end of the course, students will be able to:

CO 1	Know details of different Refining Process
CO2	Understand the chemistry of refining processes

CO3	Understand the technological changes associated with refining process
CO4	Compare and know role of different catalyst

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	-	-	-	-	-	✓	-	-	-
CO2	✓	✓	✓	-	-	-	-	-	✓	-	-	-
CO3	✓	✓	✓		-	-	-	-	✓	-	-	-
CO4	✓	✓	✓		-	-	-	-	✓	-	-	-

Detailed Syllabus :

UNIT I

Coking and thermal processes – Types,properties and uses of petroleum coke,process description for delayed coking and fluid bed coking, case study problem.

UNIT II

Catalytic Cracking – Fludized bed catalytic cracking, New design of FCC units, cracking reactions, Coking of cracking catalyst, process variables,heatrecovery,yield estimation ,capital and operating cost,casestudy problem on catalytic cracker.

UNIT III

Catalytic Hydrocracker- Hydrocracking reactions, feed preparation, process decription, hydrocracking catalyst , process variables,hydrocrckingyield,investment and operating cost,case study problem on hydrocracker.

UNIT IV

Hydroprocessing and resid processing- Composition of vacuum tower bottoms,processoptions,hydroprocessing,expanded bed hydrocracking processes,moving bed hydroprocessors, solvent extraction, summary of resid processing operations.Hydrotreating-Hydrotreating catalyst, aromatic reduction, reactions, process variables,construction and o[perating cost, case study problem on hydrotreator.

UNIT V

Catalytic reforming and isomerization- Feed preparation,catalytic reforming processes,reforming catalysts, reactor design,yields and costs.

Isomerization – Capital and operating costs, isomerization yield, case study problem on Reformer and isomerization unit.

UNIT VI

Alkylation and polymerization – Alkylation reactions, process variables, alkylation feed stocks, alkylation products, HF and sulfuric acid alkylation process, cpmpareason between the processes, alkylation yields and costs, poplymerization , case study problem on alkylation and polymerization.

Texts / References:

J.H. Gary, " Petroleum Refining - Technology and Economics" 3rd Ed., Marcel DekkarInc, 1994

G.D.Hobson, " Modern Petroleum Technology" Vol.I& II ,5th Ed., Applid science ,London

6. Process Instrumentation and Control Laboratory

BTCHL 706	**Process Instrumentation And Control Laboratory**	0-0-2	1 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Course Outcomes: At the end of the course, the student will be able to:

CO1	Calculate the characteristics of control valves
CO2	Determine the dynamics of level and temperature measurement process
CO3	Determine the dynamics of two capacity liquid level process without interaction and with interaction, U-tube manometer
CO4	Determine the performance of controllers for a flow process, pressure process, level process, temperature process
CO5	Evaluate the performance of cascade control

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	-	-✓	--		✓	-	-	✓	-		-
CO2	✓	-	-	--		✓	-	-	✓	-		-
CO3	✓	-	-	--		✓	-	-	✓	-		-
CO4	✓	-	-	--		✓	-	-	✓	-		-
CO5	✓	-	-	--		✓	-	-	✓	-		-

List of Experiments:

1. To determine the time constant of given thermometer with positive step change.
2. To determine the time constant of given thermometer with negative step change.
3. To determine the time constant and valve properties of single tank system.
4. To study the step response of two tank non-interacting liquid level system and compare the observed transient response with the theoretical transient response.

5.. To study the step response of two tank interacting liquid level system and compare the observed transient response with the theoretical transient response for the condition T1=T2=T.

6. To study the impulse response of a tank.

7. Process Equipment Design and Drawing Lab

BTCHL 707	**Process Equipment Design and Drawing Lab**	0-0-2	1 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Course Outcomes: At the end of the course, the student will be able to:

CO 1	Identify equipment and instruments based on symbols
CO 2	Draw process flow diagrams using symbols
CO 3	Apply mechanical design aspects to process equipments
CO 4	Design heat exchangers, evaporators, absorbers, distillation columns, reactors, filters etc.

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓			✓		✓	
CO2						✓			✓		✓	
CO3					✓	✓			✓		✓	
CO4					✓	✓			✓		✓	

List of Experiments : Based on the theory course students should design and draw the sheets of chemical process vessels.

8. Process Design, Flow Sheeting & Simulation I Lab

BTCHL 708		Process Design, Flow Sheeting & Simulation I Lab	0-0-2	1 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Outcomes: At the end of the course, the student will be able to:

CO1	Identify equipment and instruments based on symbols
CO2	Draw process flow diagrams using symbols
CO3	Apply mechanical design aspects to process equipment
CO4	Design heat exchangers, evaporators, absorbers, distillation columns, reactors and filters.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	✓	-	-	✓	-	-	-	-	-	✓	✓
CO2	-	✓	-	-	✓	-	-	-	-	-	-	-
CO3	✓	-	✓	✓	✓	✓	-	-	-	-	-	-
CO4	✓	-	✓	✓	✓	✓	-	-	-	-	-	-

Detailed Syllabus

Unit I: Mathematical models of chemical engineering systems: Introduction; Use of mathematical models; Scope of coverage; Principles of formulation; Fundamental laws; Contimuity equation; Energy equation; Equations of motion; Transport equations; Equations of state; Equilibrium; Chemical kinetics.

Unit II: Examples of Mathematical Models of Chemical Engineering Systems: Introduction; Series of isothermal, constant holdup CSTRs; CSTRs with variable hold-ups; Two heated tanks; Gas phase pressurized CSTR; Non-isothermal CSTR; Single component vaporizer; Multicomponent flash drum; Batch reactor; Reactor with mass transfer; Ideal binary distillation column; Batch distillation with holdup; pH systems.

Unit III: General Concepts of Simulation for Process Design: Introduction; Process simulation models; Methods for solving non-linera equations; Recycle partitioning and tearing; Simulation examples.

Unit IV: Design of Piping network using software tools

Unit V: Design of following equipment using ASPENPLUS or any good software

a. Heat Exchanger
b. Absorption column
c. Distillation column
d. Reactor
e. Evaporator
f. Flow sheeting of a chemical plant
g. Simulation of a small size chemical plant.

Unit VI: Simulation of a chemical plant using AUTOPLANT or any good software.

TEXT BOOK:

1. William L. Luyben - Process Modeling, Simulation and Control for Chemical Engineers - 2nd edition, McGraw Hill International Edition; 1990 (Ch. 1, 2 and 4)
2. Lorentz T. Biegler, E. Ignacio Grossmann and Arthur W. Westerberg - Systematic Methods of Chemical Process Design - Prentice Hall International - 1997.

9. Project Work Stage – I

9	**BTCHP* 709**	Project Work Stage – I**	-	-	4	-	20	30	2

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the project and problem definition
CO2	Explain the motivation, objectives and scope of the project
CO3	Review the literature related to the selected topic of the project
CO4	Design the mechanism, components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes

Mapping of Course outcomes with Program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		✓	✓	✓	✓	✓					✓	
CO2		✓	✓	✓		✓		✓			✓	
CO3		✓	✓	✓	✓	✓					✓	
CO4	✓	✓	✓	✓	✓	✓					✓	
CO5	✓	✓	✓	✓	✓	✓		✓			✓	

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any Process/ equipment.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Chemical Engineering.
5. Software development for particular applications.

6. A combination of the above.

It is expected that the students should complete at least 40% of the total project work in VII Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry.

The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format, before the end of VII semester. The report shall be comprehensive and presented typed on A_4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

10. Field Training / Internship/Industrial Training Evaluations

10	**BTCHF 710**	Field Training / Internship/Industrial Training Evaluations (of sem. VI)	-	-	-	-	-	50	1

Examination Scheme: End Semester Exam: 50 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Aware of industrial culture and organizational setup
CO2	Understand to apply/link academic knowledge to industry

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓	✓			✓	✓	✓
CO2						✓	✓			✓	✓	✓

Students will have to undergo 6 weeks training programme in the Industry during the summer vacation after VIth semester examination. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.

Also, students should take up a small case study and propose the possible solution(s).

They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in final year B.Tech. Programme. They will have to give a power point presentation in front of the group of examiners.

Semester VIII

Process Control : Design, analysis and assessment

BTCHC 801A	**Process Control : Design, analysis and assessment**	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand models for control
CO2	Analyse transfer function models using various techniques
CO3	Solve problems using stability analysis and frequency response analysis
CO4	Understand multivariable control
CO5	Evaluate controller performance using MATLAB tutorials

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓			✓			✓	
CO2	✓	✓	✓	✓				✓				
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓					✓				
CO5	✓	✓	✓					✓				

Unit 1 : Introductory concepts, Models for control, control structures, state space modeling

Unit 2 : Analysis of Transfer function models, Laplace transforms, stability, Controllers and closed loop transfer functions,

Unit 3 : Stability analysis, Controller tuning : Stability based methods, frequency response analysis, traditional advanced control strategies

Unit 4 : Controller tuning : Direct Synthesis, Nyquist stability criterion, traditional multivariable control

Unit 5 : Multivaraible control, Model predictive control fundamentals and its implementation

Unit 6 : Controller performance assessment and diagnosis fundamentals and its implementation, MATLAB tutorials

Computational fluid dynamics

BTCHC 801B	Computational Fluid Dynamics	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Derive flow governing equations using CFD.
CO2	Do turbulence modelling and discretization
CO3	Solve discretized linear algebraic equation using various methods
CO4	Solve coupled equations using various methods
CO5	Understand structured and unstructured grid generation methods

Mapping of Course outcomes with Program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓	✓	✓	✓		✓				
CO2	✓	✓	✓	✓		✓		✓				
CO3	✓	✓	✓	✓		✓						
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓					✓				

Unit 1 : CFD as an engineering analysis tool, derivation of flow governing equations

Unit 2 : Initial and boundary conditions, wellposedness, turbulence modelling, discretization of the governing equations using finite difference/volume methods

Unit 3 : Concepts of consistency, stability and convergence, template for the discretization of a generic unsteady transport equation, spectral analysis of errors and TVD schemes

Unit 4 : Solution of discretized linear algebraic equations, direct methods, classical iterative methods, convergence analysis, advanced methods for solution of discretized equations

Unit 5 : Solution of coupled equations: methods for compressible flows, evaluation of pressure in incompressible flows, pressure-velocity coupling algorithms

Unit 6 : Template for the solution of governing equations, structured and unstructured grid generation methods, benchmarking and calibration

Optimization in Chemical Engineering

BTCHC 801C	Optimization in Chemical Engineering	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand formulation for optimization problems
CO2	Study basic concepts of optimization
CO3	Solve problems involving unconstrained single variable optimization
CO4	Solve problems involving unconstrained multivariable optimization
CO5	Understand software tools for optimization

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓			
CO2	✓	✓	✓		✓							
CO3	✓	✓	✓		✓							
CO4	✓	✓	✓		✓							
CO5	✓	✓										

Unit 1 : Introduction to optimization, optimization problem formulation

Unit 2 : basic concepts of optimization

Unit 3: Unconstrained single variable optimization : methods and applications, Unconstrained multivariable optimization: methods and applications

Unit 4 : Unconstrained multivariable optimization : gradient based methods, introduction to linear programming

Unit 5 : Linear programming : simplex method, constrained non-linear programming

Unit 6: Applications of Optimization, Software tools for optimization

References:

1. Optimization of Chemical Processes, by T. F. Edgar and D. M. Himmelblau
2. Engineering Optimization : Methods and optimization by A. Ravindran and K. M. Ragsdell

Environmental Quality Monitoring and analysis

BTCHC 802A	Environmental Quality Monitoring and analysis	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to

CO1	Understand definition of environment , health effects
CO2	Study different parameters for environment
CO3	Study methods for sampling, processing , analysis of constituents
CO4	Solve problems using dispersion models
CO5	Understand chemical exchange between air-water, soil-air, sediment-air

Mapping of Course outcomes with Program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					✓		✓					✓
CO2					✓		✓					✓
CO3					✓		✓					✓
CO4					✓		✓					✓
CO5					✓		✓					✓

Unit1 : Introduction, definition of environment, link between source/environment/receptor, health effects, toxicology, Chemicals of concern, relevant properties for environmental fate and transport, definition of equilibrium, , equilibrium partitioning of chemicals between different phases of environment

Unit 2 : Parameters for environmental water/air/soil/sediment-screening parameters, primary air pollutants, monitoring of environmental parameters-screening parameters-BOD, COD, TOC, TDS, environmental sampling- definition and synthesis of a sampling/monitoring/analysis method, QA/QC

Unit 3 : Methods for sampling/processing/analysis of organic and inorganic constituents in air/water/soil/sediment, introduction to environmental transport-BOX Models and the application to multimedia transport of pollutants

Unit 4 : Atmospheric dispersion-Gaussian Dispersion model, fundamentals of mass transport-definition of intraphase and interphase chemical flux, interphase mass transport

Unit 5: Chemical exchange between air-water, Chemical exchange between sediment-water

Unit 6 : Chemical exchange between soil-air, overall transport model and scenario

Transport Processes I : Heat and Mass Transfer

BTCHC 802B	Transport Processes I : Heat and Mass Transfer	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to

CO1	Understand dimensional analysis for transport processes
CO2	Study transport in spherical and cylindrical coordinates
CO3	Evaluate pressure and body forces in fluid flow
CO4	Understand forced and natural convection
CO5	Solve problems involving transport processes

Mapping of Course outcomes with Program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓	✓						
CO2	✓	✓	✓			✓						
CO3	✓					✓						
CO4						✓						
CO5	✓		✓			✓						

Unit 1 : Dimensional analysis, diffusion

Unit 2 : Transport in one direction, spherical and cylindrical coordinates

Unit 3 : Pressure and body forces in fluid flow, conservation equations

Unit 4 : Diffusive Transport I and II

Unit 5 : Forced and natural convection

Unit 6 : Transport in turbulent flows

Project Stage - II

BTCHP 803	Project	Project Stage – II or Internship*	0-0-30	15 Credits

Examination Scheme: Continuous Assessment: 50 Marks End Semester Exam: 100 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the aim and objectives for this stage of the project
CO2	Construct and conduct the tests,experiments on the selected topic
CO3	Analyze the results of the tests/experiments/runs/simulations etc
CO4	Discuss the findings, draw conclusions.

Mapping of Course outcomes with Program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		✓	✓	✓	✓	✓					✓	
CO2	✓	✓	✓	✓		✓		✓			✓	
CO3	✓	✓	✓	✓	✓	✓	✓				✓	
CO4	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓

Course Contents:

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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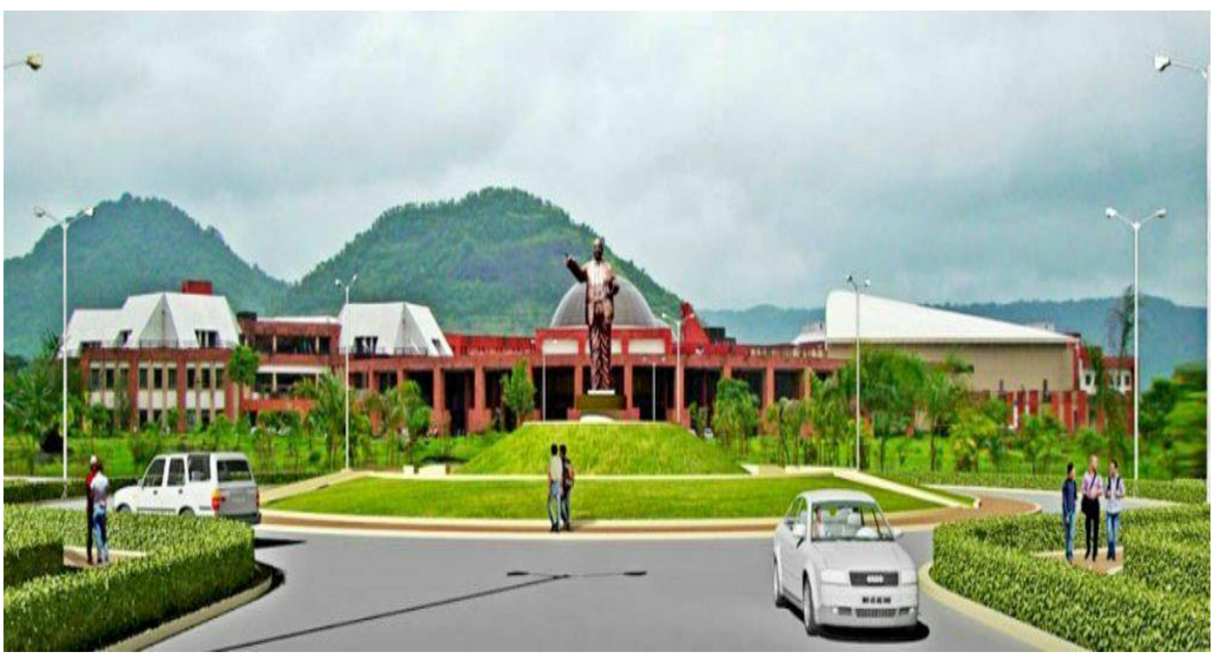
Curriculum for Undergraduate Degree Programme
S.Y. B. Tech. in Civil Engineering

With effect from AY 2021-22



Dr. Babasaheb Ambedkar Technological University
Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Teaching & Evaluation Scheme for Second Year B. Tech. Civil Engg.

Semester- III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC 5	BTBS301	Mathematics – III	3	1	-	20	20	60	100	4
ESC 8	BTCVES302	Mechanics of Solids	3	1	-	20	20	60	100	4
PCC 1	BTCVC303	Building Construction & Drawing	2	1	-	20	20	60	100	3
PCC 2	BTCVC304	Hydraulics -I	3	1	-	20	20	60	100	4
PCC 3	BTCVC305	Surveying	2	1	-	20	20	60	100	3
HSSMC2	BTHM306	Soft Skill Development	2	-	-	50	-	-	50	Audit
LC 1	BTCVL 307	Solid Mechanics Laboratory	-	-	2	20	-	30	50	1
LC 2	BTCVL 308	Hydraulics-I Laboratory	-	-	2	20	-	30	50	1
LC 3	BTCVL 309	Surveying Laboratory	-	-	2	20	-	30	50	1
Internship	BTES210P	Internship –I Evaluation (From Sem II)	-	-	-	-	-	50	50	Audit
		Total	**15**	**05**	**06**	**210**	**100**	**440**	**750**	**21**

Semester- IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 4	BTCVC401	Building Planning and Drawing	2	-	-	20	20	60	100	2
PCC 5	BTCVC402	Environmental Engineering	2	-	-	20	20	60	100	2
PCC 6	BTCVC403	Structural Mechanics - I	2	1	-	20	20	60	100	3
PCC 7	BTCVC404	Water Resources Engineering	3	-	-	20	20	60	100	3
PCC 8	BTCVC405	Hydraulics - II	2	1	-	20	20	60	100	3
PCC 9	BTCVC406	Engineering Geology	2	1	-	20	20	60	100	3
LC 4	BTCVL407	Building Planning and CAD Lab.	-	-	2	20	-	30	50	1
LC 5	BTCVL408	Environmental Engg. Lab.	-	-	2	20	-	30	50	1
LC 6	BTCVL409	HE-II Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Field Training / Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester IV and appear at examination in Semester V)	-	-	-	-	-	-	-	To be evaluated in V Sem.
		Total	**13**	**03**	**06**	**180**	**120**	**450**	**750**	**19**

Detailed Syllabus

BTBS301Mathematics – III

Teaching Scheme: (3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Laplace Transform **(Lectures 09)**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Module 2: Inverse Laplace Transform **(Lectures 09)**

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Module 3: Fourier Transform **(Lectures 09)**

Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.

Module 4: Partial Differential Equations and Their Applications **(Lectures 09)**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional heat flow equation $\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$, and two-dimensional heat flow equation

Module5: Functions of Complex Variables **(Lectures 09)**

Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection , bilinear transformation; Conformal mapping. Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1) Grewal B. S., "Higher Engineering Mathematics" Khanna Publishers, New Delhi.

2) Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.

3) Das H. K. and Er. Verma Rajnish, "Higher Engineering Mathematics", S. Chand & Co. Pvt. Ltd., New Delhi.

4) Dr. Singh B. B., "A course in Engineering Mathematics (Vol III)", Synergy Knowledgeware, Mumbai.

5) Wartikar J.N. and Wartikar P.N., "Engineering Mathematics Vol. I & II", PVG Prakashan, Pune, 1992

6) Ramana B. V., "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.

Reference Books

1) Peter O' Neil, "A Text Book of Engineering Mathematics" Thomson Asia Pte Ltd., Singapore.

2) Wylie C. R. & Barrett L. C., "Advanced Engineering Mathematics", TMH Publishing Co. Ltd., N. Delhi.

3) Dr. Singh B. B., "Integral Transforms and their Engineering Applications", Synergy Knowledgeware, Mumbai.

4) Sneddon I. N., "Integral Transforms", Tata McGraw-Hill , New York.

Course Outcomes: On completion of the course, student will be able to formulate and solve mathematical model of civilengineering phenomena in field of structures, survey, fluid mechanics and soil mechanics.

☑☑☑☑☑☑☑☑☑☑☑

BTCVES302 Mechanics of Solids

Teaching Scheme:(3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Stress and Strain **(Lectures 10)**

Simple stress -Analysis of internal forces, simple stress, shearing stress, bearing stress, diaphragm or skin stresses in thin walled vessels, statically indeterminate members and thermal stresses

Simple strains -Stress strain diagram for different engineering materials and its importance for elastic and plastic analysis, Hooke's law: axial and shearing deformations, Poisson's ratio: biaxial and tri-axial deformations, variation of stress with inclination of element, relationship between modulus of rigidity and modulus of elasticity, variation of stress at a point: analytical derivation, introduction to strain measurement devices, Sensors: working principle

Module 2: Axial Force, Shear Force and Moment in Beam **(Lectures 10)**

Axial force, shear force and moment in beams – concept of unbalanced forces at a transverse section, axial forces, shear forces and moment – interaction of these, relations among load shear and moment, introduction to moving loads

Module 3: Stresses in beams **(Lectures 10)**

Theory of cylindrical bending, Relationship between intensity of loading, shear force and bending moment over elemental length, Derivation of flexural formula, economic sections, analysis of flexural action, derivation of formula for shearing stress, concept of shear flow, shear lag and shear center

Torsion -Assumptions, derivation of torsion formulae, torsion of circular shafts, power transmission, stresses and deformation in determinate solid/hollow homogeneous shafts

Module 4: Columns and Struts **(Lectures 10)**

Concept of short and long columns, formulae by Euler and Rankin, Euler's Crippling load for different end conditions, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members, Kern of a section; load applied off the axes of symmetry, introduction to combined axial and flexural loads,

Module 5: Combined Stresses **(Lectures 8)**

State of simple shear, Analytical and graphical representation of state of combined stress at a point, absolute maximum shearing stress, application of Mohr's circle to combined loading, principal stresses and strains

Theories of Failure- maximum principal stress theory, maximum principal strain theory, maximum strain energy theory, maximum shear stress theory, maximum shear strain theory.

Text Books:

- Singer F.L. and Pytle, 2011, "Strength of Materials", Harper Collins Publishers, Fourth Edition
- Junnarkar S.B. (2014), "Mechanics of Structures", Charotor Publishers, Anand, 31st edition,
- Khurmi R.S., 2018, "Strength of Material", S. Chand and Co., Edition revised 1968, New Delhi
- Sadhu Singh, 1978, "Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-048-7
- Prasad I.B, 1988, "A text book of Strength of Materials", Khanna Publishers, N. Dehli, ISBN NO:978-81-7409-069-X
- Timoshenko S.P. and Young D.H., 2002, "Elements of Strength of Materials", East West Press, 4th edition 1962, New Delhi
- Prasad I.B, 1988, "A text book of Strength of Materials", ISBN: 978-81-7409-069-X
- Dr. Sadhu Singh, 1978, "Strength of Materials", ISBN: 978-81-7409-048-7
- Ramamrutham S., 2011, "Strength of Materials", Dhanpat rai and Sons, Delhi

Reference Books:

- Beer F P., Jhonston E. R., John. T. D E wolf, 2017, "Mechanics of Materials" TMH, 7th edition
- Popov E.P.,2015, "Introduction to Mechanics of Solids", Prentice-Hall, Second Edition 2005
- Crandall S.H., Dahl N.C., & Lardner T.J., 1955, "An Introduction to Mechanics of Solids", Tata McGraw Hill, 2nd Edi, 1978
- Nash W., 2005, "Strength of Materials Schaum's outline series", McGraw Hill, fourth edition
- Punmia B. C., 2018, "Mechanics of Materials" Laxmi Publications, revised edition, 2016
- Subramanian R., 2016, "Strength of Materials" Oxford University Press, 2nd edition, New Delhi
- Dr. Sadhu Singh, 1978, "Theory and Solved Problems in Adv. Strength of Materials", ISBN: 978-81-7409-212-7

Course Outcomes: On completion of the course, the students will be able to:

CO1: Perform the stress-strain analysis.
CO2: Draw force distribution diagrams for members and determinate beams.
CO3: Visualize force deformation behavior of bodies.
CO4: Perform failure analysis

☑☑☑☑☑☑☑☑☑☑☑☑

BTCVC 303 Building Construction & Drawing

Teaching Scheme: (2 Lectures + 1 Tutorials) hours/week

Course Contents

Module 1: Masonry Construction **(Lectures06)**

Stone masonry: Random rubble, un-coursed rubble, coursed rubble & ashlar brickwork & brick bonds - english, flemish, principles to be observed during construction composite masonry, various partition walls, brick, aluminum & timber, solid concrete blocks, hollow concrete blocks and light weight blocks (aerated autoclaved), soil stabilized blocks, fly ash blocks, cement concrete walls

Module 2: Concrete for Construction **(Lectures 06)**

Introduction and properties of ingredients, importance of admixture materials such as pozzolona, fly ash, specific purpose chemical admixtures, Properties of fresh and hardened concrete

Module 3: Arches and Lintels **(Lectures 06)**

Arches and their stability, technical terms in arches, types of arches, methods of construction; Lintel: Necessity, materials: wood, stone, brick, steel, R.C.C. and reinforced brick lintels, beams: types according to material, layout such as primary and secondary, continuous beams, formwork for RCC elements: function, requirements

Module 4: Means of Lateral Communication **(Lectures 10)**

Doors and windows-Doors - classification based on parameters such as material, geometry, fixtures and fastening

Windows - classification based on parameters such as material, geometry, fixtures and fastening

Use of composite materials for doors and window frames and shutters, laying out of passages

Stairs: Terminology, requirements of a good stair, functional aspects, various types, uses and limitations

Ramps: Requirements and types, planning aspects for physically handicapped person

Elevators: Types and their Use

Module 5: Flooring Roofs and Types **(Lectures 08)**

Flooring: Types, factors for selections of floorings, flooring in ground and upper floors, various types of tiled flooring: natural, composite, synthetic, and special purpose flooring, concrete flooring for industrial purpose: tremix flooring

Roof coverings: Terms used, roof and their selection, pitched roofs and their types, roof coverings and their selection. Natural, composite, synthetic, and special purpose roof coverings, timber trusses (King Post and Queen Post), steel trusses types and their suitability

Precast and Pre-engineered Building Advantages and disadvantages.

List of Drawing Assignments

1) Sketch Book consisting of free hand proportional scale sketches for items to be drawn on drawing sheets as mentioned below under (2)
2) Drawing to scale on a half imperial drawing sheet covering following aspects.
   a) Lettering, Symbols, Types of lines and dimensioning as per IS 962.
   b) Foundations: - Isolated, Combined Footings, Under Reamed Piles, Rafts.
   c) Types of Stone Masonry: Elevation and Sectional Drawings.
   d) Types of Brick masonry: Elevation and Sectional Drawings.
   e) Types of Doors: Elevation and Sectional Drawings.
   f) Types of Windows: Elevation and Sectional Drawings, Standard Aluminum Sections.
   g) Types of Stairs: Plan and Sectional Drawings.
   h) Trusses: Various types, various roof covering materials, sketches for sectional profiles
   i) Typical plan for a single room and sectional views.
3) Site visit: To understand various building materials and their use.

Text Books

- Punmia B.C., Jain A. K., 2008, “Building Construction", Laxmi Pub. Pvt. Ltd., 10th Edi, N. Delhi
- Arora S. P. and Bindra S. P., 2010, “Text Book of Building Construction”, Dhanpat Rai Publications
- Kumar Sushil, 2010, “Building Construction” Standard Publishers, 20th Edition,.
- P. Purushothama Raj, 2016, “Building Construction Materials and Techniques”, Pearson Education
- Jain V.K., 2015, “Automation Systems in Smart and Green Buildings” ISBN NO: 978-81-7409-237-3

Reference Books

- NBC 2005, National Building Code of India, Parts III, IV, VII and IX, B.I.S. New Delhi
- Chudley R., 1973, "Construction Technology", Vol.1, 2, 3 and 4 ELBS Publisher
- SP 7- National Building Code Group 1 to 5, B.I.S. New Delhi
- I.S. 962 - 1989 Code for Practice for Architectural and Building Drawings, B.I.S. New Delhi
- Sikka V. B., 2015, “A Course in Civil Engineering Drawing”, S. K. Kataria and Sons

- Catalogues. Information Brochures, Trade Literature by material or product manufacturers
- Mehta, Scarborough, Armpriest, 2007, "Building Construction", Pearson Education
- Macay W.B, 2004, "Building Construction", Vol. I, II, III, IV, Pearson Education
- Jain V.K., 2015, "Handbook of Designing and Installation of Services in High Rise Building Complexes" ISBN : 978-81-7409-245-8

Course Outcomes: On completion of the course, students will be able to:

CO1: Understand types of masonry structures.
CO2: Comprehend components of building and there purposes.
CO3: Draw plan, elevation and section of various structures.
CO4: Apply the principles of planning and by laws used for building planning.
CO5: Prepare detailed working drawing for doors and windows.

☑☑☑☑☑☑☑☑☑☑☑

BTCVC 304 Hydraulics - I

Teaching Scheme: (3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Fluid Statics **(Lectures 10)**

Definition of fluids, fluid properties-density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure, types of fluids - Newtonian and non-Newtonian fluid, continuum, fluid pressure
Forces on fluid elements, fundamental equation, manometers, hydrostatic thrust on submerged surfaces, buoyancy, stability of unconstrained bodies, fluids in rigid body motion

Module 2: Fluid Dynamics **(Lectures 10)**

Types of flow, continuity equation, derivation and applications of momentum equation, flow measuring devices, Euler's equation, Bernoulli's equation, velocity potential and stream function, concept of flow net

Module 3: Laminar & Turbulent Flow **(Lectures 10)**

Fully developed laminar flow between infinite parallel plates, both plates stationary, upper plate moving with constant speed, fully developed laminar flow in pipe.
Turbulent flow: Shear stress distribution and turbulent velocity profiles in fully developed pipe flow, velocity distribution and shear stresses in turbulent flow, Prandtl mixing length theory, Nikuradse's experiment, Introduction to Boundary Layer Theory

Module4: Dimensional Analysis and Similitude **(Lectures 10)**

Nature of dimensional analysis, Rayleigh's Method, Buckingham pi theorem, dimensionless groups and their physical significance, flow similarity and model studies, Scale Effects, Distorted and Undistorted Models

Module5: Flow through Pipes **(Lectures 08)**

Loss of energy in pipes, pipe discharging from a reservoir, pipe connecting two reservoirs in series and parallel, siphon, transmission of power through nozzle, water hammer in pipes- rigid and elastic water column theory, surge tanks - function, calculation of head loss, introduction to Moody's chart, nomograms and other pipe diagrams

Text Books

- Fox. R. W. And Mc-Donald. A. T., 2011, "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
- Modi and Seth, 2017, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition , 1991
- Kumar K. L., 2010, "Fluid Mechanics", S. Chand publication
- Bansal R. K., 1989, "Fluid Mechanics", Laxmi publication Delhi
- Jain A.K, 1998, "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7

Reference Books

- Streeter V. L., Bedford K. W. and Wylie E. B., 1998, "Fluid Dynamics", New York, McGraw-Hill, Ninth Edition.
- Som S. K. & Biswas G., 2017, "Introduction to Fluid Mechanics & Fluid Machines", Tata McGraw-Hill.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Calibrate the various flow measuring devices.
CO2: Determine the properties of fluid and pressure and their measurement.
CO3: Understand fundamentals of pipe flow, losses in pipe and analysis of pipe network.
CO4: Visualize fluid flow phenomena observed in Civil Engineering systems.

☑☑☑☑☑☑☑☑☑☑☑

BTCVC305 Surveying

Teaching Scheme : (2 Lectures +1 Tutorial) hours/week

Course objectives:
1) To determine the relative position of any objects or points of the earth.
2) To determine the distance and angle between different objects.
3) To prepare a map or plan to represent an area on a horizontal plan.

Course Contents

Module 1: Chain Surveying (Lectures 08)
Definition, principles, classification, fields and office work, scales, conventional signs, survey instruments, their care and adjustment, ranging and chaining, reciprocal ranging, setting perpendiculars, well-conditioned triangles, traversing, plotting , enlarging and reducing figures

Module 2: Compass & Plane Table Surveying (Lectures06)
Prismatic compass, surveyor's compass, bearing systems and conversions, local attraction, magnetic declination, dip traversing, adjustment of errors.
Plane table instruments and accessories, merits and demerits, methods: radiation, intersection, resection, traversing

Module 3: Leveling and Applications (Lectures08)
Level line - Horizontal line - Levels and Staves, Sprit level – Sensitiveness, Bench marks - Temporary and permanent adjustments, Fly and Check leveling, Booking, reduction, Curvature and Refraction – reciprocal leveling - Longitudinal and cross sections - Plotting - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs. Planimeter-Types, Theory, concept of zero circle, Study of Digital Planimeter, Computation of Areas and Volumes

Module 4: Theodolite Surveying (Lectures 08)
Theodolite - Vernier and micro-optic - Description and uses - temporary and permanent adjustments of vernier transit –Angles: Horizontal - Vertical - Heights and Distances - Traversing - Closing error and distribution - Gales's table - Omitted measurements

Module 5: Engineering Surveys (Lectures 08)
Reconnaissance, Preliminary and location surveys for engineering projects, Layout, Setting out works, Route Surveys for highways, railways and waterways, introduction to curve ranging, Mine Surveying - Instruments – Tunnels: correlation of underground and surface surveys, shafts

Text Books

- Kanetkar T.P. and Kulkarni S. V., 2014, "Surveying and Leveling", Vols. I, II and III, Vidyarthi Gruh Prakashan, Pune
- Punmia B.C., 1967, "Surveying", Vols. I, II and III, Laxmi Publications, 16th edition, 2016

Reference Books

- Clark D., 1944, "Plane and Geodetic Surveying", Vol. I & II, C.B.S. Pub. & Distri., N. Delhi, 6th edi.
- Anderson J. M. and Mikhail E. M., 1986, "Introduction to Surveying", McGraw Hill Book Company
- Bannister A. and Raymond S., 1959, "Surveying", ELBS, Sixth Edition, 1992
- Kahmen Heribert and Faig Wolfgang, 2017, "Surveying", Walter de Gruyter, 1995

Course Outcomes: On completion of the course, the students will be able to:
CO1: Perform measurements in linear/angular methods.
CO2: Perform plane table surveying in general terrain.
CO3: Know the basics of leveling and Theodolite survey in elevation and angular measurements.

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BTHM306 Soft Skill Development

Teaching Scheme: (2 Lectures) hours/week

Program Educational Objectives:

1) To build the skills like team building so that they can work efficiently in groups.

2) To provide knowledge of conflict management while working in large organizations.

3) To develop management skills required in routine work environment.

4) To polish the personality of the learners in order to make them good leaders and employees.

5) To imbibe qualities like manners & etiquettes co-ordination, mutual understanding while working in a group.

Module 1: Development of Proficiency in English **(Lectures 05)**

Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups), 5 Ws& 1 H & 7 Cs for effective Communication, Imbibing Etiquettes and manners, Study of different pictorial expressions of non-verbal communication and their analysis

Module 2:Self-Management **(Lectures 05)**

Self-Evaluation, Self-discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency, etc., Self-Awareness, Self-Management, Identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride, Leadership & Team Dynamics

Module 3: Time Management Techniques **(Lectures 04)**

Practice by game playing and other learning strategies to achieve the set targets Time Management Concept, Attendance, Discipline & Punctuality, Acting in time, Quality /Productive time

Module 4: Motivation/ Inspiration **(Lectures 04)**

Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation

Motivation techniques: Motivation techniques based on needs and field situations

Module 5: Interpersonal & Computing Skills **(Lectures 06)**

Positive Relationship, Positive Attitudesand Empathies: comprehending others' opinions, points of views, and face them with understanding Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills

Designing an effective Presentation, Contents, appearance, themes in a presentation, -Tone and Language in a presentation, Role and Importance of different tools for effective presentation

Reference Books

1) Mitra, Barun, "Personality Development and Soft Skills", Oxford University Press, 2016
2) Ramesh, Gopalswamy, "The Ace of Soft Skills: Attitude, Communication & Etiquette for Success", Pearson Education, 2013
3) Covey, Stephen R., "Seven Habits of Highly Effective People: Powerful Lessons in Personal Change"
4) Rosenberg Marshall B., "Nonviolent Communication: A Language of Life"

Program **Educational Outcomes**

1) Learners will acquire interpersonal communication skills.
2) Learners will develop the ability to work independently.
3) Learners will develop the qualities like self-discipline, self-criticism and self-management.
4) Learners will have the qualities of time management and discipline.
5) Learners would be able to present themselves as an inspiration for others.

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BTCVL307 Solid Mechanics Laboratory

Practical: 2 hours / week

Practical Work consists of performance of at least seven experiments from the list below (excluding the eleventh study)experiment: Detailed report is expected.

List of Experiments

1. Tension test on ferrous and non-ferrous alloys (mild steel / cast iron /aluminum etc.)
2. Compression test on mild steel, aluminum, concrete, and wood.
3. Shear test on mild steel and aluminum (single and double shear tests).
4. Torsion test on mild steel and cast iron solid bars and pipes.
5. Flexure test on timber and cast iron beams.
6. Deflection test on mild steel and wooden beam specimens.
7. Graphical solution method for principal stress problems.
8. Impact test on mild steel, brass, Aluminum, and cast iron specimens.
9. Experimental on thermal stresses.
10. Strain measurement involving strain gauges / rosettes.

Assignment involving computer programming for simple problems of stress, strain computations.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Evaluate Young Modulus, torsional strength, hardness and tensile strength of given specimens.

CO2: Determine the strength of coarse aggregates.
CO3: Find the compressive strength of concrete cubes and bricks.

CO4: Determine physical properties of given coarse aggregates, fine aggregates and cement samples.

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BTCVL 308 Hydraulics- I Laboratory

Practical: 2 hours / week

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

1) Measurement of Viscosity of various fluids
2) Demonstration of working of different types of valves and pipe fittings
3) Measurement of pressure Piezometer, manometers, Pressure gauges
4) Measurement of discharge - Calibration of measuring tank, Use of hook or point gauge.
5) Verification of Bernoulli's Theorem
6) Determination of metacentric height.
7) Calibration of an orifice / mouthpiece / venturimeter / orifice meter
8) Study of factors affecting coefficient of friction for pipe flow (for two different materials and two differentdiameters)
9) Determination of loss of head due to Pipe Fittings

Use of computer programs such as MS Excel is desirable for post-processing of results.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Analyze the properties of fluids and their verification.
CO2: Predict empirical behavior of fluids.
CO3: Apply principles of hydraulics while working in field.

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BTCVL309 Surveying Laboratory

Practical: 2 hours / week

Practical Work consists of performances among the list below and detailed reporting in form of field book, journal and drawing sheets.

Perform each of the following practical work

1) Use of Dumpy Level, Auto Level and Tilting Level.
2) Sensitivity of Bubble Tube using Dumpy Level.
3) Evaluation of constant of Planimeter, and use of Digital Planimeter for measurement of areas.
4) Study of Theodolite.
5) Methods of Plane Table Survey
6) Study and use of Total Station

Among following any two shall be performed

1) Reciprocal Levelling.
2) Illustration of Permanent adjustment of Dumpy Level
3) Measurement of Horizontal Angle by Various Methods
4) Measurement of Magnetic Bearing and Vertical Angle by Theodolite
5) Two Point and Three Point Problems

Among following two shall be performed

1) Road survey, 2) Radial Contouring, 3) Block Contouring, 4) Theodolite Traversing

Course Outcomes: On completion of the course, the students will be able to:

CO1: Use the theodolite along with chain/tape, compass on the field.
CO2: Apply geometric and trigonometric principles of basic surveying calculations.
CO3: Plan a survey, taking accurate measurements, field booking, and adjustment of errors.
CO4: Apply field procedures in basic types of surveys, as part of a surveying team.
CO5: Employ drawing techniques in the development of a topographic map.

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BTES210P Internship Evaluation I (from semester II)

Student shall undergo field training / industrial training / internship during summer vacation after Semester II. This training is at elementary level expecting exposure to field practices. A brief report shall be submitted. Evaluation shall be based on reportand power point presentation.

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Semester- IV										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 4	BTCVC401	Building Planning and Drawing	2	-	-	20	20	60	100	2
PCC 5	BTCVC402	Environmental Engineering	2	-	-	20	20	60	100	2
PCC 6	BTCVC403	Structural Mechanics - I	2	1	-	20	20	60	100	3
PCC 7	BTCVC404	Water Resources Engineering	3	-	-	20	20	60	100	3
PCC 8	BTCVC405	Hydraulics - II	2	1	-	20	20	60	100	3
PCC 9	BTCVC406	Engineering Geology	2	1	-	20	20	60	100	3
LC 4	BTCVL407	Building Planning and CAD Lab.	-	-	2	20	-	30	50	1
LC 5	BTCVL408	Environmental Engg. Lab.	-	-	2	20	-	30	50	1
LC 6	BTCVL409	HE-II Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Field Training / Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester IV and appear at examination in Semester V)	-	-	-	-	-	-	-	To be evaluated in V Sem.
		Total	**13**	**03**	**06**	**180**	**120**	**450**	**750**	**19**

BTCVC 401 Building Planning and Drawing

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: Principles of building planning **(6 Lectures)**

Principles of building planning, significance sun diagram, wind diagram, orientation, factors affecting, and criteria under Indian condition, concept of green building: aspect at planning level, construction stage and operational level.

Module 2: Building Services **(8 Lectures)**

Building planning byelaws & regulations as per SP-7, National Building Code of India group 1 to 5, planning of residential building: bungalows, row bungalows, apartments and twin bungalows, procedure of building permission, significance of commencement, plinth completion or occupancy certificate

Anthropometry: Study of Human dimensions, Concept of percentile in Indian standards, space required for various simple activities, Circulation spaces.

Module 3: Plumbing Systems **(8 Lectures)**

Various materials for system like stoneware, GI, AC, CI, PVC, HDPE and various types of traps, fittings, chambers, need of septic tank, concept of plumbing & drainage plan, introduction to rainwater harvesting, concept of rainwater gutters, rainwater outlet & down tank systems
Electrification: wiring types, requirements & location of various points, and concept of earthing

Fire resistance in building: Fire protection precautions, confining of fire, fire hazards, characteristics of fire resisting materials, building materials and their resistance to fire

Module4: Ventilation **(8 Lectures)**

Definition, necessity of ventilation, functional requirements, various system & selection criteria.

Air conditioning: Purpose, classification, principles, various systems

Thermal Insulation: General concept, Principles, Materials, Methods, Computation of Heat loss & heat gain in Buildings

Module 5: Introduction to Acoustics & Green Building **(6 Lectures)**

Absorption of sound, various materials, Sabine's formula, optimum reverberation time, conditions for good acoustics Sound insulation: Acceptable noise levels, noise prevention at its source, transmission of noise, Noise control-general considerations

Green Building: Concept, Principles, Materials, Characteristics, Applications

Reference Books

- Shah, Kale, Pataki, “Building Drawing”, Tata McGraw- Hill
- Sane Y. S.,“Building Design and Drawing”, Allied Book Stall, Pune
- Jain V.K., “Automation Systems in Smart and Green Buildings”, Khanna Publishers, N. Dehli ISBN No 978-81-7409-237-3
- Jain V.K., “Handbook of Designing and Installation of Services in High Rise Building Complexes”, Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-245-8
- Deodhar S.V., “Building Science and Planning”, Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-199-8
- Jain A.K., “The Idea of Green Building”Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-256-4
- SP 7- National Building Code Group 1 to 5- B.I.S. New Delhi
- I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings

Course Outcomes: On completion of the course, the students will be;

CO1: To plan buildings considering various principles of planning and byelaw of governing body.
CO2: Comprehend various utility requirements in buildings
CO3 : Understand various techniques for good acoustics.

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BTCVC402 Environmental Engineering

Teaching Scheme: (2 Lectures+1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**

Environment and its components, importance of water, role of environmental engineer, sources of water, water demand: Design flow, design period, design population, factors affecting water consumption, variation in demand, and design capacity for water supply components, quality of water: Physical, chemical, biological characteristics, Indian standard for quality of potable water

Module 2: Treatment of Water **(10 Lectures)**

Conveyance of raw water: Canals and pipelines, hydraulics of conduits, laying and jointing of pipelines, testing of pipe lines, designing of rising main, type of valves, types of pumps, intake structure, types of intake structures, necessity of water treatment processes

Types of Treatments:

Aeration: Necessity, methods, removal of taste and odour, design of aeration fountain

Sedimentation: Suspended Solids, settling velocity, types of sedimentation tanks, surface loading, detention time, inlet and outlet arrangements

Coagulation: Necessity, coagulant dosage, choice of coagulants, optimum pH

Rapid Mixing: Necessity, gravitational, mechanical, pneumatic devices

Slow Mixing and Flocculation: Design of flocculation chamber, mean velocity gradient, design of clari-flocculator, plate settler and tube settler

Filtration: Theory of filtration, filter materials, types of filters, components, working and cleaning of filters

Disinfection: Theory of disinfection, factors affecting, efficiency of disinfection, types of disinfectants, break point chlorination, bleaching powder estimation

Water softening methods: Lime-soda, ion exchange method, demineralization

Module 3: System of Water Supply **(6 Lectures)**

Continuous and intermittent system, type of distribution systems, layouts, methods of supply: gravity, pumping and combination, hydraulic analysis of distribution system

Module 4: Treatment **(10 Lectures)**

Treatment of Waste Water

Sources of wastewater flows, components of wastewater flows, wastewater constituents, characteristic of municipal waste water, necessity of treatment of waste water, sewerage systems, concept of sewage, sullage, storm water, introduction of preliminary treatment, primary treatment, secondary treatment, introduction to tertiary or advanced treatment fundamentals of anaerobic treatment, sewage and industrial waste of common origin, types

Treatment of Solid Waste

Types, sources, characteristics, ill-effects of improper solid waste management, collection, processing techniques, methods of treatment of solid waste-composting, incineration, pyrolysis and sanitary land filling. biodegradable, non-degradable segregation of solid waste, concept of hazardous waste management, e-waste disposal

Module 5: Air Pollution **(4 Lectures)**

Definition, sources of air pollution, types air pollutants, atmospheric stability, mixing heights, plume types and meteorological parameters, effects of air pollution, control measures of air pollution

Text Books

- Rao and Rao,"Air Pollution ", Tata McGraw Hill Publications, New Delhi, 1990
- Garg S. K., "Water Supply Engineering", Khanna Publishers, New Delhi
- Birdi J. S. and Birdi G. S., "Water Supply & Sanitary Engineering", DhanpatRai Pub. Company, 8th edition, New Delhi

Reference Books

- Peavy and Rowe, "Environmental Engineering", McGraw Hill Publications
- Stern, "Environmental Engineering", Vol. I to IV, McGraw Hill Publications
- Sharma and Kaur, "Environmental Chemistry", Goyal Publisher
- Government Of India Publication, "Water Supply and Treatment Manual"
- Fair and Geyr, "Environmental Engineering", McGraw Hill Publications
- Steel and McGhee, "Environmental Engineering", McGraw Hill Publications
- Viessman& Hammer, "Water Supply & Pollution Control", Harper Collins Collage Publishers
- Publications by reouted organizations such as WHO, NEERI, MERI, MPCB, CWPRS, etc.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Apply the water treatment concept and methods.
CO2: Prepare basic process designs of water and wastewater treatment plants.
CO3: Apply the wastewater treatment concept and methods.
CO4: Apply the solid waste management concepts.

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BTCVC 403 Structural Mechanics– I

Teaching Scheme: (2 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Beam Deflections **(Lectures 06)**

Calculations of deflection for determinate beams by double integration, Macaulay's method, moment area method, conjugate beam method, deflection by method of superposition

Module 2: Energy Principles **(Lectures 06)**

Strain energy and strain energy density, strain energy in traction, shear, flexure and torsion - Castiglano's and Engessor's energy theorems, principle of virtual work, application of energy theorems for computing deflections in beams, Maxwell's reciprocal theorem, Williot Mohr diagrams

Module 3: Method of Consistent Deformation **(Lectures 08)**

Different structural systems, concept of analysis, basic assumptions, indeterminacy, choice of unknowns, Castiglano's theorem **Indeterminate Beams:** Analysis of indeterminate beams: Propped cantilever and fixed beams - fixed end moments and reactions for standard cases of loading – slopes and deflections in fixed beams

Module 4: Moment Distribution Method **(Lectures 08)**

Analysis of continuous beams propped cantilevers, continuous beams - theorem of three moments - analysis of continuous beams settlement effects, thermal effect, Shear Force and Bending Moment diagrams for continuous beams, portal frames with and without sway

Module 5: Slope Deflection Method **(Lectures 08)**

Analysis of continuous beams, analysis of rigid frames, frames without sway and with sway, settlement effects, introduction to difficulties in frames with sloping legs and gabled frames

Text Books

- Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill,3rd edition 2010
- Wang C.K., "Statically Indeterminate Structures", McGraw Hill
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. I", ISBN NO:978-81-7409-140-8
- Khurmi R.S., "Theory of Structures", S Chand, Delhi
- Punmia B.C., "Structural Analysis", Laxmi Publications

Reference Books

- Timoshenko and Young, "Theory of structures", McGraw Hill
- Norris C. H. and Wilbur J. B., "Elementary Structural Analysis", McGraw Hill
- Kinney J. S., "Indeterminate Structural Analysis", Oxford and IBH
- Hibbler R. C., "Structural Analysis", Pearson Publications, 9th Edition
- Schodek, "Structures", Pearson Education, 7th edition
- Ramamrutham S. and Narayanan R., "Theory of Structures" Dhanpat Rai Publishers, Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Describe the concept of structural analysis, degree of indeterminacy.
CO2: Calculate slopes and deflection at various locations for different types of beams.
CO3: Identify determinate and indeterminate trusses and calculate forces in the members of trusses
Perform the distribution of the moments the in continuous beam and frame

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BTCVC404 Water Resources Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**

Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, methods of distribution of water, development of irrigation in India

Water Requirement of Crops

Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

Module 2: Reservoirs **(6 Lecturers)**

Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Module 3 Dams and Hydraulic structures **(8 Lectures)**

Difference between weir, barrage and dam, Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam, Introduction and types of Spillway.

Module 3: Weirs and Canals **(8 Lectures)**

Weirs on Permeable Foundations: Theories of Seepage, Bligh's Creep Theory, Limitations of Bligh's Creep Theory, Khosla's Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy's and Lacey's Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

Module 4: Hydrology **(6 Lectures)**

Introduction to hydrology: hydrologic cycle, rain, surface and ground water
measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

Module 5:

Lift Irrigation **(8 Lectures)**

Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy's law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).

Water logging and drainage

Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara.

Text Books

1. Varshney R. S., Gupta & Gupta, 1987, “Theory and Design of Irrigation Structures”, Vol. I & II
2. Punamia B. C. Pandey B. B. and Lal, 1992, “Irrigation and Water Power Engineering”, Standard Publishers, New Delhi
3. Garg S. K., 1976, “Irrigation Engineering & Hydraulic Structures”,Khanna Publishers, N. Delhi,
4. Priyani, 1982, “Irrigation and Water Power”, Charotar Publishing House, Anand
5. Bharat Singh,1979, “Irrigation”, Nemchand Brothers, Roorkee
6. Subramanya K., 1984, “Engineering Hydrology”, Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

1. USBR, “Design of Small Dam", OXFORD & IBH, Publishing Company
2. Justinn, 1961, “Engineering for Dam” Vol. I, II, III, Creager and Hinds
3. Leliavsky, “Design of Hydraulic Structures” Vol. I & II,
4. C B I & P “River Behaviour, Management and Training”
5. Circular of Government of Maharashtra, 18 February 1995, “Design of Canals”

Course Outcomes: On completion of the course, the students will be able to:
CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.
CO2: Understand various irrigation structures and schemes. CO3: Develop basis for design of irrigation schemes.

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BTCVC405 Hydraulics-II

Teaching Scheme: (2 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Uniform Flow in Open Channel **(Lectures 06)**
Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot lube, current meter) weir & spillway: sharp, broad & round crested weirs, calibration of weir, time of emptying tank with weir, profile of ogee spillway, flow below gates

Module 2: Steady & Uniform Flow **(Lecture 06)**
Chezy's& Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section- considerations for rectangular, triangular, trapezoidal, circular sections
Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow, specific force, specific discharge derivation of relationships and numerical computations

Module 3: Varied Flow & Impact of Jet **(Lectures 10)**
Gradually (G.V.F.): Definition, classification of channel Slopes, dynamic equation of G.V.F. (Assumption and derivation), classification of G.V.F. profiles-examples, direct step method of computation of G.V.F. profiles
Rapidly varied flow (R.V.F.): Definition, examples, hydraulic jump- phenomenon, relation of conjugate depths, parameters, uses, types of hydraulic jump
Impact of Jet: Impulse momentum principle, impact of jet on Vanes-flat, curved (stationary and moving), inlet & outlet velocity triangles under various conditions, Series of flat, curved vanes mounted on wheel

Module 4: Turbines **(Lectures 08)**
Turbines: Importance of hydro-power, classification of turbines, description, typical dimensions and working principle of Pelton, Francis & Kaplan turbine (detailed design need not to be dealt with), Module quantities, specific speed, performance characteristics, selection of type of turbine, description & function of draft tube, Thomas's cavitation number

Module 5: Pumps **(Lectures 06)**
Pumps: Classification, component parts, working of centrifugal pump, performance characteristics, pump selection, common troubles & remedies, introduction to different types of pumps: reciprocating, multi-stage, jet, air lift, submersible pump

Text Books

- Modi, Seth, “Fluid Mechanics – Hydraulic & Hydraulic Mechanics” Standard Book House
- Bansal R.K., “Fluid Mechanics”, Laxmi Publications, 9th edition 2017
- Garde R. J., “Fluid Mechanics through Problems”, New Age Publications, 3rd edition 2011
- Jain A. K., “Fluid Mechanics”, Khanna Publications, 8th edition, 2003, Delhi
- Kumar K. L., “Fluid Mechanics”, Eurasia Publication House, 11th edition, Delhi
- Rangaraju, “Open Channel flow”, Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., “Fluid Mechanics through Problems” Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., “Flow in Open Channel”, Edition V, Tata McGraw-Hill Pub. Co., Delhi

Reference Books

- Streeter, "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Shames, "Mechanics of Fluids", McGraw Hill, 4th edition
- Chaw V. T., "Flow in Open Channel", McGraw-Hill International Book Co., Auckland
- Hughes & Brighton, "Fluid Mechanics", Tata McGraw Hill

Course Outcomes: On completion of the course, the students will

CO1: Design open channel sections in a most economical way.
CO2: Know about the non-uniform flows in open channel and the characteristics of hydraulic jump.
CO3: Understand application of momentum principle of impact of jets on plane

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BTCVC406 Engineering Geology

Teaching Scheme: 3 hours/week

Course Contents

Module 1: Introduction and Physical Geology **(Lectures 06)**

Definition, Scope and subdivisions, applications of Geology in Civil Engineering, Major features of the Earth's structure, internal structure of earth, and Geological work of river: features of erosion, deposition and transportation, Civil Engineering Significance, Geological work of wind: Processes and features of erosion, deposition and transportation, Civil Engineering Significance. Volcano: Central and Fissure types, Products of volcano, Mountain: Origin and formation, types, examples.

Module 2: Mineralogy and Petrology **(Lectures 06)**

Mineralogy: Physical properties of mineral, Classification of minerals, Petrology: Definition, rock cycle, Igneous rocks: origin, textures and structures, classification, concordant and dis-concordant intrusions, civil engineering significance, Secondary rocks: formation, classification, residual deposits: soil, laterite and bauxite and their importance, Sedimentary deposits: formation, textures, classification and structures, civil engineering significance, chemical and organic deposits, Metamorphic rocks: agents and types of metamorphism, stress and anti-stress minerals, structures, products of metamorphism.

Module 3: Structural Geology, Building Stones and Ground Water **(Lectures 08)**

Outcrop, Strike and Dip, Unconformity-Types, Outliers and Inliers, Overlap Fold and Fault: Parameters, Classification, Causes, Civil Engineering significance Joint: Types, Civil engineering considerations.
Building Stones - Properties of rocks, Requirement of good building stone, various building stones in India.
Groundwater: Sources of groundwater, water table, zones of groundwater, porosity and permeability.

Module 4: Preliminary Geological Investigations **(Lectures 08)**

Preliminary geological survey, steps in geological investigations, consideration of structural features. Exploratory drilling: observations, preservation of cores, core logging, core recovery, graphical representation of core log, limitation of exploratory drilling method.

Module 5: Geology of Dams, Reservoirs, Tunnels and Bridges **(Lectures 08)**

Dam, types of dams, Influence of geological conditions on location, alignment, design and types of a dam, geological considerations in site selection for dams, Site improvement techniques, dams on carbonate rocks, sedimentary rocks, folded strata and Deccan traps, favorable and unfavorable geological conditions for a reservoir site**.** Tunneling:- Types of tunnels, influence of geological conditions on tunneling, difficulties during tunneling, tunnel lining, tunneling in folded strata, sedimentary rocks and Deccan traps. Bridges:- Types of bridges, dependence of types of bridges on geological conditions.

Text Books

- Singh Prabin, 2009, "Engineering and General Geology", S. K. Katariya and sons, Delhi
- Mukerjee P. K., 2013, "A Text Book of Geology", World Press Pvt. Ltd., Calcutta
- Gokhale K.V.G.K. and Rao D. M., 1982, "Experiments in Engineering Geology", TMN, New-Delhi
- Gupte R. B., "A Text Book of Engineering Geology", Pune Vidyarthi Griha Prakashan, Pune
- Subinoy Gangopadhyay, 2013, "Engineering Geology ",oxford university

Reference Books

- G. W. Tyrrell, 1926, "Principles of Petrology", B. I. Publication Pvt. Ltd., New Delhi
- A. Holmes, 1944, "Principles of Physical Geology", ELBS Chapman & Hall, London
- Billings M. P., 1942, "Structural Geology", Prentice Hall of India Private Ltd., New Delhi
- Legget R. F., 1983"Geology Hand book in Civil Engineering", McGraw-Hill, New York
- Krynine D. P. & Judd W. R., 2005, "Principles of Engineering Geology & Geo-technics", CBS Publishers &Distri., New Delhi
- Reddy Dr. D. V., 2017, "Engineering Geology for Civil Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
- Read H. H., 1962, "Rultey's Elements of Mineralogy", CBS Publishers & Distributors, Delhi

List of Assignments

It consists of study of relevant rock and mineral samples. Detailed report is expected.

- Megascopic study of Rock forming minerals
- Megascopic study of Ore forming minerals
- Megascopic study of Igneous rocks
- Megascopic study of Secondary rocks

- Megascopic study of Metamorphic rocks
- Cross-section Preparation and interpretation of geological maps
- Study of Structural Geological models
- Preparation of bore log /lithologs
- Interpretation of bore- hole data

Study Visit to the places of Engineering Geological importance.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Recognize the different land forms which are formed by various geological agents.
CO2: Identify the origin, texture and structure of various rocks and physical properties of mineral.
CO3: Emphasize distinct geological structures which have influence on the civil engineering structure.
CO4: Understand how the various geological conditions affect the design parameters of structures.

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BTCVL407 Building Planning and CAD Lab

Practical: 2 hours / week

Term work shall consist of detailed report of in form of set of drawings mentioned below. In practice sessions, free-hand sketching in drawing book shall be insisted.

1) Imperial size sheets based on actual measurement of existing residential building consisting of plan, elevation, section passing through staircase, Site plan. Area statement & brief specifications.
2) Planning & design of a building (Minimum G+1): Full set of drawings for:
    1) Municipal Submission drawing as per local statutory body bye-laws such as Town Planning, Municipal Council or Corporation Authorities.
    2) Foundation / Center Line Drawing.
    3) Furniture layout plan.
    4) Electrification plan.
    5) Water supply & drainage plan.
    6) Project report giving details of Drainage System, Water Supply System, Water Tank, Septic Tank Design of terrace Drainage System.
    7) Rain water harvesting systems
3) Setting out of planned building actually on ground using conventional or modern surveying instruments

It is desirable to use drawings produced in this submission for carrying out structural design under BTCVL708 and / orBTCVL806 in next semesters. If this is implemented, student shall get extra 10% weightage limited to maximum limit.

Course Outcomes: On completion of the course, the students will be able to:

Draw plan, elevation and section of load bearing and framed structures.

Draw plan, elevation and section of public structures.

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BTCVL 408 Environmental Engineering Laboratory

Practical: 2 hours / Week

Practical Work consists of performance of at least six experiments from the List (A) below:

(A) Determination of:

1) pH and Alkalinity
2) Hardness
3) Chlorides
4) Chlorine demand and residual chlorine
5) Turbidity and optimum dose of alum
6) MPN
7) Sulphates
8) Fluorides and Iron
9) Total Solids, Dissolved Solids & Suspended Solids
10) Sludge Volume Index (SVI)
11) Dissolved Oxygen
12) BOD and COD

B) Site Visit to Water Treatment Plant:

A report based on the visit to water treatment plant shall be submitted.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Quantify the pollutant concentration in water, wastewater and ambient air.
CO2: Recommend the degree of treatment required for the water and wastewater.
CO3: Analyze the survival conditions for the microorganism and its growth rate.

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BTCVL 409 Hydraulic Engineering Laboratory - II

Practical: 2 hours / week

Practical Work consists of at least three performances from groups listed below and detailed reporting in form of journal. Practical examination shall be based on above.

Group (A)

1) Calibration of V notch / Rectangular notch.
2) Calibration of Ogee Weir.
3) Study of hydraulic jump
    a) Verification of sequent depths,
    b) Determination of loss in jump.
    c) Study of parameters with respect to Fraud Number: i) Y2/Y1; ii) Length; iii) Energy loss
4) Study of flow below gates – Discharge v/s head relation, Equation of flow, Determination of contraction in fluid in downstream of gate.
5) Velocity distribution in open channel in transverse direction of flow.

Group (B)

1) Impact of jet.
2) Study of Turbines (Demonstration).
3) Tests on Centrifugal Pump.
4) Study of Charts for Selection of Pumps

Use of computer programs such as MS Excel is desirable for post-processing of results.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand various properties of fluids and measurement techniques.
CO2: Carry out calibrations of various flow measuring devices.
CO3: Understand mechanism of hydraulic jump, various jets and pumps.

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BTCVP410 Field Training/Internship/Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester IV and appear at examination in Semester V.

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Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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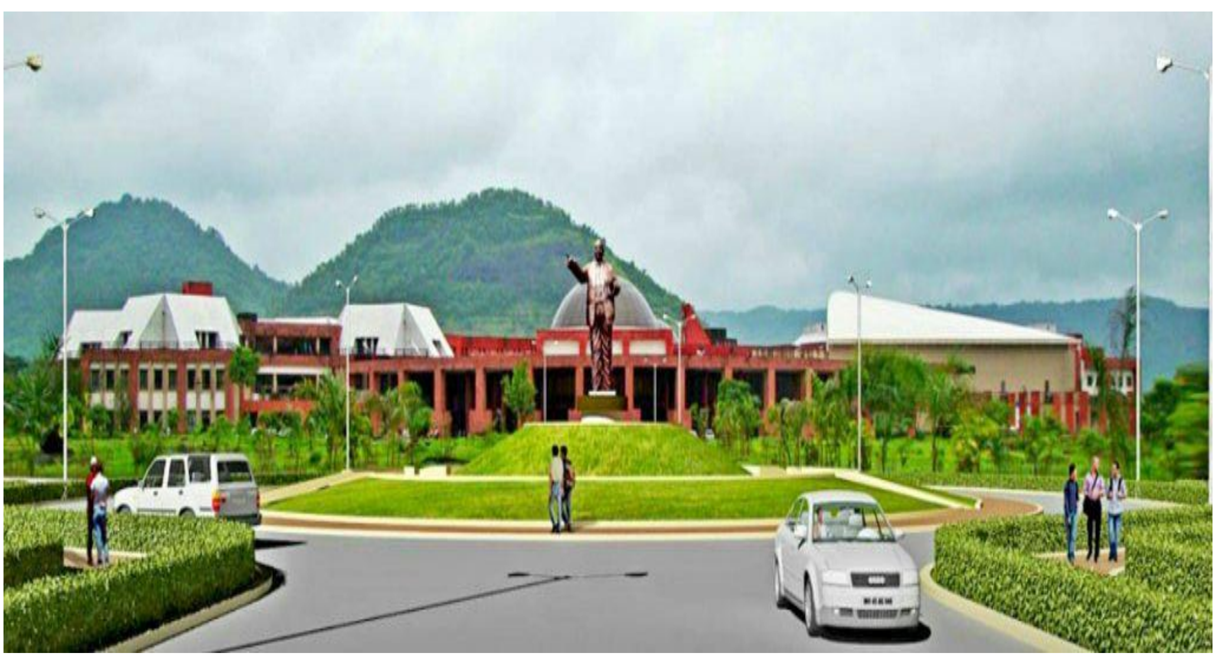
Draft Copy of Curriculum for Undergraduate Degree Programme

B. Tech. in Civil Engineering

Third Year

With effect from AY 2022-2023



Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- V										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 10	BTCVC501	Design of Steel Structures	2	1	-	20	20	60	100	3
PCC 11	BTCVC502	Geotechnical Engineering	3	1	-	20	20	60	100	4
PCC 12	BTCVC503	Structural Mechanics –II	2	1	-	20	20	60	100	3
PCC 13	BTCVC504	Concrete Technology	2	-	-	20	20	60	100	2
HSSMC3	BTHM505	Project Management	3	-	-	20	20	60	100	3
PEC 1	BTCVPE506	A. Advanced Environmental Engg. B. Applied Geology C. Hydraulic Engineering Design D. Advanced Water Resources E. Geomatics F. Town and Urban Planning G. Material, Testing and Evaluation H. Construction Economics & Finance	3	-	-	20	20	60	100	3
ESC10	BTCVES507	Software applications in Civil Engineering	2	-	-	50	-	-	50	Audit
LC 7	BTCVL508	SDD of Steel Structures Lab.	-	-	2	20	-	30	50	1
LC 8	BTCVL509	Geotechnical Engineering Lab.	-	-	2	20	-	30	50	1
LC 9	BTCVL510	Concrete Technology Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**17**	**3**	**6**	**230**	**120**	**450**	**800**	**21**

Semester- VI										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 14	BTCVC601	Design of RC Structures	3	1	-	20	20	60	100	4
PCC 15	BTCVC602	Foundation Engineering	3	1	-	20	20	60	100	4
PCC 16	BTCVC603	Transportation Engineering	3	-	-	20	20	60	100	3
PEC 2	BTCVPE604	A. Industrial Waste Treatment B. Managerial Techniques C. Open Channel Flow D. Water Power Engineering E. Ground Improvement Techniques F. Structural Audit G. Intelligent Transportation Systems H. Plastic Analysis of Structures I. Numerical Methods in Civil Engg. J. Engineering Management	3	-	-	20	20	60	100	3
OEC 1	BTCVOE605	A. Environmental Impact Assessment B. Basic Human Rights C. Business Communication and Presentation Skills D. Composite Materials E. Experimental Stress Analysis F. Python Programming G. Operation Research H. Applications of Remote Sensing and Geographic Information Systems I. Civionics: Instrumentation & Sensor Technologies for Civil Engineering J. Planning for Sustainable Development K. Development Engineering	3	-	-	20	20	60	100	3
HSSMC4	BTHM606	Indian Constitution	2	-	-	50	-	-	50	Audit
LC 10	BTCVL607	SDD of RC Structures Lab.	-	-	2	20	-	30	50	1
LC 11	BTCVL608	Transportation Engineering Lab	-	-	2	20	-	30	50	1
Project	BTCVM609	Mini Project	-	-	2	20	-	30	50	1
Internship		**Mandatory (BTCVP610)** Field Training/ Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester VI and appear at examination in Semester VII.)	-	-	-	-	-	-	-	Credits to be evaluated in VII Sem
Total			**17**	**2**	**6**	**210**	**100**	**390**	**700**	**20**

Detailed Syllabus

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- V											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTCVC 501	Design of Steel Structures	2	1	-	20	20	60	100	3
PCC 11	BTCVC 502	Geotechnical Engineering	3	1	-	20	20	60	100	4
PCC 12	BTCVC 503	Structural Mechanics –II	2	1	-	20	20	60	100	3
PCC 13	BTCVC 504	Concrete Technology	2	-	-	20	20	60	100	2
HSSMC3	BTHM505	Project Management	3	-	-	20	20	60	100	3
PEC 1	BTCVPE506	A. Advanced Environmental Engg. B. Applied Geology C. Hydraulic Engineering Design D. Advanced Water Resources E. Geomatics F. Town and Urban Planning G. Material, Testing and Evaluation H. Construction Economics & Finance	3	-	-	20	20	60	100	3
ESC9	BTCVES507	Software applications in Civil Engineering	2	-	-	50	-	-	50	Audit
LC 7	BTCVL508	SDD of Steel Structures Lab.	-	-	2	20	-	30	50	1
LC 8	BTCVL509	Geotechnical Engineering Lab.	-	-	2	20	-	30	50	1
LC 9	BTCVL510	Concrete Technology Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**17**	**3**	**6**	**230**	**120**	**450**	**800**	**21**

BTCVC 501 Design of Steel Structures

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction and Connections **(6 Lectures)**

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 2: Axially Loaded Members, and Flexure Members **(8 Lectures)**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Beams: Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections.

Module 3: Industrial Roofing **(8 Lectures)**

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details
Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Module 4: Columns and Column Bases **(6 Lectures)**

Simple and built up section, lacing, battening, column subjected to axial force and bending moment, column splices.

Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt

Module 5: Introduction to Plastic Analysis and Limit State method **(8 Lectures)**

Introduction to: Plastic Analysis, Hinge Formation, Collapse Mechanism, Recent approaches in Steel Structure design based on Plastic Analysis Method and Limit State Approach, Introduction to Provisions in IS 800-2007

Note: Contents in Module 1 to part of 4 shall be taught with help of relevant text or reference books based on elastic design concept and IS 800: 1984. Module 5 shall be taught with reference to IS 800 2007
Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

- Duggal S. K., "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Gambhir, "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Negi L. S., "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Chandra Ram, "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
- Dayaratnam P., "Design of Steel Structures", Wheeler Publishing, New Delhi
- Subramanian N., "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
- Vazirani V.N. and Ratwani M.M., "Design and Analysis of Steel Structures", ISBN NO: 978-81-7409-295-3
- Sai Ram K. S., "Design of Steel Structures", Pearson Education, 2nd Edition

Reference Books

- Arya A. S. and Ajamani J.L., "Design of Steel Structures", Nemchand and Brothers, Roorkee
- Vazirani&Ratwani, "Design of Steel Structures", Standard Book House, New Delhi
- Duggal S. K., "Limit State Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
- Gaylord E.H. and Gaylord C.N., "Design of Steel Structures" McGraw Hill, New York
- Lothers J.E., "Design in Structural Steel" Vol.-I, Prentice Hall New Jersy
- Salmon and Johnson, "Steel Structures: Design and Behaviour", Harper and Row, New York
- Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.
CO4: Understand provisions in relevant BIS Codes.

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BTCVC502 Geotechnical Engineering

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

Definition of soil and soil engineering, Application areas of soil mechanics, Three Phase system, Soil moisture, Soil minerals Soil structure, Terzaghi's effective stress concept, Effective and neutral pressure

Module 2: Soil Consistency **(10 Lectures)**

Index properties of soil: Different unit weights of soil, and their determination, unit weight of solids, unit weights of soil mass, method for determination of field density viz. sand replacement and core cutter, Specific Gravity determination methods void ratio and porosity, degree of saturation, Inter relation between weight volume state, density indexes, Atterberg's limits and their significance,Soil Classification: Soil classification based on particle size and consistency, I.S. classification system

Module 3: Flow of Water Through Soil: Permeability **(10 Lectures)**

Head, gradient and potential, Darcy's law, Factors affecting permeability, Field and Laboratory methods of determining permeability, Seepage pressure, quick sand condition, Derivation of Laplace equation, Flow net: characteristics& application, construction of flow net, piping phenomenon, Permeability through stratified soil, Discharge and seepage velocity.

Module 4: Shear Strength **(10 Lectures)**

Concept of shear, Coulomb's theory and failure envelope, Principle stress, stress analysis (Total stress approach and effective stress approach), representation of stresses on Mohr's circle for different types of soil such as cohesive and cohesionless, saturated and partly saturated soil etc, Application of shear stress parameters in the field, Different types of shear tests: Unconsolidated undrained, Consolidated undrained and consolidated drained choice of the type of test, box shear test, triaxial compression test with pore pressure and volume change measurement, Unconfined compression test, vane shear test

Module 5: Compressibility of Soils **(10 Lectures)**

CompactionTheory of compaction, factors influencing compaction, compacted density, Laboratory Standard and modified compaction test, Method and measurement of field compaction, Field compaction control Consolidation Compressibility: Definition, compressibility of laterally confined soil, compression of sand and clay, e-p and e-log p curve, compression index. Consolidation: Terzaghi's theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation, degree of consolidation, relevance of one dimensional consolidation to field condition, time factor

Earth Pressure Theories: Earth pressure at rest, active and passive conditions, Elementary idea about Rankin's and Coulomb's earth pressure.
Graphical methods for active earth pressure.

Text Books:

- Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune
- Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi
- Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
- Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
- Gopal R Rao "Basic Soil Mechanics "

Reference Books:

- Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
- Taylor D.W., "Fundamentals of Soil mechanics"
- Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York
- Scott R. F., "Principal of soil mechanics"
- Lambe T.W, "Soil Testing" by Willey Eastern Ltd., New Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand different soil properties and behavior

CO2: Understand stresses in soil and permeability and seepage aspects.

CO3: Develop ability to take up soil design of various foundations

BTCVC503 Structural Mechanics -II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Application of all methods shall be restricted to beams, Frames and /or pin jointed frames or trusses of Degree of Indeterminacy up to three.

Module 1: Analysis of trusses **(6 Lectures)**

Analysis of determinate and indeterminate pin jointed trusses by energy method, effects of settlement and pre-strains
.

Moving Loads and Influence Lines

Introduction to moving loads, concept of equivalent UDL, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending and deflection of determinate beams, influence line diagram (ILD) for forces in determinate frames and trusses, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, application of Muller Breslau principle for determinate structures to construct ILD.

Module 2: Cables, Suspension Bridges and Arches **(8 Lectures)**

Analysis of forces in cables, suspension bridges with three hinged and two hinged stiffening girders, theory of arches, Eddy's theorem, circular , parabolic and geometric arches, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches, effect of yielding of supports, rib shortening and temperature changes. ILD for 3 hinged arches and suspension bridges

Module 3: Analysis of Indeterminate Structures by direct Flexibility Method **(8 Lectures)**

Fundamental concepts of flexibility method of analysis, flexibility coefficients and their use in formulation of compatibility equations, application of above methods to propped cantilevers, fixed beams, continuous beams,simple pin jointed frames including effect of lack of members, rigid jointed frames.

Module 4: Analysis of Indeterminate Structures by direct Stiffness Method **(8 Lectures)**

Fundamental concepts of stiffness method of analysis, stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports, pin jointed frames.

Module 5: Finite Element Method (Contents to conceptual level) **(6 Lectures)**
Introduction to analysis by discretization such as finite difference method, Finite element method: types of elements-1D, 2D, 3D, Plane Strain and Plane Stress Problem, isoperimetric and axisymmetric, convergence criteria, Pascal's triangle, direct stiffness method, principle of minimum potential energy. Shape functions, concept of local and global stiffness matrix

Text Books

- Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill
- Pandit G. S. and Gupta S. P., "Structural Analysis - a Matrix Approach", Tata McGraw Hill, N.Delhi, 1986
- Chandrupatla T. R., Belegundu A. D., "Introduction to Finite Elements in Engineering, Prentice Hall, N. Delhi, 1996
- Thadani B. N. and Desai J. P., "Structural Analysis"
- Punmia B.C., "Structural Analysis", Laxmi Publications
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. II" Khanna Publishers, N. Dehli, Sadhu Singh, "Theory and Solved Problems in Adv. Strength of Materials", Khanna Publishers, N. Dehli,
- Ramamrutham S. and Narayanan R., "Theory of Structures" DhanpatRai Publishers, Delhi

Reference Books

- Norris C. H. and Wilbur J. B., "Elementary Structural Analysis", McGraw Hill
- Beaufait, F. W., "Basic Concepts of Structural Analysis", Prentice Hall, N.J. Kinney J. S., "Indeterminate Structural Analysis", Oxford and IBH
- Krishnamurthy, C.S., "Finite Element Analysis – Theory and Programing", Tata McGraw Hill, N. Delhi 1994
- Hibbler R. C., "Structural Analysis", Pearson Publications
- Kanchi M. B., "Matrix Methods of Structural Analysis", Wiley Eastern Ltd., N. Delhi
- Wang C. K., "Matrix Methods of Structural Analysis", International Text-book, Scranton, Pennsylvania, 1970
- Gere J.M., Weaver W., "Analysis of Framed Structures", D. Van Nostrand Company, Inc., Princeton, N. Jersey

Course Outcomes: On completion of the course, the students will be able to:

CO1: Have a basic understanding of matrix method of analysis and will be able to analyze the determinant structure.

CO2: Have a basic understanding of the principles and concepts related to finite difference and finite element methods

CO3: Have a basic understanding of concept of influence line

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BTCVC504 Concrete Technology

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1 **(4 Lectures)**

Materials for Concrete: Cement, Manufacturing Process, Physical Properties, Hydration of Cement, hydration products, Chemical Compounds in Cement, Types of Cement, Aggregates: Classification of aggregates, Physical Properties, Bulking of Sand, Mechanical Properties, Water: Specifications of Water to be used For Concrete

Module 2 **(4 Lectures)**

Properties of Fresh Concrete -Types of Batching, Mixing, Transportation, Placing Including Pumping and Compaction Techniques for Good Quality Concrete, Workability, Factors affecting workability, Methods of Measuring Workability, Segregation and Bleeding, setting time, Curing of Concrete, Types of curing, Temperature Effects on Fresh Concrete

Module 3 **(4 Lectures)**

Admixtures In Concrete: Types, Plasticizers and Super-plasticizers and their Effects On Workability, Air Entraining Agents, Accelerators, Retarders, Pozzolanic Admixtures, Green concrete, Bonding Admixtures, Damp-Proofing Admixtures, Construction Chemicals

Module 4 **(8 Lectures)**

Desired Properties of Concrete, Strength, Durability &Im-permeability, Characteristic Strength, Compressive, Tensile and Flexure of Concrete, Bond Strength, Tests on Concrete, Modulus of Elasticity, Effect of W/C Ratio and admixtures on Strength, Types of concrete, High Strength and High Performance Concrete Creep and Shrinkage of Concrete, Significance, Types of Shrinkage and Their Control,

Factors Affecting Creep. Durability of Concrete: Minimum & Maximum Cement Content, Strength & Durability Relationship, Exposure to Different Conditions, Factors Contributing to Cracks in Concrete, Sulphate Attack, Alkali Aggregate Reaction (AAR), factors affecting on AAR, Deteriorating effects of AAR, Chloride Attack, Corrosion of Steel (Chloride Induced)

Module 5 **(4 Lectures)**

Concrete Mix Design, Nominal Mix Concrete, Factors Governing Mix Design, Methods of Expressing Proportions, Trial Mixes, Acceptance Criteria, Factors Causing Variations, Field Control, Statistical Quality Control, Quality Measurement in Concrete Construction, Non-destructive Testing of Concrete

Text Books

- Gambhir M. L. “Concrete Technology”, Tata Mc-Graw Hill 2015 15th edition
- Shetty M. S. “Concrete Technology”, S. Chand 2005.
- Krishnaswamy, “Concrete Technology”, DhanapatRai and Sons

Reference Books

- Orchard, “Concrete Technology”, Applied Science Publishers
- Neville A. M., “Concrete Technology”, Pearson Education
- Neville A. M., “Properties of Concrete”, Pearson Education
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS:10262(2009), IS:456 (2009), IS 4926 (2003)

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand the various types and properties of ingredients of concrete.
CO2: Understand effect of admixtures on the behavior of the fresh and hardened concrete.
CO3: Formulate concrete design mix for various grades of concrete.

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BTHM505 Project Management

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Introduction, Steps in Project Management, fundamentals of material, machinery and manpower management in Project, Bar Chart, Mile stone chart, Development of network, Fulkerson's Rule, Introduction to CPM, Time estimates, floats, critical path

Module 2: **(6 Lectures)**

Network Compression, Least Cost and Optimum Duration, Resource Allocation, Updating Calculations for Updated Network

Module 3: **(8 Lectures)**

Introduction to PERT, concept of probability, normal and beta distribution, central limit theorem, time estimates, critical path, slack, probability of project completion

Module 4: **(8 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation, cash – flow diagram, economic comparisons – discontinuing methods, non-discontinuing criteria

Module 5: **(6 Lectures)**

Linear break even analysis – problems, quality control – concept, statistical methods – control charts

Total quality management– philosophy of Juran, Deming, importance, Quality Circle implementation, introduction to ISO 9000 series and 14000 series, Introduction to Computer Aided Project Management

Text Books

- Roy Pilcher, "Project Cost Control in Construction",Sheridon House Inc.(Feb1988)
- Gupta R.C. "Statistical Quality Control", khanna publishers 9th edition
- Layland Blank and Torquin, "Engineering Economics",Mc-Graw-Hill Edition
- Naik B. M. "Project Management",Stosius Inc./Advent Book division
- Khanna O.P., "Work Study",Dhanpatrai publication
- Srinath L. S. "CPM PERT", Affiliated East-West Press (Pvt) ltd

Reference Books

- Antill and Woodhead, "C.P.M. in Construction Practice", Wiley-Interscience 4th edition 1990
- Taylor. G.A., "Management and Engineering Economics", Mc-Graw Hill 4th edition
- Roy Pilcher, "Principles of Construction Management" Mc-Graw Hill Higher Education 2rd revision

Course Outcomes: On completion of the course, the students will be able to: Understand various steps in project Management, different types of charts.Construct network by using CPM and PERT method.
Determine the optimum duration of project with the help of various time estimates.
Know the concept of engineering economics, economic comparisons, and linear break even analysis problems.
Understand the concept of total quality Management including Juran and Deming's philosophy.

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BTCVPE506 A. Advanced Environmental Engineering

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module 1: Low cost wastewater treatment methods **(8 Lectures)**
Principles of waste stabilization pond, Design and operation of oxidation pond, aerobic & anaerobic Lagoons, Aerated Lagoon, Oxidation ditch, Septic tank. Concept of recycling of sewage Disposal of waste water-stream pollution, Self Purification, DO sag curve, Streeter Phelp's Equation, Stream classification, disposal on land, effluents standards for stream and land disposals

Module 2: Industrial Waste Water Treatment Management **(8 Lectures)**

Sources of Pollution: Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters –Effects of industrial effluents on sewers and treatment plants, Prevention vs Control of Industrial Pollution
Pre and Primary Treatment: Equalization, Proportioning, Neutralization, Oil Separation by Floatation, Prevention v/s Control of Industrial Pollution

Module 3: Waste Water Treatment Methods **(8 Lectures)**
Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process–Reverse osmosis– Chemical Oxidation–Ion Exchange – Air Stripping and Absorption Processes – Special Treatment Methods – Disposal of Treated Waste
Common Effluent Treatment Plants (CETPs): Need, Planning, Design, Operation & Maintenance Problems

Module 4: Environmental Sanitation **(6 Lectures)**
Communicable diseases, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control
Module 4: Insects and Rodent Control **(6 Lectures)**
Mosquitoes, life cycles, factors of diseases control methods - natural &chemical, Fly control methods and fly breeding prevention, Rodents and public health, plague control methods, engineering and bio-control methods in Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems, Rural sanitation improvement schemes.

Text Books

- Masters G.M. (2008) "Introduction to Environmental Engineering and Science"Prentice-Hall of India Pvt. Ltd., N. Delhi
- Metcalf & Eddy (1982) "Waste Water Engineering Treatment & Disposal", Tata McGraw Hill, New Delhi
- Garg S. K. (1979) "Sewage Disposal and Air Pollution Engineering", Khanna Publishers,New Delhi
- Rao M.N.& Datta A. K. (2018)"Waste water treatment", Oxford & Ibh Publishing Co Pvt Ltd, New Delhi

Reference Books

- Peavey H. S., Rowe D.R. (2017) "Environmental Engineering", McGraw-Hill Book Co., New Delhi
- Viessman W. and Hammer M. J. (2008) "Water Supply and Pollution Control",Pearson Publications, N. Delhi
- Hammer M. J. (2012) "Water and Waste water Technology", Prentice-Hall of India Private Limited,New Delhi
- Canter L. W. (1995) "Environmental Impact Assessment", Tata McGraw Hill Publication,New Delhi

Course Outcomes: On completion of the course, the students will be able to:

1. Determine the sewage characteristics and design various sewage treatment plants.
2. Understand municipal water and wastewater treatment system design and operation.
3. Apply environmental treatment technologies and design processes for treatment of industrial waste water.
4. Understand the rural sanitation schemes.

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BTCVPE 506B Applied Geology

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Stratigraphy and Indian geology **(6 Lectures)**

geological time scale, physiographic divisions of India and their geological, geomorphologic and tectonic characteristics, study of important geological formations of India namely: Vindhyan, Gondwana, and Deccan traps with respect to: distribution, lithology, tectonics, economic importance etc. significance of these studies in civil engineering

Module 2: Sub-surface exploration **(8 Lectures)**

Steps in geological studies of project site, engineering consideration of structural features, exploratory drilling, preservation of cores, core logging, graphical representation of core log, limitations of exploratory drilling method, numerical problems on core drilling, introduction to geological map

Sub-surface water: Runoff, fly off and percolation of surface water, juvenile, connate and meteoric water, water table, zones of subsurface water, perched water table, aquifer theory

Module 3: Engineering geology of Deccan traps **(8 Lectures)**

Types of basalts and associated volcanic rocks, engineering characteristics, infillings of gas cavities, compact and amygdaloidal basalt as construction material, effect of jointing, hydrothermal alteration and weathering on engineering behaviour, tail channel erosion problem in Deccan trap region, suitability for tunnelling, problems due to columnar basalt, dykes, red bole, tachylitic basalt, volcanic breccias and fractures, laterites: origin, occurrence and engineering aspects, ground water bearing capacity of rocks of Deccan trap region, percolation tanks

Module 4: Geology of soil formations **(6 Lectures)**

Soil genesis, geological classification of soils, residual and transported soils, soil components, characteristics of soils derived from different types of rocks, nature of alluvium and sand from rivers of Deccan trap region, scarcity of sand

Geophysics:

Various methods: magnetic, gravitational and electrical resistivity methods, applications of electrical resistivity method using Wenner configuration in civil engineering problems such as: finding thickness of over burden and depth of hard rock, locating the spot for ground water well, seepage of water finding,

Module 5: Rock mechanics: **(8 Lectures)**

General principles, engineering properties of rocks and their dependence upon geological characters, in- built stresses in rocks, measurements of these stresses

Plate tectonics, seismic zones of world, seismic activity of Deccan trap region, various theories on the origin of the seismic activity of Deccan trap region, prediction of earthquake, earthquake resistant constructions, numerical problems based on seismic data, cause and prediction and preventive measurement of landslide in Deccan trap region.

Text Books

- Gupte R. B., "A Text Book of Engineering Geology", Pune Vidyarthi Griha Prakashan, Pune.
- Gokhale K.V.G.K. and Rao D. M., "Experiments in Engineering Geology", TMN, New-Delhi.
- Mukerjee P. K., "A Text Book of Geology", The World Press Pvt. Ltd., Calcutta.
- Prabin Singh, "Engineering and General Geology", S. K. Katariya and sons, Delhi.

Reference Books

- Tyrrell G. W., "Principles of Petrology", B. I. Publication Pvt. Ltd., New Delhi.
- Holmes A., "Principles of Physical Geology", ELBS Chapman &Hall,London.
- Billings M. P., "Structural Geology", Prentice Hall of India Private Ltd., New Delhi.
- Farmer L. W., "Engineering Properties of Rocks", Champman& Hall, London.
- SathyaNarayanSwamiB. S., "Engineering Geology", DhanpatRai& Co.(P) Ltd, Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1 :Understand geological time scale and physiographic division of India and their geological and characteristics different geological formation in India.

CO2: Perform sub surface exploration and interpret core log.

CO3:Solve numerical problem based on core drilling and seismic data.

CO4 :Familiar with origin of earthquake, seismic wave and landslide in Deccan trap.

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BTCVPE 506C Hydraulic Engineering Design

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(6 Lectures)**

Design of Spillways and Energy Dissipation for Flood Control Storage and Conveyance Systems, major features of dams (e.g., type, design basis, spillway type), Analysis of Spillway flow, Design of stilling basis

Module 2: Hydraulic Processes: Pressurized Pipe Flow **(8 Lectures)**

Continuity and energy equations to pipe network, problems, Calculation of friction losses, DarcyWeisbach, Colebrook-White, Jain, Hazen-Williams, Manning's, loss coefficient tables to estimate local energy losses, analysis of pipe networks by interpreting energy and hydraulic grade lines

Module 3: Boundary Layer Theory **(8 Lectures)**

Concept, Boundary layer along thin plate- Characteristics, Laminar, Turbulent Boundary Layer, laminar sub layer, Various Thicknesses-Nominal, displacement, Momentum, Energy. Hydraulically smooth and Rough boundaries, Separation of Boundary layer, control of Separation, Introduction to Drag and Lift on submerged bodies (Flat plates, Sphere, Cylinder, aerofoil), Stokes law, Concept of Drag and Lift coefficients.

Module 4: **(8 Lectures)**

Impulse momentum principle, impact of jet on Vanes-flat, curved (stationary and moving), inlet & outlet velocity triangles under various conditions, Series of flat, curved vanes mounted on wheel.

Module 5: **(6 Lectures)**

Pump Performance, Analysis of pump performance with regards to pump location, multi-pump system performance in a specified hydraulic system

Text Books:

- Rajnikant M. Khatsuria "Hydraulics of Spillways and Energy Dissipators by"
- R.S.Varshney, S.C. Gupta, R.L. Gupta Theory and Design of Hydraulic Structures Vol. 1 and 2
- Bansal R.K., "Fluid Mechanics", Laxmi Publications, 9th edition 2017
- Garde R. J., "Fluid Mechanics through Problems", New Age Publications, 3rd edition 2011
- Jain A. K., "Fluid Mechanics", Khanna Publications, 8th edition, 2003, Delhi
- Subramanian K., "Fluid Mechanics through Problems" Tata McGraw-Hill Pub. Co., Delhi

Reference Books

- Streeter, "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Hughes & Brighton, "Fluid Mechanics", Tata McGraw Hill
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Course Outcomes:On completion of the course, the students will be able to:

CO1: Analyse spillway flow

CO2: Compute drag and lift coefficients using the theory of boundary layer flows.

CO3: Analyse Pump performance

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BTCVPE 506D Advanced Water Resources

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Hydrogeology **(8 Lectures)**

Porosity and Permeability of Rocks, Groundwater in Igneous, Metamorphic, Sedimentary Rocks and Non Industrated Sediments, Hydro-geological Regions of India, Surface and Subsurface Geophysical methods for Groundwater Explorations..

Module 2: Well Hydraulics **(8 Lectures)**

Aquifers and Aquifer Parameters, Darcy's law, Hydraulic Conductivity and its Characteristics, Dupuit Equation, Groundwater Flow Direction Steady Groundwater Flow, Groundwater Flow Equation, Estimation of Aquifer Parameters from Pumping Test Data, Graphical Techniques and their Limitations, Groundwater Well Losses, Interference among Wells, Potential Flow, Image well theory and its Application in Groundwater Flow.

Module 3: Water Well Design and Well Drilling **(8 Lectures)**

Water Well Design and Well Drilling: Well Screen, Development and Completion of Well, Rotary Drilling and Rotary Percussion Drilling, maintenance of Wells.

Module 4: Groundwater Management **(6 Lectures)**

Groundwater Management: Conjunctive Use, Alternative Basin Yields, Artificial Recharge of Groundwater, Groundwater Quality.
Groundwater Modelling: Groundwater Flow, mathematical, Analog and Digital modeling, Regional Groundwater Modelling.

Module 5: Ground Water Development **(6 Lectures)**

Introduction, Development of artificial recharging, Methods of artificial recharging, Suitability of artificial recharging methods.

Text Books:

- Walton, W.C.(1970) "Groundwater Resources Evaluation", McGraw Hill Inc, n York .
- Todd, D.K. (1995), "Groundwater Hydrology", John Wiley & Sons, Singapore
- Johnson, E.E. (1966),"Groundwater", E. Johnson Inc. Washington.
- Raghunath, H.M. (1992) "Groundwater", Wiley Eastern Ltd, N Delhi
- Sharma, H.D. and Chawla, A.S. (1977), "Manual on Groundwater and Tube Wells", Technical Report No. 18, CBIP, New Delhi,
- Davis, S.N. and De Weist, R.J.M. (1966), "Hydrogeology", John Wiley & Sons, N York.
- Garg, S.P. (1993) "Groundwater and Tube Wells", Oxford and IBH Publishing C. N Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Apply methods to recharge ground water

CO2: Ability to know about various surface and subsurface geophysical methods for groundwater explorations.

CO3: Ability to know about well hydraulics

CO4: Ability to know about design principles of well

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BTCVPE 506E Geomatics

Teaching Scheme: (3 Lectures) hours/week

Contents

Module 1: Tachometry **(8 Lectures)**

Significance and systems, principle, constants, basic formulae and field work stadia method, auto reduction tachometer, tangential system

Electronic Distance Measurement: Importance, principles of electronic distance measuring (EDM) instruments, classification of EDM's based on carrier waves used, study and use of total station

Module 2: Triangulation **(8 Lectures)**

Principle & classification, system, selection of station, base line measurement, correction and use of subtense bar, signals, satellite station, reduction to center, spherical excess, angular observations, tri-iteration

Triangulation Adjustments: Theory of errors, laws of weights, concept of most probable value

Module 3: Field Astronomy **(8 Lectures)**

Terms, co-ordinate systems, determination of latitude and true bearing by observation on the sun and pole star

Curves: Horizontal and vertical curves, simple curves, setting with chain and tapes, tangential angles by theodolite, double theodolite, compound and reverse curves, transition curves, functions and requirements, setting out by offsets and angles, vertical curves, sight distance requirements

Module 4: Photogrammetry **(6 Lectures)**

Terms, types, vertical photographs, scale, ground coordinates, relief displacement, flight planning photomaps and mosaics, stereoscopy and photo interpretation

Module 5: Introduction to Remote Sensing **(6 Lectures)**

Introduction, classification and principles, electromagnetic energy and its interaction with matter, idealized systems, sensors, platforms, and application in civil engineering, G.P.S & G.I.S. as surveying techniques – Overview, uses and applications

Text Books

- Bannister A., Raymond S., Wartikar J.N., Wartikar P.N.,1992 “Surveying", ELBS, 6th Editon,
- Heribert Kahmen and Wolfgang Faig,1995 “Surveying ", Walter de Gruyter,
- Kanetkar T.P., "Surveying and Leveling", Vols. I, II and III, Vidyarthi Gruh Prakashan, Pune
- Punmia B.C., “Surveying”, Vols. I , II and III, Laxmi Publications

Reference Books

- James M. Anderson and Edward M. Mikhail, “Introduction to Surveying”, McGraw Hill Book Company
- Clark D., “Plane and Geodetic Surveying", Vol. I and II, C.B.S. Publishers and Distributors, New Delhi, Sixth Edition
- Agor, “Advanced Surveying”, Khanna Publications, Delhi
- Arora K. L., “Surveying”, Vol.1 & 2
- Basak, “Surveying and Levelling”
- Duggal S. K., “Surveying”, Vol 1 & 2, Tata Mcgraw Hill Publications, New Delhi
- Gopi S., Satikumar R. and Madhu N., “Advanced Surveying”, Pearson Education
- Chandra A. M., “Higher Surveying”, New Age International Publication

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand basics different types of curves on roads and their preliminary survey.

CO2: Perform setting of curves, buildings, culverts and tunnels.

CO3: Comprehend different geodetic methods of survey such as triangulation, trigonometric leveling.

CO4: Comprehend modern advanced surveying techniques.

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BTCVPE 506 F Town and Urban Planning

Teaching Scheme: Lectures: 3 Hours / Week

Course Contents

Module 1: **(8 Lectures)**

Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

Module 2: **(8 Lectures)**

Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

Module 3: **(8 Lectures)**

Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

Module 4: **(6 Lectures)**

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module 5: **(6 Lectures)**

Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, GrowthCentre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books:

1. Hiraskar G.K. (2018) "Town and country Planning"DhanpatRai Publication, N. Delhi
2. Rangawala S.C. (2015) "Town Planning", Charotar Publications, Anand
3. Sundaram K.V. (1978) "Urban and Regional Planning in India", Vikash Publishing House P.L
4. MRTP Act 1966 & 2002
5. Land Acquisition Act - 1894
6. Misra S. N. (1984) "Rural Development Planning-Design and Method", Satvahan Publications, N. Delhi

Reference Books

1. Eisner S. and Gallion A. (1993) "The Urban Pattern", John Wiley & Sons, N. Delhi

Outcomes: Upon completion of the course the students will be able to:

1. Understand town and Urban planning and their essential attributes
2. Identify elements of planning and regulations of the same
3. Implement guidelines provided by standard authorities

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BTCVPE506 G. Materials, Testing &Evaluation

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module1: (8 Lectures)
Basic Properties of Materials: importance of materials in civil engineering construction, types of materials such as ceramics, concrete, composites, optical /electronics materials, glass, metals, nano-materials ,polymers and plastics, wood and other materials. some basic properties of materials such as temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion ,mechanical properties of metals ,stress, strain modulus of elasticity, ,stress-strain behavior, elastic and plastic deformations, elastic properties of materials, tensile properties, ductility, resilience and toughness ,compressive, shear and torsional deformation, hardness. Variability of material properties.

Module2: (8 Lectures)
Civil Engineering Materials: introduction to cement and concrete, uses of cement, strength of cement and concrete ,sand, coarse aggregates, mortar and grouts, masonry mortars, rendering, cementitious grouts, RCC, clay bricks ,calcium silicate bricks, concrete blocks., rubbles, steel , steel grades, mechanical properties of steel, different applications, floor and roofing tiles, slates, timber, strength of timber ,Engineered wood products, metals, glass for glazing, glass fibres, glass wool, bituminous materials, binder properties, binder mixtures, asphalt mixture.

Module3: (6 Lectures)
Composite Materials: RCC, FRC, steel/concrete composite bridge decks, fibre reinforced plastics structural insulated panels.
Comparison of Different Materials, Introduction, comparison of strengths of various materials, comparison for environmental impact, health and safety.

Module 4: (6 Lectures)
New Techniques in Constructions—Introduction,3D printing, photo catalytic admixture, self-healing concrete, zero cement concrete ,hemp lime, wood-glass epoxy composites, bamboo.

Module 5: (8 Lectures)
Material Testing ,Machines And Equipment Requirements---Necessity of material testing, various testing methods, destructive tests, classification of destructive tests---static, impact and cyclic testing,
non-destructive testing—its classification ,visual inspection, penetration test, magnetic detection, ultrasonic test, radiography test and spark test. Types of testing machines, UTM and CTM, force and displacement controlled machines, loading frames. Hardness testing machines, fracture tests.

Recommended Books:

- Deodhar S.V. (1990) Civil Engineering Materials' Allied Publishers, N. Delhi.
- RangwalaS.C. (1983)Civil Engineering Materials', DhanpatRai and Sons, N. Delhi.

References:

- B.I.S., 1980, "National Building Code of India', ISI, New Delhi.

Course Outcomes: The required course for emphasis in development engineering will help students

CO1: To develop skill to construct strong and durable structures by applying knowledge of material science.
CO2: To make the students aware of quality assurance and control in their real life as a professional.
CO3: To propose suitable material in adverse conditions

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BTCVPE506 H. Construction Economics & Finance

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(8 Lectures)**

Engineering Economics, Time Value of Money, Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 2 **(8 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 3 **(6 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 4 **(8 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Module 5 **(6 Lectures)**

PPP in Projects Public Private Participation in Projects- PPP Models, BOOT, BOT, Joint Ventures, BOOT, BOT, Annuity, DBFO, External Commercial Borrowings, International Finance, FIDIC.

Text Books

- Blank, L.T., and Tarquin, A. J., (1988). *Engineering Economy*, Mc-Graw Hill Book Co.
- Collier C. and Gla Gola C. (1998). *Engineering Economics & Cost Analysis*, Addison Wesley Education Publishers,
- Patel, B. M., (2000). *Project management- strategic Financial Planning, Evaluation and Control*, Vikas Publishing House Pvt. Ltd. New Delhi,
- Shrivastava, U. K., (2000). *Construction Planning and Management*, Galgotia Publications Pvt. Ltd. New Delhi.

References

- Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
- Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
- Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
- Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
- Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
- Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing
CO2: Analyze available alternatives and propose best suitable among them
CO3: Apply various models of financial management and accounting

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BTCVES507 Software Applications in Civil Engineering

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: **(5 Lectures)**

Importance and need of software for modeling, analysis and design in Civil Engineering field, Advantages and limitations of software, causes for errors, validation of software results. Failures due to errors in modeling, data entry and interpretation of software results.

Module 2: **(5 Lectures)**

Determination of Bending Moment Diagram, Deflections for different loading conditions for a Simply Supported Beam and Cantilever Beam. Determination of fixed end moments for different loading conditions of a fixed beam. Calculation of Influence line diagrams at any section of a Simply Supported Beam.

Module 3: **(5 Lectures)**

Application of problems in Hydraulics such as Hardy cross method in the Analysis of pipe network, Computation of water surface profiles in open channel flows. Estimation of Settlement of foundations in Cohesive Soil, Stability Analysis of Slopes. Estimation Earth Pressures in Cohesive and Cohesionless soils.

Module 4: **(5 Lectures)**

Application of problems in Environmental engg., Transportation Engg. Design of Slabs using I.S. Code method. Analysis and Design of Beams by using Limit state method. Design of columns subjected to axial load and Uni-axial Moment. Design of Isolated Footing. Design of rolled steel columns, built up columns, Beams and built-up Beams.

Module 5: **(4 Lectures)**

Software application in various disciplines of Civil Engineering: Learning and practice of any one software: from at least any 4 domain from 14 domain

1. Drafting and drawing: AutoCAD,
2. building information modelling:
3. Numerical Analysis and Mathematical operations:
4. Structural Analysis and Design:
5. Finite Element Analysis:
6. Project Management: MS Project
7. Geotechnical Engineering:
8. Quantity Surveying:
9. Environmental Engineering:
10. Remote Sensing and Geographical Information System: QGIS,
11. Transportation Engineering:
12. Hydraulics and Water Resources Engineering:
13. Different Open-source software used for specific problems
14. MS Excel: Conduct concrete mix design for M40 grade concrete. or any exercise of Civil Engineering domain.

(Any open source softwares such as Auto CAD, MS Project, QGIS may be used for above purpose and along with that other appropriate softwares can be used for the same.)

Text Books

- Computer aided design, software and analytical tools by C.S. Krishnamoorthy & S. Rajesh.
- Computer applications in Civil Engineering by S.K. Parikh.
- Computer aided design in Reinforced concrete by V.L. Shah.

Reference Books

- http://www.stepinau.com/offline/Civil/4-1/COMPUTER%20APPLICATIONS%20IN%20CIVIL%20%20ENGINEERING/COMPUTER%20APPLICATIONS%20IN%20CIVIL%20%20ENGINEERING.html#.YrANZXZBxQI
- https://www.inspirenignite.com/mh/ce-c507-software-applications-in-civil-engineering-syllabus-for-ce-6th-sem-2018-pattern-mumbai-university/

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand & Analyse civil engineering softwares

CO2: Use applications of various softwares in specialized works of civil engineering

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BTCVL508 SDD of Steel Structures Lab

Practical: 2 Hours / Week

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures from Group A and B. Student may use IS 800 1984 or 2007.

Group A

1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases
2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases
3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases
4) G + 3 Building Structure

Group B

1) Foot Bridge: Analysis using Influence lines for Main Truss, Cross Beams, Raker, and Joint Details
2) Plate Girder: Analysis and Design of Rivetted or Welded Plate Girder.
3) Elevated Water Tank: Analysis and Design of Staging and Tank Body.
4) Steel Chimneys

Course Outcomes: on completion of the course, student will be able to

CO1: simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.

BTCVL509 Geotechnical Engineering Lab

Practical: 2 hours / week

Term work shall consist of performance of at least seven experiments from the following mentioned list of experiments.

1) Specific gravity determination of coarse and fine grained soil
2) Particle size distribution-Mechanical sieve analysis, wet sieve analysis
3) Determination of Atterberg's consistency limit
4) Permeability- Determination of coefficient of permeability
5) Field density determination
6) Direct shear box test
7) Procter compaction test
8) Tri-axial test
9) Unconfined compression test
10) One dimensional consolidation test

Course Outcomes: On completion of the course, the students will able to:

CO1: Determine different engineering properties of soil.

CO2: Identify and classify soils based on standard geotechnical engineering practices.

CO3: Perform Laboratory oratory compaction and in-place density tests.

CO4: Perform and interpret direct shear tests and estimate shear strength parameters.

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BTCVL 510 Concrete Technology Laboratory

Practical: 2 Hours / Week

Term work shall consist of performing minimum five experimental sets from the list below.

1) Testing of Cement: Consistency, Fineness, Setting Time, Specific Gravity,
2) Soundness and Strength Test for Cement
3) Testing of Aggregates: Specific Gravity, Sieve Analysis, Bulking of Fine Aggregate, Flakiness Index, Elongation Index and Percentage Elongation
4) Placement Tests on Concrete: Workability Tests: Slump, Compaction,
5) Strength Tests on Concrete: Compression, Flexure, Split & Tensile Test,
5) Effects of Admixture: Accelerator, Retarder, Super Plasticizer,
6) Exercise and verification of Concrete Mix Design,
7) Non-destructive Testing for Concrete.

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Evaluation of (BTCVP410) Field Training/Internship/Industrial Training

Evaluation of industrial training undergone by students in Summer Vacation after Semester IV. A neat detailed report on activities carried out during training has to be submitted, along with a presentation to evaluate the training work.

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Detailed Syllabus

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- VI										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 14	BTCVC601	Design of RC Structures	3	1	-	20	20	60	100	4
PCC 15	BTCVC602	Foundation Engineering	3	1	-	20	20	60	100	4
PCC 16	BTCVC603	Transportation Engineering	3	-	-	20	20	60	100	3
PEC 2	BTCVPE604	K. Industrial Waste Treatment L. Managerial Techniques M. Open Channel Flow N. Water Power Engineering O. Ground Improvement Techniques P. Structural Audit Q. Intelligent Transportation Systems R. Plastic Analysis of Structures S. Numerical Methods in Civil Engg. T. Engineering Management	3	-	-	20	20	60	100	3
OEC 1	BTCVOE605	L. Environmental Impact Assessment M. Basic Human Rights N. Business Communication and Presentation Skills O. Composite Materials P. Experimental Stress Analysis Q. Python Programming R. Operation Research S. Applications of Remote Sensing and Geographic Information Systems T. Civionics: Instrumentation & Sensor Technologies for Civil Engineering U. Planning for Sustainable Development V. Development Engineering	3	-	-	20	20	60	100	3
HSSMC4	BTHM606	Indian Constitution	2	-	-	50	-	-	50	Audit
LC 10	BTCVL607	SDD of RC Structures Lab.	-	-	2	20	-	30	50	1
LC 11	BTCVL608	Transportation Engineering Lab	-	-	2	20	-	30	50	1
Project	BTCVM609	Mini Project	-	-	2	20	-	30	50	1
Internship		**Mandatory (BTCVP610)** Field Training/ Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester VI and appear at examination in Semester VII.)	-	-	-	-	-	-	-	Credits to be evaluated in VII Sem
Total			**17**	**2**	**6**	**210**	**100**	**390**	**700**	**20**

BTCVC 601 Design of RC Structures

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(4 Lectures)**

Basic Aspects of Structural Design, Introduction to Design Philosophies, Stress Strain behavior of Materials Working stress method, Ultimate load method and Limit state method, Comparison of Different Philosophies, Factor of Safety, Estimation of Loads.

Working Stress Method

Module 2: **(8 Lectures)**

Stress block parameters, permissible stresses, balanced, under reinforced and over reinforced section, analysis and design for flexure, shear, analysis and design of singly and doubly reinforced beams. Design of axial and uniaxial eccentric loaded columns, Isolated Column Footings, WSM design requirements as per Annexure B of IS 456:2000

Limit State Method

Module 3: Introduction to LSM **(10 Lectures)**

Introduction to limit state approach, types and classification of limit states, characteristics strength and characteristics load, load factor, partial safety factors, strain variation diagram, stress variation diagram, serviceability criteria

Limit State of Collapse in Shear and Bond

Design for shear: shear failure, types of shear reinforcement, minimum shear reinforcement, design of shear reinforcement

Design for bond: types, factors affecting, resistance, check for development length, detailing of reinforcement

Module 4: Limit State of Collapse in Flexure **(16 Lectures)**

Design of beams: Analysis and Design: Singly and Doubly Reinforced Beams, Flanged (L and T) sections.

Design of Slabs: One-Way and Two-Way Slab: Behavior of slabs, types, support conditions, analysis and design with various conditions Staircases, effective span and load distribution, design of dog- legged and open well stair case.

Module 5: Limit State of Collapse in Compression **(10 Lectures)**

Design of columns, and footings

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), construction of Interaction diagrams for uni-axial bending and its application in design, concept of design charts, concept of bi-axial bending, concept of interaction surface, Design of isolated column footing for axial load, and uni-axial bending.

Text Books

- IS: 456-2000, IS: 456-1978, Bureau of Indian Standards, New Delhi
- Karve and Shah, "Limit State Theory & Design", Structures Publications, Pune
- Jain A.K., "Reinforced Concrete Design (Limit State)", Nemchand Brothers, Roorkee
- Sinha and Roy, "Fundamentals of Reinforced Concrete"
- Sinha S.N., "Reinforced Concrete Design, Vol. I, II", Tata Mc-Graw Hill
- Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi
- Mehra H. and V.N. Vazirani, "Limit State Design of Reinforced Concrete Structures", Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-162-9
- Vazirani V.N. and Ratwani M.M., "Design of Reinforced Concrete Structures", Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-232-8
- Pillai S Unnikrishna, and Menon Devdas., "Reinforced Concrete Design" Tata Mc-Graw Hill

Reference Books

- Punmia B.C., "Reinforced Concrete Design, Vol. I, II", Laxmi Publications
- Relevant Publications by Bureau of Indian Standards, New Delhi

Course Outcomes: On completion of the course, the students will be able to comprehend the various design philosophies used in design of reinforced concrete. Analyze and design the reinforced concrete sections using working stress and limit state method.

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BTCVC 602 Foundation Engineering

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: **(8 Lectures)**

Introduction, General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations

Module 2: **(10 Lectures)**

Bearing Capacity Analysis - Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for Nc, Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion

Module 3: **(10 Lectures)**

Foundations for Difficult Soils - Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative measures for Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,

Shallow Foundations: Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation

Module 4: **(10 Lectures)**

Deep foundations: Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles, Group Action of Piles,
Caissons Foundations: Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties And Remedial Measures
Sheet Piles: Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations

Module 5: **(10 Lectures)**

Slope Stability: Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use

Text Books

- Kasamalkar, B.J., "Foundation Engineering", Pittsburgh vintage Grand Prix
- Murthy V.N.S., "Soil Mechanics and Foundation Engineering", CRC Press 2002
- Arora K.R., "Soil Mechanics and Foundation Engineering", Standard publication 2009
- Punmia B. C., "Soil Mechanics And Foundation Engineering", Laxmi publication 16th 2017
- Nayak N.V., "Foundation Design Manual", DhanpatRai And Sons
- Brahma S.P., "Foundation Engineering", Tata McGraw-Hill 5th Edition
- Braja Das, "Principles of Geotechnical Engineering", Engage Learning 9th edition
- Bowles J.E., "Foundation analysis & Design", McGraw-Hill Higher Education 5th edition

References Books

- Teng W.C., "Foundation Design", Prentice-Hall Inc
- Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall; 7th edition
- Lee, "Sheet Piles" Concrete Publication,1961
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS 6403:1981, IS 1904:1986, IS 4091:1979

Course Outcomes: On completion of the course, the students will be able to:

To predict soil behavior under the application of loads and come up with appropriate solutions to foundation design queries. Analyze the stability of slope by theoretical and graphical methods.
Analyze the results of in-situ tests and transform measurements and associated uncertainties into relevant design parameters. Synthesize the concepts of allowable stress design, appropriate factors of safety, margin of safety, and reliability.

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BTCVC603 Transportation Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**
Importance of various modes of transportation, Highway Engineering, Road Classification, Developments in RoadConstruction, Highway Planning, Alignment and Surveys

Module 2: **(6 Lectures)**
Geometric Design- Cross section elements, Sight distances, Horizontal alignment, Vertical alignment, Intersections, Construction of Pavements, Construction and Maintenance of Drainage, Road Arboriculture

Module 3: **(8 Lectures)**
Highway Materials: Soil – relevant properties, Various tests, Aggregates – strength, hardness, toughness, soundness, durability, shape, specific gravity, water absorption, Bituminous materials – Bitumen, Tar, and Asphalt – various properties, Design of Bituminous paving mixes-Marshall stability test

Module 4: Traffic Engineering **(8 Lectures)**
Traffic Characteristics, Speed, Journey Time and Delays, Vehicle Volume Counts, Origin and Destination Studies, Analysis and Interpretation of Survey Data, Traffic Operations, Design of Signals and Rotary intersections, Parking Space Design,Highway Lighting, Planning and Administration, Road Markings, Signs
Road Accidents and Safety: Classification, Causes, Mitigation and Control Measures, Aspects of Safety in Usage of Roads, Type and Design of anti-crash barriers, Introduction to Intelligent Transport Systems (ITS).

Module 5: Pavement Design **(8 Lectures)**
Basic Principles, Methods for different Types of Pavements, Design of flexible pavement using IRC: 37- 2012, Design of rigid pavement using IRC: 58-2011
Other modes of Transport
Introduction to Railways, Airways, Waterways, Pipeline Transportation, Classification, Requirements, Comparative Studies

Text Books

- Khanna and Justo, “Highway Engineering”, Nemchand& Bros., Roorkee
- Khanna S.K., “Highway Engineering”,
- Arora N. L., “Transportation Engineering”
- Bindra and Arora, “Highway Engineering”, Standard Publishers
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, VolIKhanna Publishers, N. Delhi
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, Vol II Khanna Publishers, N. Delhi ISBN NO: N/A
- Shahani P.B, “Road Techniques” Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-197-1 PRICE 149/-
- Kadiyali L.R, “Traffic Engineering and Transport Planning”, Khanna Publishers, N. Delhi, ISBN NO:978-81-7409-220-X

Reference Books

- Garber, N.J. and Hoel, L.A., “Traffic and Highway Engineering”, West Publishing Company, New York
- Jones, J.H., “Geometric Design of Modern Highways’, E & FN SPON Ltd., London.
- Khistry, C.J., “Transportation Engineering – An Introduction’, Prentice Hall of India Ltd.
- Agor R., “Surface Transportation (Railways and Highways)”,Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-273-1

CO: On completion of the course, the students will be able to:

Comprehend various types of transportation systems and their history of the development Comprehend to various types of pavements
Design the pavements by considering various aspects associated with traffic safety measures.

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BTCVPE 604A Industrial Waste Treatment

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Standards of Disposal, Monitoring of wastewater flow, Quality and quantity variations in waste discharge. Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards. Designated Water Quality Standards, Type of samples-Grab and Composite.

Module 2: Treatment objectives and strategies **(6 Lectures)**

Waste Volume reduction, Strength reduction techniques, Segregation, proportioning, Waste Neutralization methods for acidic and alkaline waste, Equalization tank- online and offline, design problem. Recycle, reuse and byproduct recovery, Concept of Zero liquid Discharge (ZLD)

Treatment objectives and strategies, Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Module 3: Manufacturing processes for industries **(6 Lectures)**

Manufacturing process flow sheets along with sources and characteristics of wastewater for various industries sugar, Distillery, Textile, Tannery, Paper and pulp mill, dairy, Fertilizer, steel mill, power plant etc.

Development of Treatment flowsheets based on characteristics of industrial wastewater. Industrial wastewater Treatment alternatives (Treatment Flowsheets) for above listed industries

Dewatering and disposal of sludge – floatation, vacuum filtration, centrifugation, filter press and membrane filters.

Module 4: Effluent Treatment Plants **(8 Lectures)**

Water pollution control act and Environmental Protection act - organizational set up of central and state boards for water pollution control, other important provisions. Classification of river on water use, minimal national standards, socio-economic aspects of water pollution control. Modern Trends in Environmental Engineering, Cleaner Production Technologies, Environmental Bio-Technology, Bioremediation.

Common Effluent Treatment Plants (CETPs): Concept, Need, Objectives, Methodology, grouping of industries, Location, Design, Operation and Maintenance Problems and Economical aspects.

Module 5: Treatability and environmental aspects **(8 Lectures)**

Treatability index, Population equivalent, Treatability aspects of raw industrial wastewater with domestic sewage, partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and effluent standards, Introduction to Water Quality Index (WQI) - simple problems.

Introduction to environmental impact assessment and environmental audit.

ISO 14000- introduction, how it is helpful to industries. Importance of Environmental management plan and environmental monitoring plan, Consent to operate and consent to establish

Text Books

- Metcalf and Eddy,1995,Wastewater Engineering - Collection, Treatment, Disposal and Reuse, McGraw Hill Pub. Co.,.
- Nelson Leonard Nemerow,2007 Industrial Waste Treatment, Butterworth-Heinemann,
- Nelson Nemerow. Theories and Practices of Industrial waste treatment
- M. N. Rao & Datta. Waste water treatment:
- IS Standard guide for treatment and disposal of various industries.
- Industrial Waste Treatment: Contemporary Practice and Vision for the Future

- Woodard, F., Industrial Waste Treatment Handbook, Butterworth-Heinemann, Woodard & Curran
- J.D. Edwards, Industrial Wastewater Treatment CRC Press
- Government of India Publication, "Water Supply and Treatment Manual"
- Publications by renowned organizations such as WHO, NEERI, MERI, MPCB, CWPRS, etc.
- Hammer M.J., "Water and Waste Water Technology", PHI Private Limited
- Peavy and Rowe, Environmental Engineering , TMH.
- Numersorn, N.L., Liquid Waste from Industry – Theories, Practice and Treatment, Addison-Wesley,

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and analyze the characteristics of industrial wastewater

CO2: Describe pollution effects of disposal of industrial effluent.

CO3: Identify and design treatment options for industrial handling industrial liquid waste

CO4: Formulate environmental management plan

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BTCVPE 604 B. Managerial Techniques

Teaching Scheme:(3 Lectures) hours/week

Course Contents

Module 1: Introduction to Managerial Techniques **(Lectures 06)**

Introduction, Evolution of Managerial techniques, Managerial aspects, management characteristics, Essentials of Managerial Techniques

Module 2: Process Control Techniques in Management **(Lectures 08)**

Quality- Improvement Programs, Starting a Quality Improvement Program, Experimental Designs for Quality improvement, Quality Control - Statistical process control: concepts of stable industrial processes, Systematic variation, random variation, Control Charts for Measurements, Control Charts for Attributes, Tolerance Limits, Acceptance Sampling

Module 3: Method Study and Work Study and Motion Study **(Lectures 08)**

Method Study: Analysis of Operations, job work, systems involving man and machines. Schematic methods, charts and other aids for analysis
Work Study: Method of work measurement, stopwatch study; PMTS; work sampling, setting of time standards.
Motion Study: Principles of motion economy and work center design

Module 4: Technology based Managerial Techniques **(Lectures 08)**

Introduction, Need of Technological advancements in management, MIS, Resources Management using softwares, Planning softwares, BIM, MSP, Primavera, Advantages, Applications

Module 5: Introduction to Six Sigma Technique **(Lectures 06)**

Introduction, Concept, Tools, DMAIC, DMADV, Justifying six sigma, Readiness of six sigma, Advantages, Applications

Text Books:

- Jain P. L. (2001) "Quality Control and Total Quality Management", Mc-Graw Hill Book Co.,New Delhi
- Breu G.(2002) "Six Sigma for Managers", Mc-Graw Hill Book Co., New Delhi
- Arora P. N., Arora S., Arora S. Arora A.(2007) "Comprehensive Statistical methods", S Chand Publishing, New Delhi
- Jhamb L. C. (2000) "Work Study & Ergonomics" Everest Publishing House, Pune

References:

- IS: 15883 (Part I): 2008 "Construction Project Management" BIS, New Delhi 2008
- Munro R. A. and Ramu G. (2012) "The certified six sigma green belt Handbook" American Society of Quality,

Course Outcomes: On completion of the course, the students will be able to:

CO1: Inculcate various managerial techniques in practices
CO2: Analyze process control tools and techniques to improve the outcome
CO3: Adopt modern technological advancements to suit the project characteristics, at large.

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BTCVPE604C Open Channel Flow

Teaching Scheme: 3 Hours /week

Course Contents

Module 1: Open Channel Flow **(08 Lectures)**
Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot lube, current meter), Discharge through open channel.

Module 2: Steady and Uniform flow (**08 Lectures)**
Chezy's & Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section considerations for rectangular, triangular, trapezoidal, circular sections

Module 3: Specific energy (**06 Lectures)**
Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow, specific force, specific discharge derivation of relationships and numerical computations

Module 4: **(08 Lectures)**
Gradually varied flow
Definition, classification of channel Slopes, Back water curve and its length, Afflux, dynamic equation of G.V.F. (Assumption and derivation), classification of G.V.F. profiles-examples, direct step method of computation of G.V.F. profiles
Rapidly varied flow
Definition, examples, hydraulic jump- phenomenon, relation of conjugate depths, loss of energy, parameters, uses, types of hydraulic jump

Module 5: weir & spillway **(06 Lectures)**
Introduction, Classification, Discharge over various notches and weirs (Rectangular, Triangular, Stepped, Broad-Crested, Narrow crested), Velocity of Approach, Cipolletti Weir, calibration of weir, time of emptying tank with weir, profile of ogee spillway, flow below gates, Most economical sections in channels: Rectangular, Trapezoidal, Circular.

Text Books:

- Modi P. N. and Seth S. M.(2017) "Fluid Mechanics – Hydraulic & Hyd. Mechanics" Standard Book HouseN. Delhi
- Bansal R.K. (2017) "Fluid Mechanics", Laxmi Publications, N. Delhi
- Garde R. J.(2011) "Fluid Mechanics through Problems", New Age Publications, Hyderabad
- Jain A. K. (2003) "Fluid Mechanics", Khanna Publications, 2003, Delhi
- Rangaraju K. G. (2001) "Open Channel flow", Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K. (2015) "Fluid Mechanics through Problems" Tata McGraw-Hill Pub. Co., Delhi

Reference Books

- Streeter V. (2017) "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Chaw V. T. (2009) "Flow in Open Channel", McGraw-Hill International Book Co., Auckland

Course Outcomes: On completion of the course, the students will be able to:

1. Understand phenomena of hydraulic jump.
2. Compute Discharge through various open channel sections.
3. Discuss different applications of gradually varied flow profiles.

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BTCVPE 604D Water Power Engineering

Teaching Schemes: (Lectures: 3) Hours/Week

Course Contents

Module 1 **(8 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

Module 2 **(8 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

Module 3 **(6 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

Module 4 **(6 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

Module 5 **(6 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants**,** Tidal Power Stations: Necessity, Advantages, Classification, Limitations

Text Books

- Dandekar and Sharma, “Water Power Engineering”, Vikas Pub. House Pvt. Ltd.
- Bhattacharya P. K., “Water Power Engineering”, Khanna Publications, New Delhi
- Deshmukh M. M. “Water Power Engineering”, Dhanapatrai and Sons N. Delhi

References

- Creager and Justin, “Hydro – Electric Hand Book”
- Brown G., “Hydro-electric Engineering Practice”, Vol. I to III
- Mosonvi, “Water Power Development”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify potential energy sources and adapt as per the requirement

CO2: inculcate basics of electricity generation and power plants

CO3: propose suitable energy source for running a project optimistically.

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BTCVPE604E Ground Improvement Techniques

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Dewatering: Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electroosmotic methods. Stabilization by thermal and freezing techniques - Applications.

Module 2: **(8 Lectures)**

Compaction and Sand Drains: Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.

Module 3: **(6 Lectures)**

Stone Column, Lime Piles and Soil Nailing: Stone column, lime piles – Functions – Methods of installation– design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.

Module 4 **(6 Lectures)**

Earth Reinforcement: Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber-based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

Module 5 **(8 Lectures)**

Grouting: Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies.

Text Books

- Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., "Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
- Cox, B.R., and Grifiths S.C., "Practical Recommendation for Evaluation and mitigation of Soil Liquefaction" in Arkansas, (Project Report), 2010.
- Day, R.W., "Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
- Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
- Das, B.M., "Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.

References Books

- Moseley, M.P., "Ground Treatment, Blackie Academic and Professionals, 1998.
- Koerner, R.M., "Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
- Hehn, R.W., "Practical Guide to Grouting of Underground Structures, ASCE, 1996.
- Jewell, R.A., "Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
- Koerner, R.M. and Welsh, J.P., "Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.

Course Outcomes: On completion of the course, the students will be able to:

CO1: To identify and evaluate the deficiencies if any in the deposits of the given project area.

CO2: Capable of providing alternative methods to improve its quality so that the structures built on it will be stable and serve the intended purpose.

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BTCVPE 604F Structural Audit

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(08 Lectures)**
Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed. Aspects of audit of Masonry buildings, RC frame buildings, Steel Structures.

Module 2: **(06 Lectures)**
Causes and types of deterioration in Structures: Permeability of concrete, capillary porosity, air voids, Micro cracks and macro cracks, corrosion of reinforcing bars, sulphate attack, alkali silica reaction.
Causes of deterioration in Steel Structures: corrosion, Uniform deterioration, pitting, crevice, galvanic, laminar, Erosion, cavitations, fretting, Exfoliation, Stress, causes of defects in connection

Module 3: **(08 Lectures)**
Elementary aspects of Non-Destructive Testing, Concrete Strength Assessment: Rebound hammer, Ultrasonic Pulse velocity, Penetration resistance, Pull out test, Chemical test: Carbonation test, Chloride test, Corrosion potential assessment, Fire damage assessment: Differential thermal analysis, X ray diffraction, Structural Integrity and soundness assessment: Radiography, Impact echo test, dynamic testing of structure, Interpretation and evaluation of test results.

Module 4 **(08 Lectures)**
Strength Evaluation of Existing Structures, Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in RC structures

Module 5: **(06 Lectures)**
Approach to conduct Structural Audits Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation.
Structural Audit Report, Study of sample Structural audit report for up-gradation of existing building, Audit for continuation of usage of old Buildings, Audit for Buildings damaged due to Earthquakes, Fire,

References

- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Outcomes: Upon completion of the course the students will be able to:

- Gain the knowledge of Bye laws, procedure of Structural audit and study the typical problems in structures.
- Aware of causes and types of deterioration in structures.
- Develop skills for use of various Nondestructive tests required during auditing of structures.
- Strength evaluation of existing structures.
- Acquire knowledge of legal procedure to conduct structural audits.
- Prepare a Structural audit report.

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BTCVPE 604G Intelligent Transport Systems

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(06 Lectures)**

Definition of intelligent transport system (ITS), History of ITS, Objectives, Benefits, data collection techniques: Detectors, automatic vehicle location, automatic vehicle identification, geographic information system.

Module 2: Telecommunication in ITS **(08 Lectures)**

Importance of telecommunication, information Management, Traffic management centers, vehicle roadside communication, vehicle positioning system.

Module 3: Functional areas **(08 Lectures)**

Traffic management systems, traveler information system, commercial vehicle operations, vehicle control system, public transportation system, rural transportation system.

Module 4: User needs and services **(06 Lectures)**

Travel and traffic management, Public transportation management, electronic payment, commercial vehicle operations, emergency management, advanced vehicle safety systems, information management.

Module 5: Automated highway systems **(06 Lectures)**

Vehicles in plantoons, integration of automated highway systems, implementations in developed countries and developing countries.

Text Books

Sarkar, P. K. and Jain, A.K., Intelligent Transportation systems. PHI learning pvt.ltd.
Chen P. K., & Miles, J., Recommendations for world road Association (PIARC). Its Hand book

References

1. M A Chowdhary and A Sadek. Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003.
2. Bob Williams. Intelligent transportation systems standards. Artech House, London, 2008

Outcomes: Upon completion of the course the students will be able to:

- Gain the knowledge Intelligent transport components
- Understand functional areas of ITS
- Management of ITS and correlated systems

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BTCVPE604H Plastic Analysis of Structures

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

Module 2: **(8 Lectures)**

Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms. Bending moment diagram at collapse

Module 3: **(6 Lectures)**

Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Module 4: **(8 Lectures)**

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force

Module 5: **(6 Lectures)**

Design of portal frames, design of corner connection with and without haunches, Consideration of deformations, calculation of deflections for plastically deformed structures

Text Books:

- Bureau of Indian Standards, "Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)".
- Bureau of Indian Standards, "IS: 800 Code of Practice for General Construction in Steel"
- Arya A.S. and Ajmani J.L., "Design of Steel Structures", Nemchand& Bros., Roorkee
- Ramchandra, "Design of Steel Structures Vol – II", Standard Book House, Delhi
- Neal B.G., "Plastic Method of Structural Analysis", Chapman & Hall
- Beedle L.S., "Plastic Design of Steel Frames", John Wiley & Sons

References:

- Bureau of Indian Standards, "Handbook for Structural Engineers SP 6"
- INSDAG Kolkata, "Teaching Resource for Structural Steel Design"
- "Steel Designers Manual" ELBS

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand modes of structural collapse

CO2: Perform the plastic analysis and design of various determinant and in-determinant structures.

CO3: Adapt plastic theory of design for various structures

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BTCVPE604I Numerical Methods in Civil Engineering

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module 1 **(Lectures 8)**

Basis of Computations, Matrix Operations on Computer, Multiplication and Inversion, Solution of Simultaneous Equations, Gauss Elimination Method, Cholesky Decomposition method, Gauss Jordan and Gauss Sceidal Methods

Module 2 **(Lectures 8)**

Roots of Equation, Trial and Error, Bisection, Secant Iteration, Newton Rapson Method, Solution of Ordinary Differential Equation, Euler's Method, Modified Euler's Method and Runga Kutta Methods.

Module 3 **(Lectures 08)**

Interpolation with Newton's Divided Differences, Lagrange's Polynomial, Finite Difference Method, Central, Forward and Backward Differences, Least Square Polynomial Approximations Application in Deflection of Determinate Beams, Buckling Load of Long Columns

Module 4 **(Lectures 04)**

Numerical Integration: Trapezoidal Rule, Simpon's Rules, Gauss Quadrature Rules

Module 5 **(Lectures 08)**

Statistical Analysis of Experimental Data, Mean, Median, Mode, Deviation, Measures of Dispersion, Least Square Method, Regression Analysis: Linear, Parabolic, Curve Fitting

Text Books

- Balaguruswami E., "Numerical Methods", Tata Mc-Graw Hill
- Scheid F, "Numerical Analysis (Schaum's series)", Tata Mc-Graw Hill
- Chapra. S. C. and Canale R. P., "Numerical Methods for Engineers", by, Tata Mc-Graw Hill
- Shantha Kumar M , "Computer Based Numerical Analysis", Khanna Publication
- Grewal B.S. and Grewal J.S., "Numerical Methods in Engineering and Science", Khanna Publication, N. Delhi
- Sastry, S.S., "Introductory Methods of Numerical Analysis", Printice Hall of India, New Delhi

Reference Books

- Jain, Aryengon, "Numerical Methods for Scientific and Engineering Applications", Wiley Eastern Publication
- Numerical Recipe , Oxford Publishing
- Manuals for the Commercial Computer Programmes

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BTCVPE604J Engineering Management

Teaching Scheme: 3 hours/week

Course Contents

Module 1: Evolution of Management Thought **(Lectures 06)**

Scientific, human behavior, system approach, introduction to elements of systems – input, output, process restriction, feedback, contingency approach, contributions by Taylor, Frank and Lillion, Gilbreth, Henry Fayol, Elton Mayo, McGregor (theory X and theory Y), H. L. Gantt, Maslo

Module 2: Functions of Management **(Lectures 06)**

Planning – nature and purpose of planning, strategies and policies, management by objectives, formal and informal organization, centralization, decentralization, line, line and staff, functional organization, principles of site layout, leading and directing, controlling and coordination (introduction only), communication process, motivation

Module 3: Decision Making **(Lectures 06)**

Importance of decision making, steps in decision making, analysis of decision, decision under certainty, uncertainty and decision under risk, criterion of optimism and regret, sensitivity of criteria and decision under conflict, expected monitory value, decision tree, theory of games (dominance pure and mixed strategy

Module 4: Operations Research & Simulation Studies **(Lectures 12)**

Linear programming, simple l-p model, simplex method - duality, sensitivity analysis, application of linear programming in transportation and assignment models

Simulation Studies

Monte-Carlo simulation, queuing or waiting line theory (simple problems), dynamic programming.

Module 5: Material management **(Lectures 06)**

Introduction to emerging optimization techniques Material management – purchasing principles, stores, coding system function, responsibilities, record and accounting. Inventory control – an introduction, inventory cost, EOQ analysis, ABC analysis, safety stocks

Text Books:

- Deshpande S. H., 1976, "Operation Research", S Chand Delhi.
- Deshpande A. S., "A Text book of Management"
- Gopal Krishnan, 2015, "Material Management", Sudeshan.
- Taha, 1971, "Operation Research", Pearson.
- Banga and Sharma, 2017, "Engineering Management", Khanna publishing.

References:

- Stoner, 2018, "Engineering Management", Pearson education.
- Davar, 1980, "Principles of Management", Progressive corporation Pvt. Limited.
- Koontz, Dounell and Weigrick, 2015, "Essentials of Management", McGraw Hill publishers.
- Kast and Rosinweig, 1973, "Management and Organization", Tata McGraw Hill Publication.
- Wagner, "Operation Research", Wikey Easter Ltd., New Delhi
- Zhamb L.C.,1999, "Quantitative Techniques in Management", Vol. I,
- Miller and Stars, 1960, "Executive Decisions & Operation Research", Prentice Hall of India

Course Outcomes: On completion of the course, the students will be able to:

CO1: Demonstrate the nuances of management functions.
CO2: Analyze the framework of a business organization.
CO3: Adopt an empirical approach toward business situations.
CO4: Apply various Management techniques.

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BTCVOE 605A Environmental Impact Assessment

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Module 2: Identifying the Key Issues **(6 Lectures)**

Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection - Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues

Module 3: EIA Methodologies **(6 Lectures)**

Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods,

Reviewing the EIA Report:

Scope, Baseline Conditions, Site and Process alternatives, Public hearing, Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System

Module 4: Review of EMP and Monitoring **(8 Lectures)**

Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Module 5: Case Studies **(6 Lectures)**

Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Text Books

- Wathern. P Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.
- Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
- Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
- Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
- Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify the environmental attributes to be considered for the EIA study

CO2: Formulate objectives of the EIA studies

CO3: Identify the methodology to prepare rapid EIA

CO4: Prepare EIA reports and environmental management plans

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BTCVOE605B Basic Human Rights

Teaching Scheme:(3 Lectures) hours/week

Course Contents

Module 1: Basic Concepts **(Lectures 06)**

Individual, group, civil society, state, equality, justice. Human Values, Human rights & Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working & exploited people

Module 2: Fundamental Rights and Economic Program **(Lectures 06)**

Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Module 3: Workers and Human Rights **(Lectures 08)**

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

NGOs and Human Rights in India

Land, Water, Forest issues.

Module 4: Human Rights in Indian Constitution and Law **(Lectures 08)**

i) The Constitution of India: Preamble; ii) Fundamental rights; iii) Directive principles of state policy; iv) Fundamental duties; v)Some other provisions

Module 5: UDHR and Indian Constitution **(Lectures 08)**

Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References

1) Shastry, T. S. N., "India and Human Rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.

2) C. J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives (Law in India)", Oxford India.

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BTCVOE605C Business Communication & Presentation Skills

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools **(06 Lectures)**

Technical vocabulary, Sentence structures, Computer Aids, Graphical presentations
Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules.

Module 2: Project Proposals and Project Reports **(08 Lectures)**

Abstract, Aims, Background & significance, Design & methods, writing a sample proposal,
Project Report: Types of reports, planning a report, Collection & organization of information, Structure & style, Proof reading etc.

Module 3: Leadership Skill and Team Building, Working **(08 Lectures)**

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies. Need of team, Effective teams, Group development

Module 4: Business Meetings **(08 Lectures)**

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, Taking notes and publishing minutes

Module 5: Presentation Skills **(06 Lectures)**

Use of presentation tools, Presentation, nonverbal techniques, handling questions

References:

- Hariharan S. (2010)"Soft Skills" MJP Publishers, Chennai
- Seely S. (2009)"Oxford Guide to Effective Writing and Speaking" Oxford University Press, UK
- Huckin T. N. and Olsen L. A."Technical Writing and Professional Communication for Nonnative Speakers of English"Tata McGraw Hills, UK
- Masters A. & Harold R. W. (2011) Personal Development for Life & Work, Learning India Private Limited.

Course Outcomes: On completion of the course, the students will be able to:

- CO1: Inculcate basics of business communication skills & relevant tools.
- CO2: Understand business SOPs and essentials of the same.

- CO3: Adapt modern skills regarding communication, presentation & team working

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BTCVOE605D Composite Materials

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module1 Introduction: **(8Lectures)**
Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

Module2 Types of Reinforcements/Fibers **(6Lectures)**
Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential

Module3 Various types of composites **(8 Lectures)**
Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC),

Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

Module 4 Fabrication methods **(6Lectures)**
Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

Module 5 Testing of Composites **(8Lectures)**
Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc

Text Books

- ASM hand book, Materials characterization, Vol. 10,
- G. Dieter, Mechanical Metallurgy, Mc-Graw Hill
- R.F. Speyer Thermal Analysis of Materials, Marcel Decker
- A.K Bhargava Engineering Materials: Polymers, Ceramics and Composites Prentice Hall India

Reference Books:

- Jones, R.M., (2015) "Mechanics of Composite Materials" McGraw Hill Co., New Delhi
- Whitney, Daniel I. M. and Pipes R. B. (1984)"Experimental Mechanics of Fibre Reinforced Composite Materials" Prentice Hall, New Jersey
- Hyer, M.W. (1998)"Stress Analysis of Fibre Reinforced Composite Materials" Mc Graw Hill Co., New Delhi
- Herakovich C. T. (1998)"Mechanics of Fibrous Composites" John Wiley Sons Inc., N. Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand fundamental knowledge in mechanical analysis
CO2: Understand design of structures made of composite materials.
CO3: Propose suitable materials in relation with the project

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BTCVOE605E Experimental Stress Analysis

Teaching Scheme: 3 Hours /week

Course Contents

Module 1: **(6 Lectures)**

Introduction to Theory of Elasticity, Assumptions made in strength of materials and theory of Elasticity, Necessary and sufficient conditions for analyzing a structure,

Module 2: **(8 Lectures)**

State of stress at a point, Specification of stress at a point-Determination of Normal thrust and Shear stress, Problems on specification of stress at a point.
Concept of Orthogonal Transformation of axes and Problems, Determination of Stress invariants, Determination of Principal Stresses and Planes, Determination of Maximum shear Stresses and their corresponding plane systems, Tresca's criteria.

Module 3: **(6 Lectures)**

Derivation of Equilibrium conditions in three dimensions, Concept of Strain at a point, Determination of Normal and Shear Strain, Generalized Hooke's Law and problems on interrelationship between stress and Strain in three dimensions.

Module 4: **(8Lectures)**

Formulation of a stress analysis problem using the necessary and sufficient conditions in three dimensions and modifying the same to identify the unknowns in plane cases, Derivation of Airy's Stress function using the boundary conditions, equilibrium equations, compatibility conditions.

Module 5: **(8 Lectures)**

Solution to stress analysis problems, Torsion of circular shafts, Strain Measurement- Types of Strain gauges, Characteristics of ideal strain gauges, gauge factor, Strain gauge Rosettes, Introduction to two dimensional photo elasticity, Stress-Optic law.

References:

- Timoshenko S. P. and Goodier J. N. (2010) Theory of Elasticity, 3rd Ed., McGraw Hill**.,** N. Delhi
- NPTEL Course on Experimental Stress Analysis, https://nptel.ac.in/courses/112/106/112106068/
- Swayam Course on Experimental Stress Analysis by Prof. K. Ramesh, IIT Madras, https://swayam.gov.in/nd1_noc20_me02/preview

Course Outcomes: On completion of the course, the students will be able to

1. Apply principles of elasticity theory to determine stresses and strains.
2. Apply theory of elasticity and formulate plane stress and plane strain problems.
3. Formulate the stress analysis problems using elasticity theory.
4. Apply experimental techniques to solve field problems.

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BTCVOE605F Python Programming

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Basics of C **(8 Lectures)**

Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms, Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

Module 2: Algorithmic Problem Solving **(7 Lectures)**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

Module 3: Data, Expressions, Statements **(7 Lectures)**

Python interpreter and interactive mode; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precede operators comments ;modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

Module 4: Control Flow, Functions **(8 Lectures)**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope,.

Functions: Function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

Module 5: Lists, Tuples, Dictionaries **(6 Lectures)**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

Files, Modules, Packages

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Text Books

- Martin C. Brown, Python: The Complete Reference.
- R. Nageswara Rao Core Python Programming.
- Kenneth A. Lambert, Introduction to Python.
- Vittorio Lora, Python for Civil and Structural Engineers.
- https://www.pythonforengineers.com/.
- W. Chun, Core Python Programming, Pearson.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Experience with an interpreted Language.

CO2: To build software for real needs

CO3: Prior Introduction to testing software

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BTCVOE605G Operation Research

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to Operation Research **(06 Lectures)**

Introduction, History of operation research, Stages of development operation research, OR tools and techniques, Applications of Operation research, Modelling approach, Defining the problem and gathering data, Formulating a mathematical model, Deriving solutions from the model, Testing the model, Preparing to apply the model, Implementation, Limitations of operation research.

Module 2: Linear Programming and graphical analysis **(06 Lectures)**

Introduction to linear programming, Assumptions, Linear programming model, Formulation with different types of constraints, Graphical analysis of linear programming, Graphical linear programming solution.

Module 3: Simplex method and Duality method **(08 Lectures)**

Simplex Method: Introduction, Basics of simplex method, Simplex method computation, Algebra of the simplex method, Simplex method in tabular form, Simplex method in matrix form, Tie breaking in the simplex method, Adapting to other model forms, Post optimality analysis.

Duality: Introduction, Economic interpretation of duality, Primal–Dual relationships, Duality problems, Duality results, Dual problem and the simplex table, Role of duality theory in sensitivity analysis, Sensitivity analysis.

Module 4: Assignment Problems **(08 Lectures)**

Introduction, Assignment problems, Unbalanced assignment problem, Balanced assignment problem, Infeasible assignment problem, Minimization & Maximization, special algorithm for the assignment problem.

Module 5: Transportation Problems **(08 Lectures)**

Introduction, Methods for initial basic feasible solution, balanced transportation problem, Minimization & Maximization, Vogel's approximation method, Optimization, Modified distribution method, Streamlined simplex method for the transportation problem, Dual of the transportation problem.

Text Books

- Gupta P. K., Hira D. S. "Operation Research" S Chand Publishers, 2006
- Taha H. A. "Operation Research", Pearson, 2014
- G.Srinivasan "Operations Research:Principles and Applications", PHI Learning Pvt. Ltd.
- Ishizika A., Nemery P., "Multi-criteria Decision Analysis", John Wiley & Sons, 2013

References:

- Vohra, N. D. "Operations Research", Tata McGraw Hill Co., New Delhi.
- Wagner, "Operation Research", Wiley Eastern Ltd., New Delhi
- Zhamb L.C., "Quantitative Techniques in Management", Vol. I,
- Miller and Stars, "Executive Decisions & Operation Research", Prentice Hall of India
- Hillier and Liberman "Operations Research: Concepts and Cases" McGraw-Hill

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt Operation Research tools and techniques while working in industry

CO2: Analyze the problem statement with computational approach

CO3: Apply various models to propose suitable outcomes.

CO4: Apply various decision-making tools to propose best suitable alternatives, at large.

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BTCVOE605H Applications of Remote Sensing and GIS

Teaching scheme: (3 Lectures) hour/week

Course contents

Module 1: Remote Sensing **(Lectures 8)**
Basic concepts in remote sensing, information and data collection, Remote Sensing process advantages & limitations, necessity, importance and use; basic laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter

Module 2: Applications of remote sensing **(Lectures 8)**
Resolution in remote sensing, Satellite remote sensing, Problems confronting in remote sensing system. Ideal and real remote sensing systems. Applications of remote sensing in civil engineering.

Module 3: Visual Interpretation of Satellite Images **(Lectures 8)**
Elements of interpretation, Interpretation keys characteristics of digital satellite image, image enhancement, filtering, classification, integration of GIS and remote sensing, urban applications- integration of GIS and remote sensing water resources, urban analysis and watershed management.

Module 4: Geographical Information System & **Geo-referencing** **(Lectures 8)**
Introduction to Geographic Information System. Applications of GIS such as visibility analysis, slope analysis, watershed analysis & preparation of thematic maps. Limitations of GIS.
Geo-referencing; GIS data, spatial (raster & vector) & a spatial data. Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of a spatial data.

Module 5: Coordinate Systems and Projections **(Lectures 4)**
Geographic coordinate system: approximation of the earth, datum; map projections: types of map projections, map projection parameters, commonly used map projections, projected coordinate systems.

Text Book:

- Chandra A. M. and Ghosh S. K., 2015, "Remote sensing and Geographical Information System", Narosa Publishing House.
- Gopi S., Sathikumar R. and Madhu N., 2017, "Advanced Surveying -Total Station, GIS and Remote Sensing", Pearson publication.
- Lilles and Kiefer," Remote sensing & image interpretation", John Wiley Pub.
- Jensen J. R., "Remote sensing of the environment – An earth resources perspective" 2nd edition Pearson Education.
- Reddy M. A., 2001, "Textbook of Remote sensing and Geographical information system", B.S. Publications, Hyderabad.

References:

- Burragh P.A. and Mc Donnnell R. A., 2016, "Principals of Geo physical Information system", Oxford Publications, 2004.
- Kumar A., 2016, "Basics of remote sensing & GIS", Laxmi publications.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Acquire knowledge demonstrating of earth resources management using remote sensing.
CO2: Gain skills in storing, managing digital data for planning and development.
CO3: Acquire skills in advance software's deals with remote sensing data for utilization.

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BTCVOE605I Civionics: Instrumentation & Sensor Technologies for Civil Engg.

Teaching scheme: (3 Lectures) hour/week

Course contents

Module 1: Instrumentation **(Lectures 8)**

Piezometer: measure pore water pressure open standpipe vibrating wire (push in). Pneumatic Inclinometers: measure tilts Strain gauges, Full Bridge, Half bridge and Quarter Bridge. Linear Variable Differential Transformer, LVDT (Linear Variable Displacement Transducer), Load Cells.

Module 2: Calibration of Instruments **(Lectures 8)**

Mechanical, electrical, electronic system and their calibration, various types of sensors for displacement, velocity, acceleration, pressure, loads, strains, full-field measurements.

Module 3: Sensor Technologies for Civil Infrastructures **(Lectures 8)**

Similitude and structural models: dimensional analysis, Buckingham's Pi theorem, scale factors and dynamic similitude; Uses and applications of models: types of model investigation, indirect and direct models, elastic and inelastic model (steel, concrete and masonry), size effects.

Module 4: Analysis of Experimental Data **(Lectures 6)**

Error and uncertainty in experiment, measurement systems, accuracy in models and reliability of results; Test planning, design and implementation: testing sequence and experimental plan, loading systems, devices, actuators and their control.

Module 5: Data Acquisition System and Data Processing **(Lectures 6)**

Analog systems, digital systems using personal computers, dynamic measurement

Data Processing: numerical and graphical data processing and archiving. Experiments to illustrate buckling of structural members; load-deformation behavior of beams, columns, joints, and frames under various loads.

Text Books:

- Wang M., Lynch L.J.P. and Sohn H., "Sensor Technologies for Civil Infrastructures, Applications in
- Structural Health Monitoring (Woodhead Publishing Series in Civil and Structural Engineering)"
- Chen H. P., 2018, "Structural Health Monitoring of Large Civil Engineering Structures", Wiley-Blackwell.
- Blake L. S., 1994, "Civil Engineer's Reference Book Butterworth-Heinemann".
- Brunelle A. and Don J., 2017, "Calibration Handbook of Measuring Instruments", the International Society of Automation (ISA).

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand workings of sensors and transducers.
CO2: Determine the in-situ characterization and various properties.
CO3: Carry out subsurface measurements and techniques of data collection.
CO4: Understand ongoing studies on use of sensors in civil engineering practice &research.

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BTCVOE605J Planning for Sustainable Development

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(Lectures 06)**
Sustainable Development-explains and critically evaluates the concept of sustainable development

Module 2: **(Lectures06)**
Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability

Module 3: **(Lectures 06)**
Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

Module 4: **(Lectures 06)**
Innovation for sustainable development- Environmental management and innovation strategies.

Module 5: **(Lectures 12)**
Societal transformations. Institutional theory, Governance for sustainable development. Policy responses to environmental degradation. Capacity development for innovation. Research methods.

Text/Reference Books:

- Harris, J.M., 2004, " Basic Principles for Sustainable Development, Global Development and Environment"
- Robinson, J., 2004, “Squaring the circle? Some thoughts on idea of sustainable Development” Ecological Economics
- Hjorth, P. & A. Bagheri, 2006, “Navigating towards Sustainable Development: A System Dynamics Approach”, Futures
- Mog, J.M., 2004, "Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs“, World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure
- Arundel, A., R. Kemp, and S. Parto, 2004,"Indicators for Environmental Innovation: What and How to Measure, forthcoming in International Handbook on Environment and Technology Management (ETM), edited by D. Annandale, J. Phillimore and D. Marinova, Cheltenham, Edward Elgar.

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BTCVOE605K Development Engineering

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module1 **(6 Lectures)**

Introduction to Development Engineering: need of development engineering, core disciplines and concept, major issues in development; urban development; rural development; socioeconomic development; scientific social research, formulation of research problem, field work and data collection, report drafting

Module 2 **(6 Lectures)**

Design of Sustainable Communities: Concept and development of sustainable communities; Sustainable design, principles, building regulations, codes and standards - ANSI, ASTM, ASHRAE, approval process; green buildings- green building techniques- energy solutions, site solutions, site solutions, exterior and interior solutions, Certification -BREEAM, GRIHA, NAHB, LEED, IGBC;

Module 3 **(8 Lectures)**

Town / City Planning: Town Planning- history of town planning 111 India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum redevelopment; Smart city planning- introduction to city planning, infrastructure elements of smart city planning, dimensions of smart cities - global standards and performance benchmark; smart solutions- e governance, waste management, water management, energy management, urban mobility, citizen services, other services such as tele-medication and education, trade facilitation, skill development; GIS for planning

Module 4 **(8 Lectures)**

Planning and Development of Rural Areas: District administration, District Planning, introduction to various sectors of rural areas such as drinking water, waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy; issues and challenges associated with these sectors; People's participation and role in development of rural areas; various schemes and policies floated by state and central government - phases in the schemes; life cycle costing of these schemes.

Module 5 **(8 Lectures)**

Geoinformatics for Planning and Development: Introduction to Geoinformatics; Advantages, benefits and limitations; Interdisciplinary applications; Data extraction; use of Geoinformatics for planning, mapping and preparation of layouts.

Development aspects: Urban and Rural: Planning and designing of a model town / city and using AutoCad and/ or GIS. Visit to a village or small town - The project will be carried out in groups. Problem faced by the villagers pertaining to various sectors or existing schemes; define the need, method, tools and techniques for development; deliver technology based solution.

Recommended Books:

- Chand, M. and Puri, U.K.(1983),'Regional Planning in India', Allied Publishers, N. Delhi.
- Kaiser, E. J ., et.al. (1995), 'Urban Land use Planning', (ed) Urbana, University of Illinois Press.
- Sundaram, K.V. 1985 'Geography & Planning', Concept Publishing Co., New Delhi.
- Ayyar, C.P.V. (1987), 'Town Planning in Early South India', Mittal Publications, Delhi.
- Reeder, L. Hoboken, NJ, 'Guide to green building rating systems', John Wiley &Sons, Inc., 2010.
- Longley, P.A., Michael F. Goodchild, Maguire, D.J., Rhind, D. W. (2005), 'Geographic Information Systems and Science', Second Edition 2005: John Wiley &, Sons, New York.
- Desai, V. (2005), 'Rural Development of India', Himalaya publishing house, Mumbai.
- Rau, S.K. (200 I), 'Global Search for Rural Development', NIRD, Hyderabad

References:

- Institute of Town Planners, India, Ministry of Urban Affairs & Employment, Government of India, New Delhi, UDPFI Guidelines, 1996.
- Miles R. Simon, 1970, 'Metropolitan Problems' Methuen Publications, Canada.
- B.I.S., 1980, ''National Building Code of India', ISI, New Delhi.
- ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings Except Low -Rise Residential Buildings
- ASHRAE Standard 90. 1, Energy Standard for Buildings Except Low-Rise Residential Buildings

Course Outcomes: The required course for emphasis in development engineering will help students

CO 1 : To develop multi scaled perspective about decisions in the built environment,

CO 2 : To expose the students to the analysis and evaluation of real world problems aiming to bring desired change in the society.

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BTHM606 Indian Constitution

Teaching Scheme: 2 Lecture / week

The constitution of India:

1. Preamble
2. Fundamental Rights
3. Directive principles of state policy
4. Fundamental Duties
5. Some other provisions

Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission.

Module.1 Introduction **(5 Lectures)**

Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy

Module.2 Union Government and its Administration **(5 Lectures)**

Structure of the Indian Union: Federalism, Centre- State, relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

Module.3 State Government and its Administration **(4 Lectures)**

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Module.4 Local Administration **(5 Lectures)**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Module.5 Election Commission **(5 Lectures)**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

TEXT/REFERENCE BOOKS:

- Sastry, T. S. N., (2005). India and Human rights: Reflections, Concept Publishing Company India (P Ltd.),
- Nirmal, C.J., (1999). Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

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BTCVL607 SDD of RC Structures Lab

Term work shall consist of detailed analytical report for structural design and drawing of the following RC structures:

A) G + 2 Building

B) Any one of the following

(The introduction, analysis and design of these topics shall be studied in self-study mode. If required the subject teacher should address the student's queries during tutorials).

1) Retaining wall
2) Elevated water tank: analysis and design of staging and tank body.
3) Staircase of special form such as helicoidal stair
4) Shell roofs
5) Special foundation type such as combined footing, raft, pile foundation

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BTCVL608 Transportation Engineering Lab

Practical: 2 Hours / Week

Practical Work consists of all experiments from (a) and at least six performances among the list (b) below and detailed reporting in form of journal and Project Reports. Practical examination shall be based on above

a) Tests on Aggregates

1) Shape Test
2) Specific Gravity and Water Absorption Test
3) Stripping Value Test
4) Soundness Test
5) CBR Test on Soil and Aggregates

b) Test on Bituminous Materials

1.

1. Penetration Test
2. Softening Point Test
3. Flash and Fire Point Test
4. Ductility Test
5. Viscosity Test
6. Specific Gravity Test
7. Demonstration of Marshall Test
8. Pavement design exercise based on flexible pavement consisting of bituminous concrete.
9. Visit to Road construction site for studying different construction equipment's.

Course Outcomes: On completion of the course, the students will be able to:

Perform tests on various road construction materials.

PerformCBRtestsonlocalsoilstodeterminesubgradepropertiesneededforroadways

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BTCVM609 Mini Project

Student shall choose a topic of his interest in consultation with faculty in the department. The topic for mini projectmay be related to Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary informationand present a summary indicating comprehension of the topic and acquired depth of knowledge. It is desirable to obtainindustry or community sponsorship. Simplified tools or devices may be presented in form of working model and a brief reportstating development.A power point presentation shall also be submitted.

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BTCVP 610 Field Training /Internship /Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training for minimum 4 weeks which can be completed partially in V Semester and VI Semester or in at one time after VI Semester. Evaluation will be done in VII Semester.

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Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad
Pin 402 103, Maharashtra
Telephone and Fax: 02140 - 275142
www.dbatu.ac.in

Proposed Course Contents for

B. Tech. in Civil Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Department of Civil Engineering

Program Objectives

Goal of the Civil Engineering at Dr. Babasaheb Ambedkar Technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) **Preparation:** To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

b) **Core Competence:** To provide students with a solid foundation in mathematical, scientific fundamentals required to solve real life civil engineering problems;

c) **Breadth:** To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) **Professionalism:** To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) **Learning Environment:** To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

Program Educational Objectives

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design various structures and systems that is safe, economical and efficient;
3. Capable of using modern tools efficiently in all aspects of professional practices;
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge;
5. Shall be engage in continuous research, development and exchange of knowledge for professional development;
6. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
7. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
8. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
9. Continue their professional development throughout their careers and provide opportunities for the professional development.

Program Outcomes

At the end of the program the student will be able to:

PO 1	Apply the knowledge of mathematics, basic sciences, and civil engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex civil engineering problems reaching substantiated conclusions.
PO 3	Design solutions for complex engineering problems and design of civil engineering structures that meet the specified needs.
PO 4	Use civil engineering research-based knowledge related to interpretation of data and provide valid conclusions.
PO 5	Create, select, and apply modern civil engineering and IT tools to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning acquired by the civil engineering knowledge to assess societal and safety issues.
PO 7	Understand the impact of engineering solutions on the environment, and demonstrate the knowledge for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO 11	Understand the engineering and management principles and apply these to the multidisciplinary environments.
PO 12	Recognize the need for life-long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

PSO 1	Make the students employable in engineering industries.
PSO 2	Motivate the students for higher studies and research.
PSO 3	Motivate the students for various competitive examinations.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam
SS:	Self Study Course

B. Tech. Civil Engineering

Course Structure for Semester VII (Fourth Year) w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVC701	**Core**	Design of Concrete Structures - II	2	1	--	20	20	60	100	3
BTCVC702	**Core**	Infrastructure Engineering	3	--	--	20	20	60	100	3
BTCVC703	**Core**	Water Resources Engineering	3	1	--	20	20	60	100	4
BTCVC704	**Core**	Professional Practices	2	1	--	20	20	60	100	3
BTCVE705A	**Elective IV**	Construction Techniques	3	--	--	20	20	60	100	3
BTCVE705B		Engineering Economics								
BTCVE705C		Finite Element Method								
BTCVE705D		Limit State Design of Steel Structures								
BTCVE705E		Plastic Analysis and Design								
BTCVE705F		Water Power Engineering								
BTCVOE706A	**Open Elective V**	Advanced Structural Mechanics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTCVOE706B		Air Pollution Control								
BTCVOE706C		Bridge Engineering								
BTCVOE706D		Introduction to Earthquake Engineering								
BTCVOE706E		Town and Urban Planning								
BTCVOE706F		Tunneling and Underground Excavations								
BTCVL707	Laboratory	Design & Drawing of RC & Steel Structures	--	--	2	30	--	20	50	1
BTCVL708	Laboratory	Professional Practices	--	--	2	30	--	20	50	1
BTCVT709	Training	Field Training /Internship/Industrial	--	--	--	--	--	50	50	1
BTCVS710	BTS	Seminar	--	--	2	--	--	50	50	1
BTCVP711	BTP	Project Stage-I**	--	--	6	--	50	50	100	3
		Total	**16**	**3**	**12**	**160**	**150**	**490**	**800**	**23**

***In case of students opting for Internship and Industry Project in the eighth semester, the Project must be industry-based.*

B. Tech. Civil Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

<table>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Type of Course</th><th rowspan="2">Course Title</th><th colspan="3">Weekly Teaching Scheme</th><th colspan="4">Evaluation Scheme$</th><th rowspan="2">Credits</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>CA</th><th>MSE</th><th>ESE</th><th>Total</th></tr>
<tr><td>BTCVSS801A</td><td rowspan="5">(Self-Study Course) #</td><td>Characterization of Construction Materials</td><td rowspan="5">03**</td><td rowspan="5">--</td><td rowspan="5">--</td><td rowspan="5">20</td><td rowspan="5">20</td><td rowspan="5">60</td><td rowspan="5">100</td><td rowspan="5">3</td></tr>
<tr><td>BTCVSS801B</td><td>Geosynthetics and Reinforced Soil Structures</td></tr>
<tr><td>BTCVSS801C</td><td>Higher Surveying</td></tr>
<tr><td>BTCVSS801D</td><td>Maintenance and Repair of Concrete Structures</td></tr>
<tr><td>BTCESS801E</td><td>Structural Dynamics</td></tr>
<tr><td>BTCESS802A</td><td rowspan="5">(Self-Study Course) #</td><td>Energy Efficiency Acoustics and Daylighting in Building</td><td rowspan="5">03**</td><td rowspan="5">--</td><td rowspan="5">--</td><td rowspan="5">20</td><td rowspan="5">20</td><td rowspan="5">60</td><td rowspan="5">100</td><td rowspan="5">3</td></tr>
<tr><td>BTCESS802B</td><td>Environmental Remediation of Contaminated Sites</td></tr>
<tr><td>BTCESS802C</td><td>Remote Sensing Essentials</td></tr>
<tr><td>BTCESS802D</td><td>Mechanical Characterization of Bituminous Materials</td></tr>
<tr><td>BTCESS802E</td><td>Soil Structure Interaction</td></tr>
<tr><td>BTCEP803</td><td>Project Stage-II</td><td>In-house Project or Internship and Project in Industry*</td><td>--</td><td>--</td><td>30</td><td>50</td><td>--</td><td>100</td><td>150</td><td>15</td></tr>
<tr><td colspan="3">Total</td><td>04</td><td>--</td><td>30</td><td>90</td><td>40</td><td>220</td><td>350</td><td>21</td></tr>
</table>

 # The subjects are to be studied on self-study mode using SWAYAM/NPTEL/any other online source approved by the University.

*****If required Coordinator may be appointed for each Self study course and an administrative load of 03 hours per week may be considered for monitoring and assisting the students, and to conduct examination (if required), evaluation and preparation of result.***

$ If the examination schedule for the online Self study course chosen by student do not match with the University's Academic Schedule, the University/Institute have to conduct exam for such courses.

**** Six months of Internship and Project in the Industry. One Faculty guide from the Institute and one Mentor from the Industry should be identified to monitor the progress of work. During the Project/Internship period of work, a review of work should be taken twice followed by a final presentation at the end of Project period.***

Detailed Syllabus (VII Semester)

BTCVC701 Design of Concrete Structures - II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Limit State Method for RC Structures

Module 1: **(6 Lectures)**

Limit State of Collapse (Torsion) - Types of torsion, behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and Torsion

Module 2: **(6 Lectures)**

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), detailing of reinforcement, and construction of Interaction diagrams for uni-axial bending, concept of bi-axial bending Prestressed Concrete

Pre-stressed Concrete

Module 3: (5 Lectures)

Introduction to prestressed concrete, concepts, types, systems and methods of pre stressing,

Module 4: (5 Lectures)

Stress analysis for rectangular and symmetrical I sections, Pressure Line, Cable Profiles

Module 5: **(4 Lectures)**

Losses in Prestressing for Pre-tensioned & Post tensioned members

Module 6: **(6 Lectures)**

Design of Rectangular and Symmetrical I sections, Design of End Block

Structural audit of various structures such as load bearing wall type, RCC, Steel Framed, Prestressed Concrete, etc.:

conceptual introduction to elaborate necessity, implementation of audit, format of reporting, consequences

Text Books

- IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
- Karve& Shah, “Limit State Theory & Design”, Structures Publications, Pune
- Lin T.Y., “Prestressed Concrete”, John Willey & Sons New York
- Jain A.K., “Reinforced Concrete Design (Limit State)”, Nemchand Brothers, Roorkee
- Sinha S.N., “Reinforced Concrete Design”, Vol. I, II, Tata Mc-Graw Hill
- Sinha& Roy, “Fundamentals of Reinforced Concrete”, S. Chand & Co. New Delhi
- Sinha& Roy, “Prestressed Concrete”, S. Chand & Co. New Delhi
- Krishnaraju N., “Prestressed Concrete”, Tata Mc-Graw Hill

Reference Books

- Punmia B.C., “Reinforced Concrete Design”, Vol. I, II, Laxmi Publications
- Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi
- Relevant Publications by Bureau of Indian Standards, New Delhi
- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Course Outcomes: On completion of the course, the students will be;

- Able to identify the behavior, analyze and design of the beam sections subjected to torsion.

- Able to analyze and design of axially and eccentrically loaded column and construct the interaction diagram for them.
- Understand various concepts, systems and losses in pre-stressing.
- Able to analyze and design the rectangular and symmetrical I-section pre-stressed beam/girders.

BTCVC702 Infrastructure Engineering

Teaching Scheme :(4 Lectures) hours/week

Course Objectives:

a. To discuss elements of Railway Engineering, tunnel engineering, Docks &Harbours
b. To discuss elements of Bridge Engineering and Airport Engineering
c. To provide information about their processing, Construction and maintenance
d. To make students understand function of infrastructural components and their significance

Course Contents

Module 1 (5 Lectures)
Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, sub grade formation, fixtures and fastenings, Geometric Design of tracks- Horizontal Alignment, Vertical Alignment

Module 2 (5 Lectures)
Points and Crossings: Standard types, Design of simple turnout, various types of Junctions, Stations and Yards: Purpose, Location, Site selection, general layouts of Terminus and Junction, Signaling and Interlocking, Construction and Maintenance of Track, Modern trends in Railways

Module 3: (10 Lectures)
Bridge Engineering: Sub-structures

Determination of design discharge, Linear Water Way, Economical Span, Afflux, Scour depth, Indian Road Congress Bridge Code
Abutments: Definition, Functions, Dimensions, Types, Forces acting on an abutment, Conditions of stability
Piers: Definition, Function, Types, Forces acting on a pier, Conditions of stability, Dimensions, Location, Abutment pier
Wing walls: Definition, Functions, Types, Forces acting on a wing wall, Conditions of stability, Dimensions, Precautions
Materials for sub-structures: Cement concrete, Masonry, Steel

Module 4: (10 Lectures)
Bridge Engineering: Super-structures

Simple bridges or beam bridges: Deck bridges, Through bridges, Semi-through bridges

Introduction, advantages and disadvantages: Continuous bridges, Cantilever bridges, Arch bridges, Bow-string girder type bridges, Rigid frame bridges, Portal frame bridges, Suspension bridges, Cable-stayed bridges, Composite bridges

Materials for super-structures: Cement concrete, Masonry, Steel, Timber

Module 5: (10 Lectures)
Tunnel Engineering: Shape and Size of Tunnel Shafts, Pilot Tunnels, Tunneling in Hard Rock, Tunneling in Soft Materials, Drilling-Patterns, Blasting, Timbering, Mucking, Tunnel Lining, Advances In Tunneling Methods, Safety Measures, Ventilation, Lighting and Drainage of Tunnels

Module 6: (5 Lectures)

Dock and Harbor Engineering: Inland Water Transport in India, Tides, Winds and Waves Erosion, Transport of Sediments, Beach Drift, Littoral Drift, Sand Bars, Coast Protection, Classification of Ports and Harbors, Site Selection, Features of Break Waters, Jetties, Wharves, Piers, Facilities required, Dry Docks, Wet Docks, Lift Docks, Floating Docks, Spillways, Navigational Aids, Lighthouses, Terminal Buildings, and Dredging- Special Equipment

Airport Engineering: Planning, Airport Surveys, Site Selection, Zoning Laws, Runways, Geometric Design, Airport Capacity, Terminal Buildings, Parking Systems, Taxiways, Hangers, Airport Drainage, Air Traffic Control, Airport Lighting

Text Books

1. Saxena S. C. and Arora S. (2003) "A Course in Railway Engineering," DhanpatRai& Sons, Delhi
2. Quinn A. D. "Planning and Construction of Docks and Harbours", Tata McGraw Hill, New Delhi
3. Oza H. P. and Oza G. H. (2012) "Dock and Harbour Engineering", Chartor Publishing House, Anand
4. Shrinivasan R. (2016) "Dock, Harbour and Tunnel Engineering", Chartor Publishing House, Anand
5. Arora N. L. (1995) "Transportation Engineering", IPH New Delhi
6. Bindra S. P. "Bridge Tunnel and Railway Engineering", Dhanpatrai and Sons, New Delhi
7. Khanna S. K. and Arora N. L. (1999), "Airport Engineering" Nemchand& Bros., Roorkee
8. Rangawala S. C. (2012) "Airport Engineering", Charotar Publishing House Pvt. Limited, Anand
9. Rangawala S. C. "Bridge Engineering", Charotar Publishing House Pvt. Limited, Anand
10. Hariharan K. V. (2002) "Multimodal Transport & Infrastructure Development in India", Shroff Publishers, Mumbai

References

1. Publications of Bureau of Indian Standards, New Delhi, Relevant To the Syl Laboratories
2. Cormick H. F. (1975) "Dock and Harbour Engineering" Giffin Publishers
3. Raina V K. (2012) "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
4. Horonjeff R. (2012) "Planning and Design of Airports", Tata McGraw Hill, New Delhi

Course Outcomes: On completion of the course, the students will be able to:

- Know about the basics and design of various components of railway engineering
- Understand the types and functions of tracks, junctions and railway stations.
- Know about the aircraft characteristics, planning and components of airport
- Understand the types and components of docks and harbors.

BTCVC703 Water Resources Engineering

Teaching Scheme :(3 Lectures+ 1 Tutorial) hours/week

Course objectives:

1) To study occurrence movement and distribution of water that is a prime resource for development of a civilization.

2) To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.

3) To know the basic principles and movement of ground water and properties of ground water flow.

Course Contents

Module 1: Introduction (10 Lectures)

Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, difference between weir, barrage and dam, methods of distribution of water, development of irrigation in India Introduction to hydrology: hydrologic cycle, rain, surface and ground water

Water Requirement of Crops

Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

Module 2: Reservoirs and Dams (10 Lecturers)
Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam,

Module 3: Spillway Weirs and Canals (8 Lectures)
Spillway, Necessity and Different Types, Location of Spill Ways, Selection Criterion, Gates for Spillways,

Weirs on Permeable Foundations: Theories of Seepage, Bligh's Creep Theory, Limitations of Bligh's Creep Theory, Khosla's Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy's and Lacey's Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

Module 4: Lift Irrigation (8 Lectures)
Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy's law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).

Module 5: Hydrology (6 Lectures)
Hydrology, measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

Module 6: Water logging and drainage (6 Lectures)

Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures

Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara.

Text Books

1. Varshney R. S., Gupta & Gupta, 1987, "Theory and Design of Irrigation Structures", Vol. I & II
2. Punamia B. C. Pandey B. B. and Lal, 1992, "Irrigation and Water Power Engineering", Standard Publishers, New Delhi
3. Garg S. K., 1976, "Irrigation Engineering & Hydraulic Structures",Khanna Publishers, N. Delhi,
4. Priyani, 1982, "Irrigation and Water Power", Charotar Publishing House, Anand
5. Bharat Singh,1979, "Irrigation", Nemchand Brothers, Roorkee
6. Subramanya K., 1984, "Engineering Hydrology", Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

1. USBR, "Design of Small Dam", OXFORD & IBH, Publishing Company
2. Justinn, 1961, "Engineering for Dam" Vol. I, II, III, Creager and Hinds
3. Leliavsky, "Design of Hydraulic Structures" Vol. I & II,

4. C B I & P "River Behaviour, Management and Training"
5. Circular of Government of Maharashtra, 18 February 1995, "Design of Canals"

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.

CO2: Understand various irrigation structures and schemes.

CO3: Develop basis for design of irrigation schemes.

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BTCVC704 Professional Practices

Teaching Scheme :(2 Lectures + 1 Tutorial) hours/week

Pre Requisites: Building Construction

Course Objectives:

1. To discuss introduce methods of quantity surveying, costing, and valuation
2. To facilitate students with concepts of costing involved in infrastructures
3. To make students familiar with process involved during tendering & contracting

Course Contents

Module 1: Introduction **(04 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates

Module 2: Quantity Surveying **(06 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates, specifications: purpose general and detailed specifications for various items of work, prime cost, provisional sums and provisional quantities, taking out quantity, P.W.D. method, recording of measurements

Module 3: Costing **(10 Lectures)**

Analysis of rates for various items of construction of civil engineering works, standard schedule of rate, price escalation, detailed and approximate estimates for buildings, R.C.C works, culverts, earthwork for canals, roads including hill roads and other civil engineering works

Module 4: Tendering **(6 Lectures)**

Types, preparation of tender papers, conditions of contracts, competitive bidding, types of bids, invitation of tenders, scrutiny and acceptance of tenders, award of jobs, introduction to B.O.T. and similar other basis of execution,

Module 5: Contracts **(8 Lectures)**

Essentials of legally valid contract, types and forms of contract between various agencies, organizational set up of P.W.D. classification of works, method of carrying out work in P.W.D. mode of payment, bill forms, introduction to arbitration

Module 6: Valuation **(6 Lectures)**

Principles, types, price and cost, attributes of value, valuer and his duties, factors affecting the valuation of properties, methods of valuation, different types of lease

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

Text Books

1. Dutta B. N. (2012) "Estimating and Costing", UBS Publishers Distributors, New Delhi

2. Namavati R. H. (2016) “Professional Practice Estimating and Valuation”, Lakhani book Depot, Mumbai
3. Patil B. S. (2015) “Civil Engineering Contracts and Estimates”, Universities Press, Hyderabad
4. Bhasin P. L. (1987) “Quantity Surveying”, S. Chand & Co. Ltd., Mumbai
5. Rangwala S. C. (1990), “Elements of Estimating and Costing”, Charotar Publication, Anand
6. Birdi G. S. (2014) “Estimating and Costing”, DhanpatRai& Sons, N. Delhi
7. Chakroborty M. (2010) “Estimating, Costing & Specification in Civil Engineering”, M.Chakraborty Publication, Nepal
8. Rangwala S. C. (2011) “Valuation of real Properties”, Charotar Publication, Anand

References

1. Govt. of Maharashtra P.W. and Housing Department Publication edition 1979 and 1981
2. P. W. D. Maharashtra, “Standard Specifications”, Volumes I & II
3. C.P.W.D. Specifications
4. C.P.W.D. Schedule of Rates
5. P.W.D. Maharashtra Schedule of Rates
6. Publications of Bureau of Indian Standards: IS 1200 all parts, and other relevant

Course Outcomes: On completion of the course, the students will be able to:
Understand the importance of preparing the types of estimates under different conditions for various structures.

Know about the rate analysis and bill preparations and to study about the specification writing.

Know the various types of contract, accounts in PWD, methods for initiating the works in PWD and tendering.

Understand the valuation of land and buildings, various methods and factors affecting valuation.

BTCVE705A Construction Techniques

Course Objectives:

The main objectives of the course are:

1. To study different methods of construction to successfully achieve the structural design with recommended specifications.
2. To involve the application of scientific and technological principles of planning, analysis, design and management to construction technology.

Teaching Scheme: (3 Lectures+1Tutorials) hours/week

Course Contents

Module 1: (8 Lectures)
Introduction, planning of a new project, site access and services, mechanical and manual construction, excavation in earth: Understanding basics and functions of equipment, earthmoving equipment - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates, drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities

Module 2:(8 Lectures)
Excavation in hard rock, Rippers, jack hammers, drills, compressors and pneumatic equipment, blasting explosives, detonators, fuses, drainage in excavation – necessity and methods of dewatering

Module 3:(8Lectures)
RMC Plant, layout and production capacity, type of concrete mixers, machinery for vertical and horizontal transportation of concrete, grouting, Shotcreting, under water concreting, Type of formwork, Slip formwork, equipment for placing of concrete in normal and difficult situations

Module 4: (8 Lectures)
Prefabricated construction: Relative economy, steel construction: planning and field operations, erection equipment, cranes of various types such as tower, crawler, luffing jib tower crane, floating and dredging equipment

Module 5: (4 Lectures)

Road construction aspects, asphalt mixing and batching plant (Hot Mix Plant), sensor paver for rigid roads, crushing plants belt conveyers, cableway, construction of a new railway track, aspects of bridge construction

Module 6: (4 Lectures)

Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

Text Books

1. Peurifoy R.L. (2010). *Construction, Planning, Equipment & Methods*, McGraw hill Book Co. N. Delhi
2. Verma Mahesh, (1975). *Construction Equipment*, Metropolitan book Co., New York
3. Singh J., (2006). *Heavy Construction - Planning, Equipment & Methods*, Oxford & IBH Pub., N. Delhi

Reference Books

1. Quin A. (1961), Planning and Construction of Docks and Harbors, Mc-Graw Hill Company, New York.
2. Stubbs F. W., (1971). Hand Book of Heavy Construction, Mc-Graw Hill Inc, US 2nd edition.
3. Boyes R.G.H, (1975). Structural & cut off Diaphragm Walls, Applied Science Publishers Ltd. London.
4. Ataev S. S., (1999). Construction Technology, Mir Publishers, Mascow.

Course Outcomes: On completion of the course, the students will be able to:

1. Understand the planning of new project with site accessibility and services required.
2. Comprehend the various civil construction equipment's.
3. Familiar with layout of RMC plant, production, capacity and operation process.
4. Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.

BTCVE705B Engineering Economics

Course Objectives:

The main objectives of the course are:

1. To learn the economics behind any constructional activities.
2. To Emphasis upon develop interest in investment evaluation and financing projects.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(04 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation,

Module 2 **(06 Lectures)**

Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 3 **(06 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 4 **(06 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 5 **(08 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Module 6 **(06 Lectures)**

PPP in Projects Public Private Participation in Projects- PPP Models, BOOT, BOT, Joint Ventures, BOOT, BOT, Annuity, DBFO, External Commercial Borrowings, International Finance, FIDIC.

Text Books

1. Blank, L.T., and Tarquin, A. J., (1988). *Engineering Economy*, Mc-Graw Hill Book Co.
2. Collier C. and GlaGola C. (1998). *Engineering Economics & Cost Analysis*, Addison Wesley Education Publishers,
3. Patel, B. M., (2000). *Project management- strategic Financial Planning, Evaluation and Control*,Vikas Publishing House Pvt. Ltd. New Delhi,
4. Shrivastava, U. K., (2000). *Construction Planning and Management*, Galgotia Publications Pvt. Ltd. New Delhi.

References

1. Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
2. Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
3. Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
4. Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
5. Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
6. Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing

CO2: Analyze available alternatives and propose best suitable among them

CO3: Apply various models of financial management and accounting

BTCVE705C Finite Element Method

Course Objectives:

The main objectives of the course are:

1. To solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.
2. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to FEM & Approximate Methods **(06 Lectures)**

Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's

Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure.

Module 2: One Dimensional FE Analysis **(06 Lectures)**

Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C^0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses)

Module 3: FE Analysis by Direct Approach **(06 Lectures)**

C^1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Simple applications to Beams.

Module 4: Two Dimensional FE Analysis **(06 Lectures)**

Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems

Module 5: Three Dimensional FE Analysis **(04 Lectures)**

3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, FEA of Axi-symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (all contents at introductory level)

Module 6: Applications of FEA **(04 Lectures)**

Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to software's, elementary problem-solving using freeware

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class test shall cover syllabus of any three consecutive Modules.

References:

1. Mukhopdhyay, M., (1984). *Concept and Application of Finite Element Analysis*, Oxford and IBH Publishing Co. Pvt. Ltd.

2. Zienkiewicz, O.C and Taylor R.L., (2000). *The Finite Element Method*, Vol 1 & 2; 5th Ed, Butterworth-Heinemann,

3. Reddy J. N. (2005). *An Introduction to Finite Element Method*, McGraw Hill , 3rd Ed,
4. Cook R.D., Malcus D.S. and Plesha, (1997). *Concepts and Applications of Finite Element Analysis*,4th Ed, Wiley.
5. Hutton D.V., (2004). *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Pub.
6. Desai C. S. & Abel J. F., (1974). *Introduction to the Finite Element Method*, CBS Pub.
7. Krishnamoorthy C. S, (1994). *Programming in the Finite Element Method*, Tata McGraw Hill.

8. Chandrupatla T. R. and Belegundu,(2002). *Introduction to the Finite Element in Engineering,* Pearson Education.
9. Bathe K.J., (1996). *Finite Element Procedures*, PHI learning pvt.ltd
10. Desai Y.M., and Eldho T.I, (2011). *Finite Element Method with application in Engineering*, Pearson, Delhi
11. Bhavikatti S. S. (2015). *Finite Element Analysis*, New Age International Publication.

Course Outcomes: Upon completion of the course the students will be able to:

1. Understand the different energy methods in structural analysis and basic concepts of finite element method.
2. Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
3. Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
4. Solve 2-D problems using knowledge of theory of elasticity.
5. Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics.
6. Analyze 1D, 2D, and 3D structures using different software packages based on FEM.

BTCVE705D Limit State Design of Steel Structures

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Design of Steel structures

Course Objectives:

- To introduce the design loads and the stresses developed in the steel member
- To discuss the various connections and identify the potential failure modes
- To provide guidelines for various tension, compression and flexural members.
- To make students aware of various guidelines set by Standards & Codes

Course Contents

Module 1: Introduction **(4 Lectures)**

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Module 2: Connections **(4 Lectures)**

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 3: Axially Loaded Members **(6 Lectures)**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice

Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Module 4: Beams **(6 Lectures)**

Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections

Module 5: Industrial Roofing **(6 Lectures)**

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details

Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Module6: Columns and Column Bases **(8 Lectures)**

Simple and built up section; lacing, battening, column subjected to axial force and bending moment, column splices. Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt.

Note: Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic design **concept and shall be taught with reference to IS 800 2007**

Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

1. Duggal S. K. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Gambhir M. L. (2017) "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Negi L. S. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Chandra Ram (2016) "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
5. Subramanian N. (2010) "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
6. Sai Ram K. S. (2015) "Design of Steel Structures", Pearson Education, Delhi

Reference Books

1. Arya A. S. and Ajamani J.L. (2014) "Design of Steel Structures", Nemchand and Brothers, Roorkee
2. Vazirani V.N. and Ratwani M.M. (1988) "Design of Steel Structures", Standard Book House, New Delhi
3. Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
4. Gaylord E.H. and Gaylord C.N. (1991) "Design of Steel Structures" McGraw Hill, New York
5. Salmon C. G. and Johnson J. E. (2008) "Steel Structures: Design and Behaviour", Harper and Row, New York
6. Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.

CO4: Understand provisions in relevant BIS Codes.

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BTCVE705E Plastic Analysis and Design

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Structural Mechanics I, Structural Mechanics-II, Design of Steel Structures

Course Objectives:

1. To introduce plasticity in various materials & components and their behavior.

2. To understand analysis of determinate and indeterminate members for collapse load
3. To understand philosophy of limit state design
4. To introduce potential design considerations for design calculations

Course Contents

Module 1 **(8 Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

Module 2: **(8 Lectures)**

Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms. Bending moment diagram at collapse

Module 3: **(6 Lectures)**

Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Module 4: **(6 Lectures)**

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force

Module 5 **(4 Lectures)**

Design of portal frames, design of corner connection with and without haunches.

Module 6 **(4 Lectures)**

Consideration of deformations, calculation of deflections for plastically deformed structures

Text Books:

- Bureau of Indian Standards, “Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)”.
- Bureau of Indian Standards, “IS: 800 Code of Practice for General Construction in Steel”
- Arya A.S. and Ajmani J.L., “Design of Steel Structures”, Nemchand& Bros., Roorkee
- Ramchandra, “Design of Steel Structures Vol – II”, Standard Book House, Delhi
- Neal B.G., “Plastic Method of Structural Analysis”, Chapman & Hall
- Beedle L.S., “Plastic Design of Steel Frames”, John Wiley & Sons

References:

- Bureau of Indian Standards, “Handbook for Structural Engineers SP 6”
- INSDAG Kolkata, “Teaching Resource for Structural Steel Design”
- “Steel Designers Manual” ELBS

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand modes of structural collapse

CO2: Perform the plastic analysis and design of various determinant and in-determinant structures.

CO3: Adapt plastic theory of design for various structures

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BTCVE705F Water Power Engineering

Teaching Schemes: Lectures: 3 Hours/Week

Course Objectives:

1. To introduce hydraulic energy sources and methods of generation’
2. To provide information of components, layout, and arrangements of power station
3. To inculcate the knowledge of essential collateral components and their practical significance.

Course Contents

Module 1 **(08 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

Module 2 **(08 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

Module 3 **(06 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

Module 4 **(06 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

Module 5 **(04 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants

Module 6 **(04 Lectures)**

Tidal Power Stations: Necessity, Advantages, Classification, Limitations

Text Books

1. Dandekar and Sharma, “Water Power Engineering”, Vikas Pub. House Pvt. Ltd.

2. Bhattacharya P. K., “Water Power Engineering”, Khanna Publications, New Delhi

3. Deshmukh M. M. “Water Power Engineering”, Dhanapatrai and Sons N. Delhi

References

1. Creager and Justin, “Hydro – Electric Hand Book”

2. Brown G., “Hydro-electric Engineering Practice”, Vol. I to III

3. Mosonvi, “Water Power Development”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify potential energy sources and adapt as per the requirement

CO2: inculcate basics of electricity generation and power plants

CO3: propose suitable energy source for running a project optimistically.

BTCVOE706 A Advanced Structural Mechanics

Teaching Schemes: Lectures: 3 Hours/Week

Course Contents

Module 1:Review of basic concepts in structural analysis (06 Lectures)
structure, loads, response, statically determinate structures, principle of virtual work and displacement-based and force-based energy principlesderiving stiffness and flexibilitycoefficients,Force method, Displacement Methods

Module 2: Matrix concepts and Matrix analysis of structures (06 Lectures)
Matrix; vector; basic matrix operations;rank; solution of linear simultaneousequations; eigenvalues andeigenvectors.Introduction; coordinate systems;displacement and force transformationmatrices;Contra-gradient principle; element andstructure stiffness matrices;Element and structure flexibilitymatrices; equivalent joint loads;stiffness and flexibility approaches

Module 3:Matrix analysis of structures with axialelements: (08 Lectures)
Introduction:Axial stiffness and flexibility; stiffnessmatrices for an axial element (two dof),plane truss element (four dof) andspace truss element (six dof);One-dimensional axial structures:Analysis by conventional stiffnessmethod (two dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Plane trusses:Analysis by conventional stiffness, method (four dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Space trusses:Analysis by conventional stiffnessmethod (six dof per element) andreduced element stiffness method(single dof).

Module 4:Matrix analysis of beams and grids (10 Lectures)

Conventional stiffness method forbeams:Beam element stiffness (four dof);generation of stiffness matrix forcontinuous beam; dealing with internalhinges, hinged and guided-fixed endsupports; accounting for sheardeformations;

Reduced stiffness method for beams:Beam element stiffness (two dof);dealing with moment releases, hingedand guided-fixed end supports;

Flexibility method for fixed andcontinuous beams:Force transformation matrix; elementflexibility matrix; solution procedure (including support movements);Stiffness method for grids:Introduction; torsional stiffness of gridelement and advantage of torsionrelease; analysis by conventionalstiffness method using grid elementwith six dof; analysis by reducedstiffness method (three dof perelement);

Module 5:Matrix analysis of planeframes: (06 Lectures)
Conventional stiffness method for planeframes:Element stiffness (six dof); generationof structure stiffness matrix andsolution procedure; dealing withinternal hinges and various endconditions;

Reduced stiffness method for planeframes:Element stiffness (three dof); ignoringaxial deformations; dealing withmoment releases, hinged and guidedfixedend supports;

Flexibility method for plane frames:Force transformation matrix; elementflexibility matrix; solution procedure(including support movements);Ignoring axial deformations;

Module 6:Matrix analysis of spaceframes: (04 Lectures)
Stiffness method for space frames:Introduction; element stiffness matrixof space frame element with 12 dofand 6 dof; coordinate transformations;analysis by reduced stiffness method(six dof per element);

References

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.

BTCVOE706B Air Pollution Control

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

a. To discuss the sources of air pollutants and their effect on human, plants and materials
b. To get the knowledge of meteorology for controlling air pollution
c. To facilitate students with design methodologies of air pollution control equipment
d. To make aware of legislation for prevention and control of air pollution

Course Contents

Module 1: Introduction to Air Pollution (04 Lectures)

The Structure of the atmosphere, Composition of dry ambient air and properties of air. BIS Definition and scope of Air Pollution, Scales of air pollution, Types of exposures.Air Pollutants,

Module 1: Classification (04 Lectures)

Classifications, Natural and Artificial, Primary and Secondary, point and Non-Point, Line and Area Sources of air pollution. Stationary and mobile sources, composition of particulate& gaseous pollutant, units of measurement.Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, air pollution episodes. Global effects of air pollution- global warming, ozonedepletion, acid rain and heat island effect.

Module3: Meteorology and Air pollution (06 Lectures)

Solar radiation, wind circulation, factors affecting dispersion of pollutants, Lapse rate, stabilityconditions, wind velocity profile, Maximum mixing depth (MMD), visibility, Windrosediagram,General characteristics of stack plume (Plume behaviour). Gaussion diffusion modelfor finding groundlevel concentration. Plume rise. Formulae for stack height and determinationof minimum stack height.

Module4: Air Sampling and Analysis (06 Lectures)

Air pollution survey, basis and statistical considerations of sampling sites. Devices and methods used for sampling gases and particulates. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Module5: Photochemical Smog, Odour Pollution & Indoor Pollution (08 Lectures)

Chemistry of air pollution, Chain reactions of hydrocarbons, nitrogen oxide, Sulphuric oxidesand intermediates, photochemical smog formation, air pollution indices -aerosols, fog, smog index. Odour pollution: Theory, sources, measurement and methods of control of odour pollution. Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.

Module6: Control of Air Pollution (08 Lectures)

By process modification, change of raw materials, fuels, process equipment and process operation by use of air pollution control equipment for particulate and gaseous pollutants. Design of control equipment as Settling chamber, cyclone, fabric filter, Electrostatic precipitator and Wet scrubber. Principles of removal of gaseous pollutants, design of incineration, absorption adsorption systems. Control of air pollution from automobiles.Vehicular pollution, composition, quantityandcontrol.Air (Prevention and Control) Pollution Act, 1981.Emission standards for stationary and mobile sources.National Ambient air quality standards, 2009 (NAAQS).

Text Books

1. Wark K. and Warner C. F. (1997) “Air pollution: Its Origin and Control” Pearson Education, Delhi
2. Rao M. and Rao H. V. N. (2017) “Air Pollution” Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Peavy S. H. and Rowe D. R. (2017) “Environmental Engineering” Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Muralio Krishna K. V. S. G. (2017) “Air Pollution and Control” Jain Brothers, Mumbai

Reference Books

1. Crawford M. (1984) “Air pollution Control Theory” McGraw Hill, New York
2. Anjaneyulu Y. (2002) “Air Pollution and Control Technologies” Allied Publishers, Mumbai
3. Raju B. S. N. (2018) “Fundamentals of Air Pollution” CBS Publishers and Distributors Pvt. Ltd., N. Delhi

Course Outcomes:On successful completion of this course the students will be able to

- Identify the sources of air pollutants and their effect on human, plants and materials.
- Apply knowledge of meteorology for controlling air pollution
- Design air pollution controlling equipment.
- Apply knowledge of legislation for prevention and control of air pollution.

BTCVOE706C Bridge Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction (4 Lectures)

History of bridges, components and definitions, classification of road bridges, span length, classical examples of each type, people involved in the total process, history of analysis

Module 2: Selection of site and initial decision process (8 Lectures)

Survey and alignment, geotechnical investigations and interpretations

River Bridge: Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard.

Road Bridge: Selection of bridge site and planning, collection of bridge design data, vertical clearance.

Module 3: Standard loading for bridge design as per different codes (6 Lectures)

Road Bridges: IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept, equivalent loads, trafficload, width of roadway and footway, use of influence lines for maximum forces in members, transverse distribution of live loads among deck longitudinal,load combinations for different working state and limit state designs.

Railway Bridges: Loadings for railway bridges, rail road data, pre-design considerations, rail road v/s highway bridges.

Module 4: Superstructures (6 Lectures)

Selection of main bridge parameters, design methodologies, choices of superstructure types: orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis (Preferable), different types of superstructure (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge.

Transverse analysis of bridge: Slab bridge and voided slab bridge, beam-slab bridge, box girder bridge, temperature analysis, distortional analysis, effects of differential settlement of supports, reinforced earth structures.

Typical details: Slab bridge, slab-girder bridge (straight/skew), box girder bridge (straight/skew).

Module 5: Substructure (4 Lectures)

Pier, abutment, wing walls, importance of soil structure interaction

Foundations:open foundation, pile foundation, well foundation, examples - simply supported bridge, continuous bridge.

Module 6: Bearings and deck joints (6 Lectures)

Different types of bridge bearings and expansion joints, Design of bearings and joints.

Parapets for highway bridges: Definitions, classification of bridge parapets, various details

Text/Reference Books

- Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.
- Raju N. K., Design of Bridges, Oxford & IBH.
- Ponnuswamy S., Bridge Engineering, Tata McGraw Hill
- Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4^{th} Edition, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation),, 2^{nd} Edition, Shroff Publishers,
- Raina V. K., Field Manual for Highway and Bridge Engineers", 3^{rd} Edition, Shroff Publishers, Mumbai
- Raina V. K., "World of Bridges", Shroff Publishers, Mumbai

Course Outcomes: On completion of the course, the students will be able to:

1. Understand components of bridges and its various types.
2. Understand site selection criteria and comprehend various forces acting on bridges.
3. Analyze bridge structures using different analysis techniques.
4. Understand the importance of different types of bridge bearings.

BTCVOE706D Introduction to Earthquake Engineering

Course Objectives:

The main objectives of the course are:

1. To provide a coherent development to the students for the courses in sector of earthquake engineering.
2. To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Teaching Scheme: (3 Lectures) hours/week

Pre-Requisites: Structural Mechanics I & II

Course Contents

Module 1 **(6 Lectures)**

Elements of seismology: Terminology, structure of the earth, causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquakes, Accelerogram, prominent earthquakes of India.

Module 2 **(6 Lectures)**

Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral.

Module 3:(6 Lectures)

Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads.

Module 4 **(6 Lectures)**

Principles of Earthquake Resistant Design (EQRD), planning aspects, resistance of structural elements and structures for dynamic load, design criteria, ductile detailing of RCC members, energy absorption, provisions of IS 13920.

Module 5 **(6 Lectures)**

Construction aspects of masonry and timber structures, retrofitting and strengthening techniques of low cost and low-rise buildings, provisions of IS 4326.

Module 6 (6 Lectures)

Dynamic properties of soils, field and Laboratory tests, site evaluation, behavior under dynamic loads, effect on bearing capacity, settlement, liquefaction.

Text Books

1. IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of Indian Standards, New Delhi.

2. Chopra A.K. (2001). *Dynamics of Structures*, 2nd Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.

3. Mario Paz,(1985). *Structural Dynamics*, CBS Publication.

4. Arya A.S., (1987). *Elements of Earthquake Engineering*, South Asian Pub., New Delhi.

Reference Books

1. Clough R.W. and Penzien J.(1993), Dynamics of Structures, McGraw Hill New York

2. Humar J. L., (2002). Dynamics of Structures, 2nd Edition Swets and Zeitlinger, Netherlands.

3. FarzadNaiem, (2001). The Seismic Design Handbook, Kluwer Academic Pub. Massachusetts, ISBN: 0-7923-7301-4.

4. Dowrick D. J., (1977). Earthquake Resistant Design for Engineers & Architects, John Wiley and Sons Ltd.

5. Pauley T. and Priestley M.J.N., (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.

6. Nayak N. V., (1985). Foundation Design Manual, Dhanpatrai and Sons, Delhi.

7. Housner G.W. & Hudson D. E., (1950). Applied Mechanics- Dynamics, East-West Edition, N. Delhi.

8. Kramer S. L., (2003). Geotechnical Earthquake Engineering, Pearson Education.

Course Outcomes: On completion of the course, the students will be able to:

CO1 Capture complexities in earthquake resistant design of structures

CO2 Grasp Nature of earthquake vibration and associated forces on structures

CO3 Understand importance of designing the building to targeted seismic performance.

BTCVOE706E Town and Urban Planning

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

1. To discuss town and Urban planning with essential attributes
2. To provide information of various aspects involved town and Urban planning
3. To make students familiar with various standards, acts, laws and guidelines

Course Contents

Module 1: **(06 Lectures)**

Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

Module 2: **(06 Lectures)**

Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

Module 3: **(06 Lectures)**

Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

Module 4: **(08 Lectures)**

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

Module 5: **(04 Lectures)**

Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module6: **(04 Lectures)**

Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books:

1. Hiraskar G.K. (2018) “Town and country Planning”DhanpatRai Publication, N. Delhi
2. Rangawala S.C. (2015) “Town Planning”, Charotar Publications, Anand
3. Sundaram K.V. (1978) “Urban and Regional Planning in India”, Vikash Publishing House Pvt. Ltd.
4. MRTP Act 1966 & 2002
5. Land Acquisition Act - 1894
6. Misra S. N. (1984) “Rural Development Planning-Design and Method”, Satvahan Publications, N. Delhi

Reference Books

1. Eisner S. and Gallion A. (1993) “The Urban Pattern”, John Wiley & Sons, N. Delhi

Outcomes: Upon completion of the course the students will be able to:

1. Understand town and Urban planning and their essential attributes
2. Identify elements of planning and regulations of the same
3. Implement guidelines provided by standard authorities

BTCVOE706F Tunneling and Underground Excavations

Course Objectives:

The main objectives of the course are:

1. To understand the need of utilization of Underground Space for various applications.
2. To develop the plan for infrastructure for transport.

Teaching Scheme: Lectures: 3 hours/week

Course Contents

Module 1 **(06 Lectures)**

Tunneling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Module 2 **(08 Lectures)**

Tunneling by Drilling and Blasting: Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, specific drilling; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

Module 3 **(06 Lectures)**

Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems.Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

Module 4 **(06 Lectures)**

Excavation of large and deep tunnels Introduction; purpose and use of large and deep tunnels; excavation issues governing large and deep tunnels; excavation methods of large and deep tunnels - unit operations, different equipment, types of rock

pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels.

Module 5 **(6 Lectures)**

Shield Tunneling: Introduction; advantages of shield tunneling; classification; different types of shield tunneling techniques – open shield, close shield, half shield; conventional shields, special features in shield tunneling; factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields, other shield development methods, problems encountered with possible remedies.

Module 6 **(4 Lectures)**

Submerged and Floating Tunnels; Micro-tunneling; Trenchless excavation. Novel Excavation Techniques: Penetrating Cone Fracture, Bottom-hole pressurization, expanding cements, Diamond wire saw.

Text Books:

1. Srinivasan R., (2016). *Harbour, Docks and Tunnel Engineering*, Charotar Pub. House.
2. Saxena S. C. (2015). *Tunnel Engineering*, DhanpatRai Publications.
3. Tatiya R. R., (2013), *Surface and Underground Excavation*, CRC Press.

References:

2. Stack, B. (1982). Handbook of Mining and Tunnelling Machinery, Wiley, New York.
3. Chugh, C.P., (1977). Drilling Technology Handbook, Oxford & IBH Publication.
4. Bickel J.O. and. Kuesel T.R, (2018). Tunnel Engineering Handbook, CBS Publishers and Distributors Pvt. Ltd.
5. Brebbia C.A., Kaliampakos D., Prochazka P., (2008). Underground Spaces Design, Engineering and EnvironmentalAspects, WIT Press,

Web links:

1. https://www.isrm.net
2. www.nirm.in
3. http://umich.edu/~gs265/tunnel.html
4. http://se.sze.hu/images/ngm_se108_1/Tunnels_2015-03-20_Toth_1-Excavation.pdf
5. https://www.usbr.gov/ssle/safety/RSHS/sec23.pdf
6. https://www.osha.gov/Publications/osha3115.html

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand types of tunnels and tunneling methods conforming to site conditions

CO2: Investigate various tunneling operations and relevant machinery required

CO3: Understand methods and operations of excavating large and deep tunnels

CO4: Propose suitable tunneling and excavations methods to optimize the same.

BTCVL707 Design Drawing of RC & Steel Structures

Practical: 2 Hours / Week Term Work: 50 Marks

Part A -Design and Drawing of Steel Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures. Student may use IS 800 1984 or 2007.

1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases

2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases

3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases

4) G + 3 Building Structure

Part B - Design and Drawing of RC Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following RC structures:

1) G + 2 Building

2) Elevated water tank: analysis and design of staging and tank body.

Course Outcomes: On completion of the course, student will be able to simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.

BTCVL708 Professional Practices Laboratory

Practical:2 Hours / Week

Term work include detailed study and working of following set of assignments
1) Detailed estimate for a two storied RCC or load bearing wall building
2) Preparing detailed estimate for any four of the following:
   a) A small culvert
   b) A stretch of a road about 1 Km. long including earthwork
   c) A reach of canal about 1 Km. long
   d) A percolation tank
   e) A factory shed of steel frame

f) Water supply scheme
g) Drainage scheme
h) Water Treatment plants.

3) Valuation report including valuation certificate for any one of the following:
a) A building for residential purpose or commercial purpose
b) A hotel
c) A theatre
d) Any one construction machine.

4) Drafting of Detailed specification for any five civil engineering items. This shall include at least one item each from Roads, Irrigation works, Water Supply, Sanitation and buildings

Assignment (1) and (2) shall include Rate Analysis of at least two items.

BTCVT709 Field Training /Internship/Industrial

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of field training shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVS710 Seminar

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVP711 Project Stage I

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project must be industry-based.

Detailed Syllabus (VIII Semester)

BTCVSS801 Characterization of Construction Materials

By Prof. Manu Santhanam, Prof. PiyushChaunsali IIT Madras

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. The course will be focused primarily on cement and concrete, and include the following techniques; the physics of the techniques and their application to cement science, including lab demonstrations and experiments will be covered.

Week 1: Introduction to course; Structure of Construction Materials – An Overview
Week 2: Calorimetry
Week 3: X-ray diffraction
Week 4: X-ray diffraction
Week 5: Thermal analysis
Week 6: Surface area measurement
Week 7: Optical microscopy
Week 8: Scanning electron microscopy
Week 9: Image analysis
Week 10: Spectroscopic techniques
Week 11: Mercury intrusion porosimetry
Week 12: Impedance analysis and ultrasonic methods

1. Karen Scrivener, Ruben Snellings, Barbara Lothenbach, A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2015.
2. V. S. Ramachandran and James J. Beaudoin, Eds., Handbook of Analytical Techniques in Concrete Science and Technology, William Andrew Publishing, New York, 2001.
3. D A St. John, A. W. Poole, and I. Sims, Concrete Petrography – A Handbook of Investigative Techniques, Arnold Publishing.London, 1998.
4. William D. Callister, Materials Science and Engineering: An Introduction, Sixth Edition, John Wiley and Sons, 2003.
6. J. M. Illston and P. L. J. Domone, Construction Materials – Their Nature and Behaviour, Third Edition, Spon Press, 2001.
5. Jan Skalny, Editor, Materials Science of Concrete, Volumes I – VII, American Ceramic Society, 1989 – 2005.
7. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.

Link - https://swayam.gov.in/nd1_noc20_ce01/preview

BTCVSS801B Geosynthetics and Reinforced Soil Structures

Link - https://nptel.ac.in/content/syllabus_pdf/105106052.pdf

BTCVSS801C Higher Surveying

Link - https://swayam.gov.in/nd1_noc20_ce16/preview

BTCVSS801D Maintenance and Repair of Concrete Structures

Link-https://nptel.ac.in/content/syllabus_pdf/105106202.pdf

BTCVSS801E Structural Dynamics

Link- https://swayam.gov.in/nd1_noc20_ce21/preview

BTCVSS802A Energy Efficiency Acoustics & Daylighting in Building

Link-https://swayam.gov.in/nd1_noc20_ce08/preview

BTCVSS802B Environmental Remediation of Contaminated Sites

Link-https://swayam.gov.in/nd1_noc20_ce31/preview

BTCVSS802C Remote Sensing Essentials

Link-https://swayam.gov.in/nd1_noc20_ce29/preview

BTCVSS802D Mechanical characterization of Bituminous Materials

Link- https://swayam.gov.in/nd1_noc20_ce04/preview

BTCVSS802E Soil Structure Interaction

Link-https://swayam.gov.in/nd1_noc20_ce22/preview

BTCVC803 Project Stage II or Internship

Term work shall consist of detailed report for chosen topic and output of final working proposed in previous semester. Report shall summarise the literature survey, spell out the scope of work, methodology and results.

Viva-voce Examination shall be based on work carried out by the student.

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Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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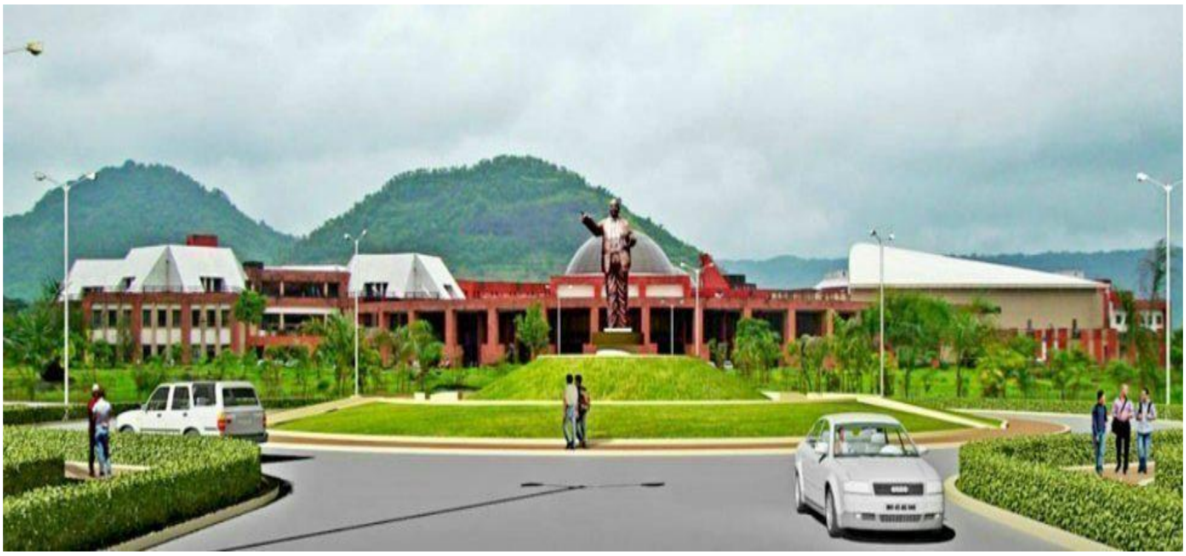
PROPOSED CURRICULUM
UNDER GRADUATE PROGRAMME
B.TECH

COMPUTER ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR 2020-2021



Rules and Regulations

1. The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid- July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maxi- mum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.

4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

COURSE PRE-REQUISITES:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

   (a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination

   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

   (c) Paid all required advance payments of the Institute and hostel for the current semester;

   (d) Not been debarred from registering on any specific ground by the Institute**.**

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2019-20, starting from I year B.Tech.

Percentage of Marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. **Class is awarded based on CGPA of all eighth semester of B.Tech Program.**

CGPA for pass is minimum 5.0	
CGPA upto < 5.50	Pass Class
CGPA ≥ 5.50 & < 6.00	Second Class
CGPA ≥ 6.00 & < 7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks = CGPA*10.0]	

3. **A total of 100 Marks for each theory course are distributed as follows:**

1	Mid Semester Exam (MSE) Marks	20
2	Continuous Assessment Marks	20
3	End Semester Examination (ESE)Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1	Continuous Assessment Marks	60
2	End Semester Examination (ESE) Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance. The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA): The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his perfor- mance as per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall per- formance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since she entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places). Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where
‘m’ is the total number of subjects from the first semester onwards up to and including the semester S,
‘ci’ is the number of credits allotted to a particular subject, and
‘gi’ is the grade-points awarded to the student for the subject based on his/her performance as per the above table.
-CGPA will be rounded off to the second place of decimal and recorded as such.

AWARD OF DEGREE OF HONOURS (MAJOR) DEGREE

The concept of Major and Minors at B.Tech level is introduced, to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for majors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL / SWAYAM courses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for minors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL / SWAYAM platform. (if the credits of NPTEL / SWAYAM courses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded with B.Tech Degree in
-------Engineering with Minor in -------------Engineering.

(For e. g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. Representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
   The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
   In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University / Institutions / Colleges /Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

(a) 20% of the total credit will be considered for respective calculations.
(b) Credits transferred will be considered for overall credits requirements of the programme.
(c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.
(d) A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor / project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.
(e) A student has to get minimum passing grades / marks for such courses for which the credits transfers are to be made.
(f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.
(g) In exceptional cases, the students may opt for higher credits than the prescribed.

Different Categories of Courses and Credits for Degree Requirements

a) Basic Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTBS101	Engineering Mathematics – I	(3-1-0) 4
2	BTBS102	Engineering Physics	(3-1-0) 4
3	BTBS107L	Engineering Physics Laboratory	(0-0-2) 1
4	BTBS201	Engineering Mathematics-II	(3-1-0) 4
5	BTBS202	Engineering Chemistry	(3-1-0) 4
6	BTBS207L	Engineering Chemistry Laboratory	(0-0-2) 1
7	BTBS301	Engineering Mathematics-III	(3-1-0) 4
8	BTBS404	Probability Theory and Random Processes	(3-0-0) 3
		TOTAL	**25**

b) Engineering Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES103	Engineering Graphics	(2-0-0) 2
2	BTES105	Energy and Environment Engineering	(2-0-0) 2
3	BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
4	BTES108L	Engineering Graphics Laboratory	(0-0-4) 2
5	BTES203	Engineering Mechanics	(2-1-0) 3
6	BTES204	Computer Programming	(3-0-0) 3
7	BTES205	Workshop Practices	(0-0-4) 2
8	BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
9	BTES208L	Engineering Mechanics Laboratory	(0-0-2) 1
10	BTES209L	Basic Computer Programming Laboratory	(0-0-2) 1
11	BTES405	Digital Logic Design & Microprocessors	(3-1-0) 4
		TOTAL	**20**

c) Humanities and Social Science including Management Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTHM104	Communication Skills	(2-0-0) 2
2	BTHM109L	Communication Skills Laboratory	(0-0-2) 1
3	BTHM403	Basic Human Rights	(3-0-0) 3
4	BTHM605	(A) Development Engineering (B) Employability and Skills Development (C) Consumer Behaviour	(3-0-0) 3
5	BTHM505	(A) Economics and Management (B) Business Communication	(3-0-0) 3
6	BTHM706	Foreign Language Studies	Audit
		TOTAL	**12**

d) Professional Core Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOC302	Discrete Mathematics	(3-1-0) 4
2	BTCOC303	Data Structures	(3-1-0) 4
3	BTCOC304	Computer Architecture & Organization	(3-1-0) 4
4	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	(0-0-4) 2
5	BTCOC401	Design & Analysis of Algorithms	(3-1-0) 4
6	BTCOC402	Operating Systems	(3-1-0) 4
7	BTCOC501	Database Systems	(3-1-0) 4
8	BTCOC502	Theory of Computation	(3-1-0) 4
9	BTCOC503	Software Engineering	(3-1-0) 4
10	BTCOL506	Database Management System & Software Engineering Lab	(0-0-4) 2
11	BTCOC601	Compiler Design	(3-1-0) 4
12	BTCOC602	Computer Networks	(3-1-0) 4
		TOTAL	**44**

e) Professional Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE504	(A) Human Computer Interaction (B) Numerical Methods	(3-0-0) 3
2	BTCOE604	(A) Geographic Information System (B) Internet of Things (C) Embedded Systems	(3-0-0) 3
3	BTCOE703	(A) Bioinformatics (B) Distributed System (C) Big Data Analytics	(3-0-0) 3
		TOTAL	**09**

f) Open Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE704	(A) Cryptography and Network Security (B) Business Intelligence (C) Block Chain Technology	(3-0-0) 3
2	BTCOE705	(A) Virtual Reality (B) Deep Learning (C) Design Thinking	(3-0-0) 3
		TOTAL	**06**

g) Seminar / Mini Project / Internship

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	Audit
2	BTCOS307	Seminar-I	(0-0-4) 2
3	BTCOS407	Seminar-II	(0-0-4) 2
4	BTCOM507	Mini Project-I	(0-0-4) 2
5	BTCOM607	Mini Project-II	(0-0-4) 2
6	BTCOS708	Project Phase-I	(0-0-4) 2
7	BTCOF801	Project Work / Internship	(0-0-24) 12
		TOTAL	**22**

h) Emerging Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOL305	Object Oriented Programming in Java	(3-1-0) 4
2	BTCOL406	Operating Systems & Python Programming Lab	(1-0-4) 3
3	BTCOC603	Machine Learning	(3-1-0) 4
4	BTCOL606	Competitive Programming & Machine Learning Lab	(1-0-4) 3
5	BTCOC701	Artificial Intelligence	(3-0-0) 3
6	BTCOC702	Cloud Computing	(3-0-0) 3
7	BTCOC707	Artificial Intelligence & Cloud Computing Lab	(0-0-4) 2
		TOTAL	**22**

Category – wise total number of credits

Sr. No.	Category of courses	Minimum credits to be Earned
1	Basic Science Course (BSC)	25
2	Engineering Science Course (ESC)	20
3	Humanities and Social Science including Management Courses (HSSMC)	12
4	Professional Core Course (PCC)	44
5	Professional Elective Course (PEC)	09
6	Open Elective Course (OEC)	06
7	Seminar / Mini Project / Internship / Major Project	22
8	Emerging Courses	22
	TOTAL	**160**

Programme Educational Objectives (PEO)

Name of Programme: Bachelor of Technology (Computer Engineering)

A graduate in the discipline of Computer Engineering is generally expected to have three kinds of knowledge. First, the graduate should have conceptual knowledge of the core topics of Computer Science. Second, she/he should have knowledge of mathematical formalism underlying various programming concepts. Third, graduates in the discipline of Computer Engineering should have the knowledge of the state of the technologies and tools so that he/she can apply the principles of Computer Science to solve real-life problems from diverse application domains. The programme of B.Tech in Computer Engineering at Dr. Babasaheb Ambedkar Technological University (DBATU) essentially aims to meet these broad expectations. At the same time, the program intends to comply with the courses and syllabus available at National Program on Technology Enhanced Learning (NPTEL) and SWAYAM. The following specific educational objective aims to achieve these global and regional expectations**.**

Objective Identifier	Objectives
PEO1	To provide knowledge of sound mathematical principles underlying various programming concepts.
PEO2	To develop an ability to understand complex issues in the analysis, design, implementation and operation of information systems.
PEO3	To provide knowledge of mechanisms for building large-scale computer-based systems.
PEO4	To develop an ability to provide computer-based solutions to the problems from other disciplines of science and engineering.
PEO5	To impart skills necessary for adapting rapid changes taking place in the field of information and communication technologies.
PEO6	To provide knowledge of ethical issues arising due to deployment of information and communication technologies in the society on large scale.

Programme Outcomes (PO)

After undergoing the learning process of four years, students of B.Tech. (Computer Engineering) at Dr. Babasaheb Ambedkar Technological University will have an ability to build information systems and provide computer based solutions to real life problems. The graduates of this programme will demonstrate following abilities and skill sets.

Outcome Identifier	Outcomes
PO1	The graduates will possess the knowledge of various discrete mathematical structures, Logic and numerical techniques.
PO2	The graduates will have an ability to apply mathematical formalism of Finite Automata and Probability in modeling and analysis of systems.
PO3	The graduates will have knowledge of core programming paradigms such as database orientation, object orientation, and agent orientation and concepts essential to implement software based system.
PO4	The graduates will have an ability to analyze problem, specify algorithmic solutions to them and to evaluate alternative solutions.
PO5	The graduate will have broad understanding of the impact of a computer based solutions in economic, environmental and social context and will demonstrate use of analytical tools in gathering requirements and distilling relevant information to provide computer based solutions.
PO6	The graduates will demonstrate the ability to build human centric interfaces to computers.
PO7	The graduates will posses the knowledge of advanced and emerging topics in the fields of operating systems, databases and computer networks.
PO8	The graduates will posses skills necessary to communicate design engineering ideas. The skills set include verbal, written and listening skills.
PO9	The graduates will understand ethical issues in providing computer based solutions also they will have an ability and attitude to address the ethical issues.
PO10	The graduates will understand the role of system software such as operating systems, database management systems, compilers, middle-ware and internet protocols in realizing distributed information environment

Graduate Attributes / ABET's Criteria

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

(a) Engineering knowledge: An ability to apply knowledge of mathematics, science and engineering.

(b) Problem analysis: An ability to design and conduct experiments as well as to analyze and interpret data.

(c) Design / development of solutions: An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(d) Individual and team work: An ability to function on multidisciplinary teams.

(e) Problem Solving: An ability to identify, formulate and solve engineering problems.

(f) Ethics: An understanding of professional and ethical responsibility.

(g) Communication: An ability to communicate effectively.

(h) Environment and sustainability: The broad education necessary to understand the impact of engineering solutions in a global, economical, environmental and social context.

(i) Life-long learning: Recognition of the need for and an ability to engage in life-long learning.

(j) A knowledge of technology: A knowledge of contemporary issues, and state of art technology

(k) Modern tool usage: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(l) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply in multidisciplinary environments.

Mapping of Programme Outcomes with Graduate Attributes / ABET's Criteria

	A	B	C	D	E	F	G	H	I	J	K	L
PO1	X											
PO2	X								X			
PO3		X	X									
PO4			X		X							
PO5			X					X				X
PO6					X							
PO7										X		
PO8							X					
PO9						X						
PO10											X	

Semester –III (Second Year)
Proposed Scheme w.e.f. July – 2021

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
	BTCOC302	Discrete Mathematics	3	1	-	20	20	60	100	4
	BTCOC303	Data Structures	3	1	-	20	20	60	100	4
	BTCOC304	Computer Architecture & Organization	3	1	-	20	20	60	100	4
	BTCOC305	Elective –I (a) Object - oriented Programming in C++ (b) Object Oriented Programming in Java	3	1	-	20	20	60	100	4
	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
	BTCOS307	Seminar – I	-		4	60	-	40	100	2
	BTES211P	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
TOTAL			**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

Semester –IV (Second Year)
Proposed Scheme w.e.f. January – 2022

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC401	Design & Analysis of Algorithms	3	1	-	20	20	60	100	4
	BTCOC402	Operating Systems	3	1	-	20	20	60	100	4
	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
	BTES405	Digital Logic Design & Microprocessors	3	1	-	20	20	60	100	4
	BTCOL406	Operating Systems & Python Programming Lab	1*	-	4	60	-	40	100	3
	BTCOS407	Seminar – II			4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training Evaluation						-	-	Audit to be evaluated in V Sem.
TOTAL			**16**	**3**	**8**	**220**	**100**	**380**	**700**	**23**

*Note: Lecture should be conducted only for Python Programming

Semester –V (Third Year)
Proposed Scheme w.e.f. July – 2022

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC501	Database Systems	3	1	-	20	20	20	100	4
	BTCOC502	Theory of Computation	3	1	-	20	20	20	100	4
	BTCOC503	Software Engineering	3	1	-	20	20	20	100	4
	BTCOE504	Elective – II (A) Human computer Interaction (B) Numerical Methods	3	-	-	20	20	20	100	3
	BTHM505	Elective – III (A) Economics and Management (B) Business Communication	3	-	-	20	20	20	100	3
	BTCOL506	Database Systems & Software Engineering Lab	-	-	4	60	-	40	100	2
	BTCOM507	Mini-project – I	-	-	4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training Evaluation	-	-	-	-	-	-	-	Audit
		TOTAL	**15**	**3**	**8**	**220**	**100**	**380**	**700**	**22**

Semester –VI (Third Year)
Proposed Scheme w.e.f. January – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC601	Compiler Design	3	1	-	20	20	60	100	4
	BTCOC602	Computer Networks	3	1	-	20	20	60	100	4
	BTCOC603	Machine Learning	3	1	-	20	20	60	100	4
	BTCOE604	Elective – IV (A) Geographic Information System (B) Internet of Things (C) Embedded Systems	3	-	-	20	20	60	100	3
	BTHM605	Elective – V (A) Development Engineering (B) Employability and Skill Development (C) Consumer Behaviour	3	-	-	20	20	60	100	3
	BTCOL606	Competitive Programming & Machine Learning Lab	1*	-	4	60	-	40	100	3
	BTCOM607	Mini-project – II	-	-	4	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit to be Evaluated in VII Sem.
		TOTAL	**16**	**3**	**8**	**220**	**100**	**380**	**700**	**23**

*Note: Lecture should be conducted only for Competitive Programming

Semester –VII (Final Year)
Proposed Scheme w.e.f. July – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC701	Artificial Intelligence	3	-	-	20	20	60	100	3
	BTCOC702	Cloud Computing	3	-	-	20	20	60	100	3
	BTCOE703	Elective – VI (A) Bioinformatics (B) Distributed System (C) Big Data Analytics	3	-	-	20	20	60	100	3
	BTCOE704	Open Elective – VII (A) Cryptography and Network Security (B) Business Intelligence (C) Block chain Technology	3	-	-	20	20	60	100	3
	BTCOE705	Open Elective – VIII (A) Virtual Reality (B) Deep Learning (C) Design Thinking	3	-	-	20	20	60	100	3
	BTHM706	Foreign Language Studies	-	-	4	-	-	-	-	Audit
	BTCOL707	Artificial Intelligence & Cloud Computing Lab	-	-	4	60	-	40	100	2
	BTCOS708	Project Phase – I	-	-	-	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training	-	-	-	-	-	-	-	Audit
		TOTAL	**15**	**-**	**8**	**220**	**100**	**380**	**700**	**19**

Semester –VIII (Final Year)
Proposed Scheme w.e.f. January – 2024

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOF801	Project phase – II (In-house) / Internship and Project in Industry	-	-	24	60	-	40	100	12
TOTAL			**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BTES 301: Engineering Mathematics-III

[UNIT 1] **[7 Hours]**

Introduction, Vectors in R^n, Vector Addition and Scalar Multiplication, Dot (Inner) Product, Located Vectors, Hyperplanes, Lines, Curves in R^n, Vectors in R^3 (Spatial Vectors), ijk Notation, Complex Numbers, Vectors in C^n.

[UNIT 2] **[7 Hours]**

Introduction, Matrix Addition and Scalar Multiplication, Summation Symbol, Matrix Multiplication, Transpose of a Matrix, Square Matrices, Powers of Matrices, Polynomials in Matrices, Invertible (Nonsingular) Matrices, Special Types of Square Matrices, Complex Matrices, Block Matrices.

[UNIT 3] **[7 Hours]**

Introduction, Basic Definitions, Solutions, Equivalent Systems, Elementary Operations, Small Square Systems of Linear Equations, Systems in Triangular and Echelon Forms, Gaussian Elimination, Echelon Matrices, Row Canonical Form, Row Equivalence, Gaussian Elimination, Matrix Formulation, Matrix Equation of System of Linear Equations, Systems of Linear Equations and Linear Combinations of Vectors, Homogeneous Systems of Linear Equations, Elementary Matrices, LU Decomposition. Applications: Linear Programming, Fourier series: Linear Algebra for Functions, Computer Graphics, Linear Algebra for Cryptography.

[UNIT 4] **[7 Hours]**

Determinants: Introduction, Determinants of Orders 1 and 2, Determinants of Order 3, Permutations, Determinants of Arbitrary Order, Properties of Determinants, Minors and Cofactors, Evaluation of Determinants, Classical Adjoint, Applications to Linear Equations, Cramer's Rule, Submatrices, Minors, Principal Minors, Block Matrices and Determinants, Determinants and Volume, Determinant of a Linear Operator, Multilinearity and Determinants.

[UNIT 5] **[7 Hours]**

Diagonalization Introduction, Polynomials of Matrices, Characteristic Polynomial, Cayley–Hamilton Theorem, Diagonalization, Eigenvalues and Eigenvectors, Computing Eigenvalues and Eigenvectors, Diagonalizing Matrices, Diagonalizing Real Symmetric Matrices and Quadratic Forms, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices. Applications: Graphs and Networks, Matrices in Engineering, Markov Matrices, Population, and Economics.

Text Book:

1. Linear Algebra, Seymour Lipschutz, Schaums outlines, 4th Edition, McGraw-Hill Publication.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley-Cambridge Press.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.

BTCOC302: Discrete Mathematics

[UNIT 1] Fundamental Structures and Basic Logic **[7 Hours]**

Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic, Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

[UNIT 2] Functions and Relations **[7 Hours]**

Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.
Combinatorics: Counting, Recurrence relations, generating functions.

[UNIT 3] Graph **[7 Hours]**

Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graph, Isomorphic graphs, Planar graphs, Connectivity, Matching Colouring.

[UNIT 4] Trees **[7 Hours]**

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree.

[UNIT 5] Algebraic Structures and Morphism **[7 Hours]**

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
5. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

BTCOC303: Data Structures

[UNIT 1] Introduction **[7 Hours]**

Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. Arrays and Hash Tables Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

[UNIT 2] Stacks and Queues **[7 Hours]**

Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

[UNIT 3] Linked list **[7 Hours]**

Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

[UNIT 4] Trees and Graphs **[7 Hours]**

Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall's algorithm.

[UNIT 5] Searching and Sorting **[7 Hours]**

Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations– insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Text Book:

1. Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition,2013

Reference Books:

1. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
2. Y. Langsm, M. Augenstin, A. Tanenbaum , Data Structure using C and C++, Prentice Hall India Learning Private Limited,2nd edition,1998.
3. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition,2008.
4. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition,2002.
5. Venkatesan& Rose, Data Structures, Wiley Publication, 1st Edition,2015.
6. Goodrich &Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition,2011.
7. R. G. Dromey, How to Solve it by Computer, 2nd Impression, PearsonEducation.
8. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition,1999.

BTCOC 304: Computer Architecture and Organization

[UNIT 1] Introduction **[7 Hours]**

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function

[Unit 2] Instruction Sets **[7 Hours]**

Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

[Unit 3] Computer Arithmetic **[7 Hours]**

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

[Unit 4] Memory Organization **[7 Hours]**

Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

[Unit 5] Control Unit and Input / Output Organization **[7 Hours]**

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming. **Input/output Organization:** External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface. Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Book:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition,2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Elective –I

(A) BTCOC 305: Object Oriented Programming in C++

[Unit 1] Introduction to Object Oriented Programming and Objects and Classes [7 Hours]

Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages, class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

[Unit 2] Operator Overloading, Inheritance and Polymorphism [7 Hours]

Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

[Unit 3] Polymorphism [7 Hours]

Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

[Unit 4] Streams and Files [7 Hours]

Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

[Unit 5] Templates, Exception Handling and STL [7 Hours]

Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.

Reference Books:

1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001.
2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.
3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1stEditio,2008
4. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
5. P. J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.
6. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
7. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.

Elective –I
(B) BTCOC 305: Object Oriented Programming in JAVA

[Unit 1] Introduction to Java Applications **[7 Hours]**

Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Introduction to Classes and Objects: Introduction, Classes, Objects, Methods and Instance Variables, Declaring a Class witha Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, *set* Methods and *get* Methods, Primitive Types vs. Reference type double Types ,Initializing Objects with Constructors, floating point numbers.

[Unit 2] Control Statements **[7 Hours]**

Control structures *if* single-selection statement, *if….else* double-selection statement, *while* repetition statement, *do….while* repetition statement, *switch* multi-selection statement, *break* and *continue* statements, logical operators. Methods :Introduction, Program modules in Java, *static* methods, *static* Fields and *Class Math*, declaring methods with multiple parameters, scope of declaration, method overloading and Java API packages.

[Unit3]Arrays **[7 Hours]**

Arrays,declaring and creating arrays in java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

[Unit 4] Inheritance and Polymorphism in Java **[7 Hours]**

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, objectclass. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples and Interfaces.

[Unit 5] Exception-handling and Java script **[7 Hours]**

Exception-handling overview, handling *Arithmetic Exceptions* and *Input Mismatch Exceptions*, when to use exception handling, java exception hierarchy, *finally* block. Introduction to Java Applets. Java script: Introduction to client side scripting, Syntax basics, Operators, Comparisons, Statements, Loops, Events, Objects, and User defined functions, Validations using object functions, Validations using regular expressions, JS document object model, popovers, windows

Text Book:

1. Paul Deitel and Harvey Detail, *Java: How to Program*, Pearson's Publication, 9thEdition.

Reference Books:

1. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016. Doug Lowe, *Java All-in-One For Dummies*, Wiley Publication, 4th Edition,2014.
2. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Publication, 9thEdition.
3. Patrick Niemeyer, Daniel Leuck, *Learning Java*, O'Reilly Media, 4th Edition,2013.
4. "JavaScript: The Good Parts", Douglas Crockford, O'Reilly, ISBN: 9782744055973. "Microsoft® .NET: Architecting Applications for the Enterprise", Microsoft Press; 1st edition, ISBN:978-0735626096

BTCOL306: Data Structure Laboratory

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list (b)Double linked list.
10. Write a program to implement a stack using a linked list such that the push and pop operations of stack still take O(1)time.
11. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b) Maximum key (c) Search for a given key (d) Find predecessor of a node (e) Find successor of a node (f) delete a node with given key.
12. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
13. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
14. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort.
15. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.

Elective –I

BTCOL306: Object Oriented Programming Lab

(a) Object Oriented Programming in C++

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on dealing with Arrays.
3. Programs on Classes: String and Math.
4. Programs on Inheritance and Polymorphism.
5. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
6. Programs on Interfaces block initializers, final Modifier, as well as static and dynamic binding.
7. Programs on file handling and stream manipulation.
8. Programs on Dynamic Polymorphism.
9. Programs on Dynamic Memory Management.
10. Programs on Exception Handling.
11. Programs on generic programming using templates.
12. Programs on STL-containers and iterators

(b) Object Oriented Programming in JAVA

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate following Function concepts
   i) Function overloading
   ii) Constructors of all types
   iii) Default parameters, returning by reference
4. Programs on dealing with Arrays.
5. Programs on Classes: String and Math.
6. Programs on Inheritance and Polymorphism.
7. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
8. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
9. Programs on Exception Handling.
10. Write a Java program that illustrates the following
    a) Creation of simple package.
    b) Accessing a package.
    c) Implementing interfaces.
11. Programs on Java script client side scripting.
12. Programs on Java script Operators, Comparisons, Statements, Loops, Events, Objects.
13. Programs on Java script User defined functions.
14. Programs on Java script Validations using object functions.
15. Programs on Java script Validations using regular expressions.
16. Programs on Java script JS document object model, Popovers, Windows.

BTCOC401: Design and Analysis of Algorithms

[Unit 1] Introduction to Algorithms **[7 Hours]**

Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem, Changing Variable, Heap Sort.

[Unit 2] Divide and Conquer **[7 Hours]**

Introduction, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

[Unit 3] Backtracking **[7 Hours]**

Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Colouring Problem, Branch and Bound: Introduction, Travelling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

[Unit 4] Greedy Algorithms [**7 Hours]**

Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm

.

[Unit 5] Dynamic Programming **[7 Hours]**

Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Sub-sequence, matrix multiplication, shortest paths: Bellman Ford, Floyd Warshall, Application of Dynamic Programming. NP Completeness: Introduction, the Complexity Class P, the Complexity Class NP, Polynomial-Time Reduction, the Complexity Class NP-Complete.

Text Book:

1. T. Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.

Reference Books:

1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition,1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition,2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.
4. Ellise Horowitz, SartajSahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988

BTCOC402: Operating Systems

[Unit 1] [7 Hours]

Introduction and Operating system structures: Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.

[Unit 2] [7 Hours]

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.

[Unit 3] [7 Hours]

Process Synchronization: The critical-section problem, Critical regions, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

[Unit 4] [7 Hours]

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

[Unit 5] [7 Hours]

File Management: File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.

Reference Books:

1. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
2. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
3. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
4. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
5. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

BTHM403: Basic Human Rights

[Unit 1] [6 Hours]

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people.

[Unit 2] [6 Hours]

Fundamental rights and economic programme, Society, religion, culture, and their inter relationship, Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

[Unit 3] [6 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged, State, Individual liberty, Freedom and democracy, NGOs and human rights in India: - Land, Water, Forest issues.

[Unit 4] [6 Hours]

Human rights in Indian constitution and law:- i) The constitution of India: Preamble ii) Fundamental rights iii) Directive principles of state policy vi)Fundamental duties v) Some other provisions.

[Unit 5] [6 Hours]

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

Text Book:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

Reference books:

1. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India

BTBS404: Probability and Statistics

[Unit 1] Probability Theory **[7 Hours]**

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

[Unit 2] Random Variable and Mathematical Expectation **[7 Hours]**

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

[Unit 3] Correlation **[7 Hours]**

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.

[Unit 4] Linear Regression Analysis **[7 Hours]**

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

[Unit 5] Estimation and Hypothesis **[7 Hours]**

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Book:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.

Reference Books:

1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability And Statistics, Wiley

Publication, 2nd Edition, 2001.

8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition, Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics for engineers & scientists, 9th edition, Prentice Hall.

BTES405: Digital Logic Design & Microprocessor

[Unit1] Introduction **[7 Hours]**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, Number Systems: binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes.

[Unit 2] Combinational Digital Circuits **[7 Hours]**

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions, Don't care conditions, Multiplexer, De-Multiplexer / Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, parity checker / generator.

[Unit 3] Sequential circuits and systems **[7 Hours]**

1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

[Unit 4] Fundamentals of Microprocessors **[7 Hours]**

Fundamentals of Microprocessor, Comparison of 8-bit, (8085) 16-bit (8086), and 32-bit microprocessors (80386), The 8086 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

[Unit 5] 8086 Instruction Set and Programming **[7 Hours]**

Memory Interfacing, I/O Interfacing, Direct Memory Access (DMA), Interrupts in 8086, 8086 Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs, C language programs, Assemblers and compilers, Programming and debugging tools.

Text Book:

1. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

Reference Books:

1. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
2. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
3. Douglas Hall, Microprocessors and Interfacing, McGraw-Hill Publication, Revised 2nd Edition, 2006.

BTCOL406: Python Programming

One hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

[Unit 1] **[2 Hours]**

Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.

[Unit 2] **[2 Hours]**

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.

[Unit 3] **[2 Hours]**

Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.

[Unit 4] **[2 Hours]**

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

[Unit 5] **[4 Hours]**

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.

*Programming assignments are mandatory.

Text Book:

1. Michael Urban and Joel Murach, Murach’s Python Programming, Murach's Publication, 2016.

Reference Books:

1. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
2. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
3. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
4. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
5. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
6. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

BTCOL406: Python Programming

List of Experiments:

1	Program to calculate area of triangle, rectangle, circle
2	Program to find the union of two lists.
3	Program to find the intersection of two lists.
4	Program to remove the “i” th occurrence of the given word in a list where words repeat.
5	Program to count the occurrences of each word in a given string sentence.
6	Program to check if a substring is present in a given string.
7	Program to map two lists into a dictionary.
8	Program to count the frequency of words appearing in a string using a dictionary.
9	Program to create a dictionary with key as first character and value as words starting with that character.
10	Program to find the length of a list using recursion.
11	compute the diameter, circumference, and volume of a sphere using class
12	Program to read a file and capitalize the first letter of every word in the file.

BTCOL406: Operating Systems Laboratory

List of Experiments:

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers and systems administration of different operating systems. Writing utilities and OS performance tuning

BTCOS407: Seminar – II

[Unit 1]

Web Site development Essentials: Overview of Web Design Concepts, Web Project Management Fundamentals, Web Site Development Process, HTML and the Evolution of Markup languages, HTML basic tags, Web Page Layout and Elements, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

[Unit 2]

Cascading Style Sheets: Cascading Style Sheets for Web page design, Creating CSS rules, Format Text with CSS, Use of CSS Selectors, Embed Style Sheets, and Attach External Style Sheets. Using CSS with Tables: Insert and Styling Tables, Import Table Data, Style Tables with CSS, Sort Data in Table.

[Unit 3]

Introduction to JavaScript, Variables, Basic in JavaScript — Numbers and operators, Handling text — Strings in JavaScript, Useful string methods, Arrays, Troubleshooting JavaScript;

Programming fundamentals: If...Else Statements, Else...If Statements, For Loops, While Loops, Breaking Out Of Loops, Switch Statements, Functions; JavaScript Events, Selecting HTML elements using get Element ById().

[Unit 4]

PHP: Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Handling Html Form with PHP: Capturing Form Data, Dealing with Multi-value filed, redirecting a form after submission, PHP Session.

[Unit 5]

JQuery: Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples

AJAX: Introduction to AJAX, PHP with AJAX Introduction to RDBMS: Connection with MySQL Database, Performing basic database operation (DML)(Insert, Delete, Update, Select)

Suggestive List of Experiments:

1. Design an html form for displaying information using interactive css including images, tables.
2. Create a webpage with HTML describing your department with following specification:
    a. Change the background color of the page. At the bottom create a link to take user to the top of the page.
    b. Insert an image and create a link such that clicking on image takes user to other page.
    c. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.
3. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
4. Write a JavaScript to validate the following fields of employee on html form: email, name, mobile no., address, salary.
5. Develop and demonstrate a HTML file that includes JavaScript script that uses functions for the following problems:
    a. Parameter: A string
       Output: Length of the String
    b. Parameter: A number
    Output: The number with its digits in the reverse order
6. Develop and demonstrate a HTML file that includes JavaScript for the following problems:
    a. Input: A starting and ending number
    b. Output: find all the prime numbers between starting and ending number.
7. Write a PHP program to display a digital clock which displays the current time of the server.

8. Write a PHP program to implement sign-In and Sign-out functionality.
9. Write a PHP program to keep track of the number of visitors visiting the Web page and to display this count of visitors, with proper headings.
10. Write a PHP code to implement AJAX functionality.
11. Write a PHP program to perform search operation on the student records using AJAX.
12. Write a PHP program to sort the student records which are stored in the database using ascending/descending order.

Text Book:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, Ajax, PHP and jQuery, 2ed (English, Paperback, DT Editorial Services).

Reference Books:

1. Robin Nixon, Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5 Paperback by Orielly Pub**.**
2. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, 2nd Edition, 2012.

Guidelines for Seminar:

1. Each candidate shall deliver a seminar as per the Scheme of Teaching and Examination for a minimum 35 minutes including questions and answers.
2. Students can choose/propose any topic for web application development.
3. Students can use HTML, CSS, Java Script, AJAX, PHP or any other front-end tool for web application development.
4. Applications developed must be demonstrated on desktop/laptop as a web based application in the seminar.
5. A seminar report must be submitted at the end of semester on the base of application developed and technology used.

BTCOC501: Database Systems

[Unit 1] Introduction **[7 Hours]**

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture Data modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd's rules, Extended ER model, Generalization, Aggregation, , Reduction of an ER diagrams to tables.

[Unit 2] Relational Data Model, Relational Algebra and Calculus **[7 Hours]**

Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

[Unit 3] Introduction to SQL **[7 Hours]**

Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database Intermediate SQL : Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization, Advanced SQL : Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,

[Unit 4] Relational Database Design and File Organization, Indexing & Hashing **[7 Hours]**

Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.

File Organization, Ordered Indices, B+tree Index files, B Tree Index File, Static Hashing, Dynamic Hashing,

[Unit 5] Transaction Processing **[7 Hours]**

Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, ACID Properties, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols, Recovery System.

Text Book:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011**.**

Reference Books:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-HillPublication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.
4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2ndEdition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Reprint by Addison-Wesley.

BTCOC502: Theory of Computation

[Unit 1] Finite Automata and Regular Expressions [7 Hours]

Definition of deterministic finite automata, Non-deterministic finite automata, Moore and Mealy machines and their conversions, Regular expressions, Recursive definition, NFA with e-moves, Inter-conversion between NFA and DFA, Regular expression and FA, Pumping lemma.

[Unit 2] Context Free Grammars [7 Hours]

Definition, Production rules, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) – definition, Simplification of CFG.

[Unit 3] Context Free Languages [7 Hours]

Definition of context free languages, Regular grammar definition, Left linear, Right linear grammar, Inter-conversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, Derivation graphs, Type 0 and Type 1grammars.

[Unit 4] Push down Automata [7 Hours]

Formal definition, Pushdown automata (PDA), Deterministic Pushdown automata (DPDA) – definition, Non-deterministic Pushdown automata (NPDA) - definition, relative powers of DPDA and NPDA.

[Unit 5] Turing Machines and Undecidability [7 Hours]

Definition, Computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars, The Church's Turing hypothesis, Universal Turing machines, The Halting problem, Unsolvable problems about Turing machines.

Text Book:

1. Hopcroft, Ullman, Motwani, *Introduction to Automata Theory, Languages, and Computation*, Addison Wesley Publication, 2nd Edition, 2001.

Reference Books:

1. Daniel I. A. Cohen, *Introduction to Computer Theory*, Wiley Publication, 1st Edition, 1986.
2. John C. Martin, *Introduction to Languages and Theory of Computation*, McGraw-Hill Publication, 4th Edition, 2010.
3. Krithivasan Kamala, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education, 1st Edition, 2009.
4. Papadimitriou, Lewis, *Elements of the Theory of Computations*, PHI Publication, 2nd Edition, 1997.
5. E. V. Krishnamurthy, *Introductory Theory of Computer Science*, Springer-Velang New York Inc., 1st Edition, 1985.

BTCOC503: Software Engineering

[Unit 1] **[7 Hours]**

Introduction: Professional software development, Software engineering ethics, Case studies. Software processes: Software process models, Process activities, Coping with change, The rational unified process.

[Unit 2] **[7 Hours]**

Agile software development: Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods. Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

[Unit 3] **[7 Hours]**

System modeling: Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering. Architectural design: Architectural design decisions, Architectural views, Architectural patterns, Application architectures.

[Unit 4] **[7 Hours]**

Design and implementation, Object-oriented design using UML, Design patterns Implementation issues, Open source development.

[Unit 5] **[7 Hours]**

Software testing, Development testing, Test-driven development, Release testing, User testing. Dependability properties, Availability and reliability, Safety Security.

Text Book:

1. Ian Sommerville, *Software Engineering*; 9th Edition, Addison-Wesley Publishing Company, USA.

Reference Books:

1. S.A. Kelkar, Software Engineering, , Prentice Hall of India, 2007.
2. Pressman, Software Engineering, Tata McGraw Hill, 6th Edition, 2006.
3. Pankaj Jalote, Software Engineering, Narosa Publishers, 3rd Edition, 2006.

NPTEL Course:

1. Software Engineering, Prof. Rajib Mall, Department of Computer Science and Engineering, IIT Kharagpur.

BTCOE504 (A): Human Computer Interaction

[Unit 1] [7 Hours]

Introduction: Course objective and overview, Historical evolution of the field, The Human, The Computer, The Interaction.

[Unit2] [7 Hours]

Design processes: Interaction Design basics, Concept of usability – definition and elaboration, HCI in the Soft- ware Process, Design Rules.

[Unit3] [7 Hours]

Implementation and Evaluation: Implementation Support, Evaluation Techniques, Universal Design, Use Support.

[Unit4] [7 Hours]

Models: Cognitive Models, Socio – Organizational Issues and Stakeholders Requirements, Communication and Collaboration models. Theories: Task Analysis Dialog notations and Design Models of the system Modeling Rich Interactions.

[Unit5] [7 Hours]

Modern Systems: Group ware, Ubiquitous Computing and Augmented Realities, Hypertext, Multimedia and World Wide Web.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale "Human Computer Interaction", Pearson Education, 3rd Edition, 2003.

Reference Books:

1. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
3. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.
4. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O'Reilly Media, 2nd Edition, 2010.

NPTEL Course:

1. Human Computer Interaction, Prof. K. Ponnurangam, Dept. of Computer Science and Engineering, IIIT Delhi.

BTCOE504 (B): Numerical Methods

[Unit 1] **[7 Hours]**

Solution of Algebraic and Transcendental Equation: Bisection method, Method of false position, Newton's method and Newton-Raphson method.

[Unit 2] **[7 Hours]**

Solution of Linear Simultaneous Equation: Gauss elimination method, Gauss-Jordan method, Iterative method of solution- Jacobi iteration method, Gauss-Seidal iteration method, Relaxation method.

[Unit 3] **[7 Hours]**

Finite Differences: Forward difference operator, Backward difference operator, Central difference operator, New- ton's interpolation formulae, Newton's forward–backward-central interpolation formulae.

[Unit 4] **[7 Hours]**

Differentiation and Integration: Newton-Cortes formula, Trapezoidal rule, Simpson one–third rule, Simpson three- eighth rule.

[Unit 5] **[7 Hours]**

Numerical Solution of ODE: Picard's methods, Taylor series method, Euler's method, Modified Euler's method, Runge Kutta method.

Text Book:

1. B. S Grewal, Higher Engineering Mathematics, 40th edition, Khanna publication

Reference Books:

1. S. S. Shastri, Introduction to Numerical Methods, PHI publication.
2. V. Rajaraman, Computer Oriented Methods, 3rd edition, PHI publication.
3. Conte and De boor, Elementary Numerical Analysis, BPB publication.
4. E. Kreyszig, Advanced Engineering Mathematics, BPB publication.
5. Steven C Chapra, Numerical Methods for Engineers, 5th edition, McGraw Hill publication.

NPTEL Course:

1. Numerical Methods, Prof. Ameeya Kumar Nayak and Prof. Sanjeev Kumar, IIT Roorkee.

BTHM505 (A): Economics and Management

[Unit 1] **[7 Hours]**

Introduction, Market Equilibrium: Demand and Supply, Elasticity of Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System.

[Unit 2] **[7 Hours]**

Relevant Information and Decision Making, Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

[Unit 3] **[7 Hours]**

Financial Statements, Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

[Unit 4] **[7 Hours]**

Depreciation Accounting, Evolution of Management Thoughts, Functions of Management Directing.

[Unit 5] **[7 Hours]**

Product Development, Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

Text Book:

1. R. Paneerselvam, Engineering Economics, PHI publication.

Reference Books:

1. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
2. L. M. Prasad, Principles and Practices of Management.
3. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications.

NPTEL Course:

1. Economics / Management / Entrepreneurship, by Prof. P. K. J. Mohapatra Department of Industrial Engineering & Management, IIT Kharagpur.

BTHM505 (B): Business Communication

[Unit 1] **[6 Hours]**
Introduction, Definitions & Concepts, Communicative Competence.

[Unit 2] **[6 Hours]**
Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as Problematic Discourse.

[Unit 3] **[6 Hours]**
Barriers to Communication, Listening, Communication Rules, Communication Style.

[Unit 4] **[6 Hours]**
Interpersonal Communication, Relational Communication, Organizational Communication. Collaboration, Communication in Groups and Teams, Persuasive Communication.

[Unit 5] **[7 Hours]**
Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication, Ethics in Business Communication.

Text Book:

1. Mary Ellen Guffey, Essentials of Business Communication, Sixth Edition, South-Western College Publishing

Reference Books:

1. Bovee, Courtland, John Thill & Mukesh Chaturvedi, Business Communication Today: Dorling kindersley, Delhi.
2. Kaul, Asha, Business Communication, Prentice-Hall of India, Delhi.
3. Monippally, Matthukutty M. Business Communication Strategies. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Sharma, Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd., New Delhi.

NPTEL Course:

1. International Business Communication, by Aradhana Malik, IIT Kharagpur.

BTCOL506: Database Systems Laboratory

List of Experiments:

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.

BTCOL506: Software Engineering Laboratory

List of Experiments:

1. To perform the system analysis: Requirement analysis, SRS. (Both Functional and Nonfunctional requirements. For a set of 10 sample problems, from a book on Software Engineering by Rajib Mall.)
2. To perform the function oriented diagram: DFD and Structured chart.
3. To perform the user's view analysis: Use case diagram.
4. To draw the structural view diagram: Class diagram, object diagram.
5. To draw the behavioral view diagram: Sequence diagram, Collaboration diagram.
6. To draw the behavioral view diagram: State-chart diagram, Activity diagram.
7. To draw the implementation view diagram: Component diagram.
8. To draw the environmental view diagram: Deployment diagram.
9. To perform various testing using the testing tool unit testing, integration testing

BTCOM507: Mini Project-1

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / near by vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 20-25 pages report using latex
6. Present / demonstrate the solution in front of faculty member

BTCOC601: Compiler Design

[Unit 1] Introduction to Compiling **[7 Hours]**

Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler,

[Unit 2] Lexical Analysis **[7 Hours]**

The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

[Unit 3] Syntax Analysis **[7 Hours]**

The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.

[Unit 4] Syntax-Directed Translation **[7 Hours]**

Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S- Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes. Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

[Unit 5] Code Generation **[7 Hours]**

Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators.

Text Book:

1. Aho, Sethi, Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2013

Reference Books:

1. Hopcroft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publication, 2nd Edition, 2001.
2. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, Modern Compiler Design, Springer, 2nd Edition, 2012.

BTCOC602: Computer Networks

[Unit 1] Introduction **[7 Hours]**

Applications of computer networks, Network hardware, Network software: Protocol Hierarchy, Design Issue, connection oriented vs. connectionless, Service Primitives, Reference models: OSI and TCP/IP, Example networks: Internet, Network standardization, Performance: Bandwidth and Latency, Delay and bandwidth product, High- Speed Network, Application Performance Needs.

[Unit 2] LAN Technologies **[7 Hours]**

X5, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.

[Unit 3] Data Link Layer **[7 Hours]**

Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes.

[Unit 4] Network Layer and Congestion Control **[7 Hours]**

IPv4/IPv6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets, General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.

[Unit 5] Application Layer Protocols **[7 Hours]**

DNS, SMTP, POP, FTP, HTTP. Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Text Book:

1. A. Tanenbaum, Computer Networks, PHI Publication, 5th Edition, 2011.

Reference Books:

1. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
2. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman Publication, 5th Edition, 2012.
3. S. Keshav, An Engineering Approach to Computer Networking, Addison-Wesley Professional.
4. D. Comer, Computer Networks and Internet, Pearson Education, 6th Edition, 2014.
5. M. Gallo, W. Hancock, Computer Communications and Networking Technologies, Brooks/Cole Publisher, 2001.
6. Natalia Olifer, Victor Olifer, Computer Networks: Principles, Technologies and Protocols for Network Design, Wiley Publication, 2005.

BTCOC603: Machine Learning

[Unit 1] [7 Hours]

Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation

[Unit 2] [7 Hours]

Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

[Unit 3] [7 Hours]

Perceptron, multilayer network, back propagation, introduction to deep neural network.

[Unit 4] [7 Hours]

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

[Unit 5] [7 Hours]

Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model.

Text Book:

1. Tom Mitchell, Machine Learning, First Edition, McGraw Hill, 1997.

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition,

BTCOE604 (A): Geographic Information System

[Unit 1] **[6 Hours]**

What is Geographic Information Systems?, Different components of GIS, Different types of vector data, Raster data models and their types TIN data model.

[Unit 2] **[6 Hours]**

Advantages and disadvantages associated with vector, raster and TIN Non-spatial data attributes and their type Raster data compression techniques Different raster data file formats spatial database systems and their types.

[Unit 3] **[6 Hours]**

Pre-processing of spatial datasets Different map projections, Spatial interpolation techniques Different types of resolutions Digital Elevation Model (DEM).

[Unit 4] **[6 Hours]**

Quality assessment of freely available DEMS GIS analysis-1

[Unit 5] **[6 Hours]**

GIS analysis-2 and applications Errors in GIS Key elements of maps.

Text Book:

1. Ian Heywood, Sarah Cornelius and Steve Carver, An Introduction to Geographical Information Systems (4th Edition) 2012.

Reference Books:

1. Chang Kang-tsung (Karl), Introduction to Geographic Information Systems, 2006
2. Tor Bernhardsen Geographic Information Systems: An Introduction, May 2002

NPTEL Course:

1. Dr. Arun K. Saraf, Introduction to Geographical Information System, IIT Roorkee.

BTCOE604 (B): Internet of Things

[Unit 1] IoT Introduction **[7 Hours]**

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

[Unit 2] Smart Objects **[7 Hours]**

The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

[Unit 3] IP Layer **[7 Hours]**

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

[Unit 4] Data and Analytics for IoT **[7 Hours]**

An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

[Unit 5] IoT Physical Devices and Endpoints **[7 Hours]**

Building iot with Arduino: Arduino–Interfaces-Arduino IDE–Programming, RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Text Book:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things”, 1st Edition, Pearson Education.

Reference Books:

1. Srinivasa K G, “Internet of Things”, CENGAGE Leaning India, 2017.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
3. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education, 2017.

BTCOE604 (C): Embedded Systems

[Unit 1] **[7 Hours]**

Introduction: Embedded system overview, Design challenge, Processor technology, IC technology, Design technology, Custom single processor technology, Hardware-combinational logic, Sequential logic, Custom single purpose processor design, RT-level custom single purpose processor design, Optimizing custom single purpose processors.

[Unit 2] **[7 Hours]**

General purpose processor Software: Basic architecture, Operation, Programmers view, Development environment, Application specific instruction set processor, Selecting a microprocessor, General purpose processor design. Introduction, ARM7TDMI-S processor, Block diagram, Memory mapping, Memory accelerator module.

[Unit 3] **[7 Hours]**

System control: Pin description, Register description, Crystal oscillator, External interrupt inputs, Other system controls, Memory mapping control, Phase locked loop, Power control, Reset, APB divider, Wakeup timer. GPIO: GPIO register map, Timer-TIMER / COUNTER0 and TIMER / COUNTER1 register map, Example timer operation, Architecture.

[Unit 4] **[7 Hours]**

UART: UART0/1 - UART0/1 register map, UART0/1 baud rate, UART0/1 auto-baud, UART0/1 block diagram. Serial peripheral interface: SPI data transfers, SPI pin description, SPI register map, SPI block diagram; I2C-bus interface: I2C bus configuration, I2C operating modes, I2C Bus serial interface block diagram, Summary of I2C registers.

[Unit 5] **[7 Hours]**

Introduction, Process scheduling, Examples of RTOS, Microprocessor and microcontroller based system design, typical design examples, system design and simulation using simulation software such as Proteus VSM. Digital Camera Example Introduction, Introduction to a Simple Digital Camera; User's Perspective, Designer's perspective requirements specification non functional requirements, Informal functional specification, refined functional specification.

Text Book:

1. Frank Vahid "Embedded System Design- A Unified system Hardwar/Software Introduction", (3rd Edition, John Wiley India) ISBN 978-81-265-0837-2.

Reference Books:

1. LPC 214x User manual (UM10139):- www.nxp.com..
2. Andrew N. Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide – Designing and Optimizing System Software", (Elsevier) ISBN: 1-55860-874-5.
3. LPC 17xx User manual (UM10360) :- www.nxp.com
4. ARM architecture reference manual : - www.arm.com
5. Steve Furber "An Engineer's Introduction to the LPC2100 series" Trevor Martin (Hitex (UK) Ltd.)."ARM System-on-Chip Architecture" (2nd Edition, Addison-Wesley Professional)ISBN-13: 9780201403527

BTHM605 (A): Development Engineering

[Unit 1] **[7 Hours]**

Introduction, Various Definitions of Development Engineering.

[Unit 2] **[7 Hours]**

World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer's Role.

[Unit 3] **[7 Hours]**

Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

[Unit 4] **[7 Hours]**

Development Strategies: Society, Technological Change, and Development, Development Economists' Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

[Unit 5] **[7 Hours]**

Engineering for Sustainable Community Development: The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education. ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

Text Book:

1. Kevin M. Passino, Humanitarian Engineering: Advancing Technology for Sustainable Development.

BTHM605 (B): Employability and Skill Development

[Unit 1] Soft Skills & Communication basics: **[7 Hours]**

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

[Unit 2] Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability: **[7 Hours]**

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).
Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

[Unit 3] Grammar and Comprehension: **[7 Hours]**

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

[Unit 4] Skills for interviews: **[7 Hours]**

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

[Unit 5] Problem Solving Techniques: **[7 Hours]**

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.
Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

Text Book:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016

Reference Books:

1. Wiley Wren and Martin, "English grammar and Composition", S. Chand publications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum;s Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. McMurrey, “A Guide to Writing as an Engineer”, ISBN: 978- 1-118-30027-5 4th Edition, 2014, Wiley.

BTHM605 (C): Consumer Behavior

[Unit 1] [7 Hours]

Introduction to the Study of Consumer Behavior: Defining Consumer Behavior, Scope and Application of Consumer Behavior, Why Study Consumer Behavior, Evolution of Consumer Behavior as a Field Of Study and its relationship with Marketing: Behavioral Dimension, The Interdisciplinary Nature of Consumer Behavior. Market Research and Consumer Behavior, Relevance of Market Research with Consumer Behavior, Approaches to Consumer Behavior Research, Quantitative Research, Qualitative Research.

[Unit 2] [7 Hours]

Market Segmentation and Positioning, Market Segmentation, Basis for Segmentation, Alternatives available for Segmentation, Positioning. The Consumer Decision Making Process: Buying Motives, Buying Roles, Consumer Decision Making Process, Levels of Consumer Decision Making, Perspectives to Consumer Decision Making, Consumer Decision Making Process.

[Unit 3] [7 Hours]

Models of Consumer Behavior: The Economic model, Learning model, Psychoanalytic model, The sociological model. The Howard Sheth model of Buying Behaviour, The Nicosia model, The Engel - Kollat - Blackwell Model, Engel, Blackwell and Miniard (EBM) model.

[Unit 4] [7 Hours]

Psychological Influences on Consumer Decision Making: Consumers Needs & Motivation, Emotions and Mood, Consumer Involvement, Consumer Learning, Personality, Self-concept and Self-image, Consumer Perception, Risk and Imagery. Consumer Attitude: Belief, Affect, Attitude and Intention, Attitude Formation and Attitude Change, Consumer Communication. Sociological Influences on Consumer Decision Making: Consumer groups, Consumer reference groups, Family and Life cycle, Social class and mobility, lifestyle analysis, Culture; Sub-Culture, Cross Culture, Interpersonal Communication and influence, Opinion Leadership.

[Unit 5] [7 Hours]

Diffusion of innovation Diffusion Process, Adoption Process, Consumer Innovators, Multiplicative innovation adoption (MIA) model. Organizational Buying: Differences between Industrial Markets and Consumer Markets, Differences between Organizational and Consumer Buying, Buying Decisions in Organizational Buying Process, Types of Decision Making, Organization Buyer's Decision Making Process, and Factors influencing Organizational Buying Behaviour, Decision Makers in Organizational Buying, Webster and Wind model of Organizational buying behaviour, The Sheth model of Industrial buying, The Sheth model of Industrial buying Consumer Behavior Analysis and Marketing Strategy: Consumer Behavior and Product Strategy, Consumer Behavior and Pricing Strategy, Consumer Behavior and Distribution Channel Strategy, Consumer Behavior and Promotion Strategy.

Text Book:

1. Consumer Behavior, Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

Reference Books:

1. Consumer Behavior, Concepts and Applications, Loudon, D.L. and Bitta, A.J.D, Tata McGraw Hill.
2. Consumer Behavior and Marketing Startegy, Peter, J.P. and Olson, J.C., Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

BTCOL606: Competitive Programming

[Unit 1] [7 Hours]

Introduction: Online Judge The Programming Challenges Robot Judge, Understanding Feedback From the Judge, Choosing Programming Languages, Reading Our Programs, Standard Input/Output, Programming Hints, Elementary Data Types.

Challenging Problems

(1) The 3n + 1 Problem (2) Minesweeper (3) The Trip, (4) LCD Display (5) Graphical Editor (6) Interpreter (7) Check the Check (8) Australian Voting.

[Unit 2] [7 Hours]

Elementary Data Structures: Data Structures: Elementary Data Structures, Stacks, Dictionaries, Priority Queues Sets, Object Libraries, The C++ Standard Template Library, The Java java.util Package, Program Design Example: Going to War, Hitting the Dec, String Input/Output, Winning the War, Testing and Debugging.

Challenging Problems

(1) Jolly (2) Poker Hands (3) Hartals (4) Crypt Kicker (5) Stack 'em Up (6) Erd¨os Numbers (7) Contest Scoreboard (8) Yahtzee.

[Unit 3] [7 Hours]

Strings: Character Codes, Representing Strings, Program Design Example: Corporate Renamings, Searching for Patterns, Manipulating Strings, Completing the Merger, String Library Functions.

Challenging Problems

(1) WERTYU (2) Where's Waldorf? (3) Common Permutation (4) Crypt Kicker II (5) Automated Judge Script (6) File Fragmentation (7) Doublets (8) Fmt

[Unit 4] [7 Hours]

Sorting: Sorting, Sorting Applications Sorting Algorithms, Program Design Example: Rating the Field, Sorting Library Functions, Rating the Field.

Challenging Problems

(1) Vito's Family (2) Stacks of Flapjacks (3) Bridge (4) Longest Nap (5) Shoemaker's Problem (6) CDVII (7) Shell Sort (8) Football.

[Unit 5] [8 Hours]

Arithmetic and Algebra: Machine Arithmetic, Integer Libraries, High-Precision Integers, High-Precision Arithmetic, Numerical Bases and Conversion, Real Numbers, Dealing With Real Numbers, Fractions, Decimals, Algebra, Manipulating Polynomials, Root Finding, Logarithms, Real Mathematical Libraries.

Challenging Problems

(1) Primary Arithmetic (2) Reverse and Add (3) The Archeologist's Dilemma (4) Ones (5) A Multiplication Game (6) Polynomial Coefficients (7) The Stern-Brocot Number System (8) Pairsumonious Numbers.

Combinatorics: Basic Counting Techniques, Recurrence Relations, Binomial Coefficients, Other Counting Sequences, Recursion and Induction Problems.

Challenging Problems

(1) How Many Fibs? (2) How Many Pieces of Land? (3) Counting (4) Expressions (5) Complete Tree Labeling (6) The Priest Mathematician (7) Self-describing Sequence (8) Steps

List of Practical:

At least twenty five problems solving on competitive programming platforms such as, https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/

Text Book:

1. Steven S. Skiena Miguel A. Revilla, Programming Challenges The Programming Contest Training Manual, Springer

Reference Books:

1. Antti Laaksonen, Competitive Programmer's Handbook.
2. Steven Halim, Competitive Programming 3: The Lower Bounds of Programming Contests.
3. Gayle Lakaman Cracking the Coding Interview.
4. The Hitchhiker's Guide to the Programming Contests.

BTCOL606: Machine Learning Laboratory

As a part of lab exercises for Machine Learning Laboratory, it is suggested that the student should get hands-on experience by solving data analysis problems available on Machine Learning competition platforms such as Hacker Earth and Kaggle. Some of the suggestive list of problem solving is given below. Knowledge of R programming or Python is required to solve these problems, students get this prerequisite in Second Year.

1	Regression Analysis and Plot interpretation.
2	Logistic Regression Analysis in R.
3	Random Forest and Parameter Tuning in R.
4	Clustering Algorithms and Evaluation in R.
5	Machine Learning Project in Python on Hourse Prices Data.

BTCOC701: Artificial Intelligence

[Unit1] Introduction [7 Hours]

What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

[Unit2]Problem-solving [7 Hours]

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.

[Unit 3]Knowledge & Reasoning [7 Hours]

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.

[Unit 4]Probabilistic Reasoning [7 Hours]

Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics,

Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

[Unit5]Natural Language processing: [7 Hours]

Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing.

Learning: Forms of learning, Inductive learning, Learning decision trees, explanation based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells and knowledge acquisition.

Text Book:

1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill

Reference Books:

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

BTCOE702 Cloud Computing

[Unit 1] Introduction **[7 Hours]**

Definition and evolution of Cloud Computing, Enabling Technologies, Service and Deployment Models, Popular Cloud Stacks and Use Cases, Benefits, Risks, and Challenges of Cloud Computing, Economic Models and SLAs, Topics in Cloud Security.

[Unit 2] Cloud Infrastructure **[7 Hours]**

Historical Perspective of Data Centres, Data centre Components: IT Equipment and Facilities, Design Considerations: Requirements, Power, Efficiency, & Redundancy, Power Calculations, PUE and Challenges in Cloud, Data Centres, Cloud Management and Cloud Software Deployment Considerations.

[Unit 3] Virtualization **[7 Hours]**

Virtualization (CPU, Memory, I/O) Case Study: Amazon EC2, Software Defined Networks (SDN). Software Defined Storage (SDS).

[Unit 4] Cloud Storage **[7 Hours]**

Introduction to Storage Systems, Cloud Storage Concepts, Distributed File Systems (HDFS, CephFS), Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB),

[Unit 5] Cloud Object Storage **[6 Hours]**

Cloud Object Storage (Amazon S3, Open Stack Swift, Ceph).

Text Book:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.

Reference Books:

1. Gautam Shroff, Enterprise Cloud Computing - Technology, Architecture, Applications; Cambridge University Press, 2010.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
3. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
4. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH, 2010

NPTEL Course:

1. Cloud Computing, Prof. Soumya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur.

BTCOE703 (A): Bioinformatics

[Unit 1] Introduction to Bioinformatics [6 Hours]

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological Databases The Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

[Unit 2] Genomics & Proteomics [7 Hours]

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for Medical Science Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

[Unit 3] Phylogenetic Analysis [7 Hours]

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

[Unit 4] Bioinformatics in Drug Discovery [6 Hours]

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

[Unit 5] Human Genome Project [6 Hours]

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

Text Book:

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.

NPTEL Course:

1. Prof. M. Michael Gromiha, Algorithms and Applications.

BTCOE703 (B): Distributed Systems

[Unit1]Introduction **[7 Hours]**

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message-Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multidatagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

[Unit 2] Remote Procedure Calls **[7 Hours]**

RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, Case studies: Sun RPC, DCE, RPC.

[Unit 3] Distributed Shared Memory **[6 Hours]**

General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

[Unit 4] Resource Management And Process Management **[6 Hours]**

Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

[Unit 5] Distributed File System **[6 Hours]**

Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Book:

1. P. K. Sinha, Distributed Operating System, PHI Publication

Reference Books:

1. Colorouis, Distributed Systems, Addison Wesley Publication.
2. M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley, 2004.

NPTEL Course:

1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

BTCOE703 (C): Big Data Analytics

[Unit 1]   Introduction to Big Data **[6 Hours]**

Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.

[Unit 2] Big Data Platforms **[7 Hours]**

Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

[Unit 3] Big Data Streaming Platforms **[6 Hours]**

Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.

[Unit 4] Big Data Applications **[6 Hours]**

Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, Spark MLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.

[Unit 5] Database for the Modern Web **[7 Hours]**

Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript' sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.

Text Book:

1. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley and SAS Business Series.

Reference Books:

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, "Big Data Principals and Paradiagram", Elsevier, ISBN: 978-0-12-805394-2
2. Kyle Banker, Peter Bakkum and Shaun Verch, "MongoDB in Action", 2nd Edition Dream tech Press, ISBN: 978-9351199359.
3. Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", 3rd edition, Cambridge University Press
4. Sima Acharya, Subhashini Chhellappan, "BIG Data and Analytics", ,Willey publication, ISBN: 978-8126554782.

NPTEL COURSE:

1. Big Data Computing by Prof. Rajiv Misra, Dept. of Computer Science and Engineering, IIT Patna

BTCOE704 (A): Cryptography & Network Security

[Unit 1] **[6 Hours]**

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon's Theory.

[Unit 2] **[6 Hours]**

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES).Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

[Unit 3] **[6 Hours]**

Stream Ciphers and Pseudo-randomness: Stream Ciphers, Pseudo-random functions. Hash Functions and MACs: Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs).

[Unit 4] **[6 Hours]**

Asymmetric Key Ciphers: Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie-Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.

[Unit -5] **[6 Hours]**

Digital Signatures: Signature schemes: I, Signature schemes: II. Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II. Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

Text Book:

1. Douglas Stinson, *"Cryptography Theory and Practice"*, 2nd Edition, Chapman & Hall/CRC.

Reference Books:

1. B. A. Forouzan, *"Cryptography & Network Security"*, McGraw Hill Publication.
2. William Stallings, *"Cryptography and Network Security"*, Pearson Education.
3. Dr. B. B. Meshram, *TCP/IP & Network Security*, SPD Publication.
4. Wenbo Mao, *"Modern Cryptography, Theory & Practice"*, Pearson Education.
5. Hoffstein, Pipher, Silvermman, *"An Introduction to Mathematical Cryptography"*, Springer.
6. Alang.Konheim, *Computer Security and Cryptography*, Wiley Publication.
7. A. Joux, *"Algorithmic Crypt-analysis"*, CRC Press.
8. S. G. Telang, *"Number Theory"*, McGraw Hill.
9. Matt Bishop, *"Computer Security"*, Pearson Education.

BTCOE704 (B): Business Intelligence

[Unit 1] Business Intelligence Introduction [6 Hours]

Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics, BI Life Cycle. Data for BI – Data Issues and Data Quality for BI.

[Unit 2] BI Implementation [6 Hours]

Key Drivers, Key Performance Indicators and operational metrics, BI Architecture/Framework, Best Practices, Business Decision Making. Business Analytics: Objective Curve, Web Analytics and Web Intelligence, Customer Relationship Management.

[Unit 3] Business/Corporate Performance Management [6 Hours]

Dash Boards and Scorecards, Business Activity Monitoring, Six Sigma. Advanced BI: Big Data and BI, Social Networks, Mobile BI, emerging trends. Working with BI Tools: Overview of managerial, strategic and technical issues associated with Business Intelligence and Data Warehouse design, implementation, and utilization. Critical issues in planning, physical design process, deployment and ongoing maintenance.

[Unit 4] Data Warehousing (DW) [6 Hours]

Data Warehousing (DW): Introduction & Overview; Data Marts, DW architecture – DW components, Implementation options; Meta Data, Information delivery. ETL: Data Extraction, Data Transformation – Conditioning, Scrubbing, Merging, etc., Data Loading, Data Staging, Data Quality.

[Unit 5] Dimensional Modeling [6 Hours]

Dimensional Modeling: Facts, dimensions, measures, examples; Schema Design – Star and Snowflake, Fact constellation, slow changing Dimensions. OLAP: OLAP Vs OLTP, Multi-Dimensional Databases (MDD); OLAP – ROLAP, MOLAP, HOLAP; Data Warehouse Project Management: Critical issues in planning, physical design process, deployment and ongoing maintenance.

Text Book:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009

Reference Books:

1. David Loshin, Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 2009.

BTCOE704 (C): Blockchain Technology

[Unit 1] Introduction **[6 Hours]**

Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Crypto currency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

[Unit 2] Bitcoin and Blockchain **[7 Hours]**

Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

[Unit 3] Permissioned Blockchain **[7 Hours]**

Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport- Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

[Unit 4] Enterprise application of Blockchain **[6 Hours]**

Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain.

[Unit 5] Blockchain Application Development **[6 Hours]**

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text Book:

1. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.

Reference Books:

1. Josh Thompsons, "Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming".
2. Daniel Drescher, "Blockchain Basics", Apress; 1st Edition, 2017.
3. Anshul Kaushik, "Blockchain and Crypto Currencies", Khanna Publishing House, Delhi.
4. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing.
5. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing.
6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

NPTEL Course:

1. Prof. Sandip Chakraborty, Department of Computer Science And Engineering, IIT Kharagpur and Dr. Praveen Jayachandran, Research Staff Member, IBM.

BTCOE705 (A): Virtual Reality

[Unit 1] Introduction to Virtual Reality **[6 Hours]**

Virtual Reality and Virtual Environment: Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

[Unit 2] Geometric Modelling **[6 Hours]**

From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

[Unit 3] Virtual Environment **[6 Hours]**

Animating the Virtual Environment: The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation, particle system.

[Unit 4] Physical Simulation **[4 Hours]**

Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

[Unit 5] VR Hardware and Software **[6 Hours]**

Human factors: The eye, the ear, the somatic senses. VR Hardware: Sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

VR Applications: Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

Text Book:

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.

Reference Books:

1. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.
2. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
3. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006.
4. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008.
5. www.vresources.org
6. www.vrac.iastate.edu
7. www.w3.org/MarkUp/VRM

BTCOE705 (B): Deep Learning

[Unit 1] **[6 Hours]**

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks.

[Unit 2] **[6 Hours]**

FeedForward Neural Networks, Backpropagation. Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp. Principal Component Analysis and its interpretations, Singular Value Decomposition.

[Unit 3] **[6 Hours]**

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying. Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

[Unit 4] **[6 Hours]**

Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Learning Vectorial Representations of Words,

[Unit 5] **[6 Hours]**

Recurrent Neural Networks, Back propagation through time, Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Book:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press

Reference Books:

1. Raúl Rojas, Neural Networks: A Systematic Introduction, 1996.
2. Christopher Bishop, Pattern Recognition and Machine Learning, 2007.

NPTEL Courses:

1. Prof. Prof. Mitesh M. Khapra, Prof. Sudarshan Iyengar, Dept. of Computer Science and Engineering, IIT Madras & IIT Ropar, NPTEL Course on Deep Learning (Part-I).

BTCOE705 (C): Design Thinking

[Unit 1] Overview of Design Thinking Process [6 Hours]

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

[Unit 2] Empathize [5 Hours]

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions.

[Unit 3] Analyze or Define [5 Hours]

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

[Unit 4] Test (Prototyping and Validation) [5 Hours]

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

[Unit 5] Design Innovation [5 Hours]

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

Text Book:

1. Bala Ramadurai, “Karmic Design Thinking”, First Edition, 2020.

Reference Books:

1. Vijay Kumar,” 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization “.
2. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World by IDEO.
3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

BTCOL706 Artificial Intelligence

List of Experiments:

1. Study of PROLOG. Write the following programs using PROLOG.
2. Write a program to solve 8 queens problem.
3. Solve any problem using depth first search.
4. Solve any problem using best first search.
5. Solve 8-puzzle problem using best first search.
6. Solve Robot (traversal) problem using means End Analysis.
7. Solve traveling salesman problem.

BTCOL706 Cloud Computing

List of Experiments:

(Pl. Note: List of Experiments should be as per theory covered in the class based on Cloud Environments.

Following list can be used as a reference.)

1. Sketch out and analyze architecture of Moodle cloud portal and moodle cloud site and create different entities dynamically.
2. Create a scenario in wordpress for Social Marketing, Search engine and Sharing Tools.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Implement and configure Google App Engine to deploy Python Program application.
6. Installation and configuration of virtual machine with guest OS.
7. Demonstrate the use of map and reduce tasks.
8. Implementation of SOAP Web services in C#/JAVA Applications.
9. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
10. Implement and use sample cloud services with the help of Microsoft Azure.
11. Design and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
12. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
13. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.

BTCOS707: Project phase - I

BTCOF801: Project phase – II (In-house) / Internship and Project in the Industry

In this course, it is expected that students will go to industry for internship for one semester and do industry based project in that period. Student will be assigned one dept. one Industry guide to monitor progress of the student. After, completion of the Internship student will submit project report to the dept. and project examination will be conducted in consultation with the Industry guide.

In case, if student not opting / not doing Internship in the Industry, such students can do project work in the dept.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Linear Algebra	BTES301	III	https://nptel.ac.in/courses/111/101/111101115/ https://nptel.ac.in/courses/111/106/111106051/	IIT, Madras	85 90	8 Weeks 12 Weeks
2	Discrete Mathematics	BTCOC302	III	https://nptel.ac.in/courses/106/106/106106094/ https://nptel.ac.in/courses/111/107/111107058/	IIT, Madras IIT, Roorkee	90 90	8 Weeks
3	Data Structures	BTCOC303	III	https://nptel.ac.in/courses/106/102/106102064/	IIT, Delhi	90	Not mentioned
4	Computer Architecture & Organization	BTCOC304	III	https://nptel.ac.in/courses/106/106/106106092/ https://nptel.ac.in/courses/106/103/106103180/ https://nptel.ac.in/courses/106/106/106106166/ https://nptel.ac.in/courses/106/105/106105163/ https://swayam.gov.in/nd1_noc20_cs64/preview	IIT, Madras IIT, Guwahati IIT, Madras ,IIT, Kharagpur IIT, Kharagpur	85 75 70 85 85	12 weeks
5	Object Oriented Programming in C++	BTCOC305	III	https://nptel.ac.in/courses/106/105/106105151/	IIT, Kharagpur	58	8 weeks
6	JAVA Programming	BTCOL306	III	https://nptel.ac.in/courses/106/105/106105191/	IIT, Kharagpur	90	12 Weeks
7	Design & Analysis of Algorithms	BTCOC401	IV	https://nptel.ac.in/courses/106/101/106101060/ https://nptel.ac.in/courses/106/105/106105164/ https://swayam.gov.in/nd1_noc20_cs71/preview	IIT, Kharagpur IIT, Madras Chennai Mathematical Institute	40	12 weeks
8	Probability & Statistics	BTBS402	IV	https://nptel.ac.in/courses/111/106/111106112/# https://nptel.ac.in/courses/111/105/111105090/	IIT, Madras IIT, Kharagpur	80 90	4 weeks 12 weeks
9	Operating Systems	BTCOC403	IV	https://nptel.ac.in/courses/106/108/106108101/ https://nptel.ac.in/courses/106/106/106106144/	IISc, Bangalore IIT, Madras	1. 85 2. 80	1. 8 Weeks 2. 8 Weeks
10	Basic Human Rights	BTHM404	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT, Kanpur	75	30 Hours

11	Digital Electronics & Microprocessors	BTES405	IV	https://nptel.ac.in/courses/108/105/108105132/ https://nptel.ac.in/courses/108/103/108103157/	IIT, Kharagpur IIT, Guwahati	50	12 weeks
12	Python Programming	BTCOL406	IV	https://nptel.ac.in/courses/106/106/106106182/	IIT, Ropar	95	12 weeks
14	Database Systems	BTCOC501	V	http://nptel.ac.in/courses/106 1 06093/	IIT, Madras	95	12 Weeks
15	Theory of Computation	BTCOC502	V	https://nptel.ac.in/courses/106/104/106104028/ https://nptel.ac.in/courses/106/106/106106049/	IIT, Kharagpur IIT, Madras	92	45 Hrs 42 Hrs
16	Machine Learning	BTCOC503	V	https://nptel.ac.in/courses/106/105/106105152/	IIT, Kharagpur	100	8 Weeks
17	Human Computer Interaction	BTCOE504 (A)	V	https://nptel.ac.in/courses/106/103/106103115/#	IIT, Guwahati	70	8 Weeks
18	Numerical Methods	BTCOE504 (B)	V	https://nptel.ac.in/courses/111/107/111107105/	IIT, Roorkee	90	8 Weeks
19	Economics and Management	BTHM505 (A)	V	https://nptel.ac.in/courses/110/105/110105067/	IIT, Kharagpur	90	8 Week
20	Business Communication	BTHM505 (B)	V	https://nptel.ac.in/courses/110/105/110105052/	IIT, Kharagpur	90	8 Weeks
21	Compiler Design	BTCOC601	VI	https://nptel.ac.in/courses/106/108/106108113/ https://nptel.ac.in/courses/106/104/106104123/	IISc, Banglore IIT Kanpur	80	40 Hrs
22	Computer Networks	BTCOC602	VI	https://nptel.ac.in/courses/106/105/106105081/ https://nptel.ac.in/courses/106/105/106105080/	IIT Kharagpur	90	12 Weeks
23	Software Engineering	BTCOC603	VI	https://nptel.ac.in/courses/106/105/106105182/	IIT, Kharagpur	70	9 weeks
24	Geographic Information System	BTCOE604 (A)	VI	Introduction to Geographic Information Systems	IIT, Roorkee	90	4 weeks
25	Internet of Things	BTCOE604 (B)	VI	https://nptel.ac.in/courses/106/105/106105166/	IIT, Kharagpur	60	12 Weeks
26	Embedded Systems	BTCOE604 (C)	VI	https://nptel.ac.in/courses/106/105/106105193/	IIT, Kharagpur	80	8 Weeks
27	Development Engineering	BTCOE605 (A)	VI	https://nptel.ac.in/courses/109/103/109103023/ https://nptel.ac.in/courses/109/104/109104074/	IIT, Guwahati IIT, Kanpur	30 40	8 Weeks
28	Employability and Skills Development	BTCOE605 (B)	VI	https://nptel.ac.in/courses/109/105/109105144/	IIT, Kharagpur	75	8 Weeks
29	Consumer Behaviour	BTCOE605 (C)	VI	https://nptel.ac.in/courses/110/105/110105054/	IIT Kharagpur	90	40 Hrs

30	Artificial Intelligence	BTCOC701	VII	https://nptel.ac.in/courses/106/106/106106126/ https://nptel.ac.in/courses/106/105/106105078/	IIT, Madras IIT, Kharagpur	70	48 Hrs 41 Hrs
31	Cloud Computing	BTCOE702	VII	https://nptel.ac.in/courses/106/104/106104182/ https://nptel.ac.in/courses/106/105/106105167/	IIT, PATNA IIT, Kharagpur	30 40	8 weeks
32	Bioinformatics	BTCOE703 (A)	VII	https://nptel.ac.in/courses/102/106/102106065/	IIT, Madras	50	12 Weeks
33	Distributed Systems	BTCOE703 (B)	VII	https://nptel.ac.in/courses/106/106/106106168/	IIT, PATNA	50	8 Weeks
34	Big Data Analytics	BTCOE703 (C)	VII	https://nptel.ac.in/courses/106/104/106104189/	IIT, PATNA	50	8 Weeks
35	Cryptography and Network Security	BTCOE704 (A)	VII	https://swayam.gov.in/nd2_nou19_cs08/preview	Uttarakhand Open University, Haldwani	20	12 Weeks
36	Business Intelligence	BTCOE704 (B)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, Kharagpur	10	12 Weeks
37	Blockchain	BTCOE704 (C)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, KANPUR	60	8 Weeks
38	Virtual Reality	BTCOE705 (A)	VII	https://nptel.ac.in/course/106/106/106106138	IIT Madras & UIUC	30	8 Weeks
39	Deep Learning	BTCOE705 (B)	VII	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs85/	IIT Madras & IIT Ropar	100	12 Weeks
40	Design Thinking	BTCOE705 (C)	VII	https://nptel.ac.in/courses/110/106/110106124/	IIT Madras	75	4 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course	Name of Institute offering course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	1)https://www.coursera.org/learn/discrete-mathematics/home/welcome 2)https://www.coursera.org/specializations/discrete-mathematics	1)Shanghai Jiao Tong University 2)University of California San Diego National Research University Higher School of Economics	1) 75 2) 90	8 Weeks
2	Data Structures	BTCOC303	III	1) Data Structures 2) Data Structures & Algorithms	1) UC SanDiego 2) UC SanDiego	1) 90 2) 80	1) 6 Weeks 2) 6 Weeks
3	Computer Architecture & Organization	BTCOC304	III	Computer Architecture	Princeton University, US	25	4 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	C++ For C Programmers, Part A	University of California, Santa Cruz	27	5 Weeks
5	Digital Electronics & Microprocessors	BTES403	IV	1) Digital Systems: From Logic Gates to Processors	1) Universitat Autonoma de Barcelona 2) Princetone University	20	4 Weeks
6	Design & Analysis of Algorithms	BTCOC401	IV	Algorithms Specialization	Stanford University	40	16 Weeks
7	Probability & Statistics	BTBS402	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
8	Operating Systems	BTCOC403	IV	Operating Systems and You: Becoming a Power User	Google	20	6 Weeks
9	Database Systems	BTCOC501	V	Relational database systems	Universidad Nacional Autónoma de México	30	4 Weeks
10	Theory of Computation	BTCOC502	V	Computer Science: Algorithms, Theory, and Machines	Princeton University	25	4 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python	IBM	50	6 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Interaction Design Specialization	UCSanDiego	30	13 Weeks
13	Economics and Management	BTHM505 (A)	V	Managerial Economics and Business Analysis Specialization	University of Illinois	30	4 Weeks

14	Business Communication	BTHM505 (B)	V	Communication theory: bridging academia and practice	National Research University Higher School of Economics	35	9 Weeks
15	Compiler Design	BTCOC601	VI	Nil	Nil	Nil	Nil
16	Computer Networks	BTCOC602	VI	The Bits and Bytes of Computer Networking	Google	50	4 Weeks
17	Software Engineering	BTCOC603	VI	Software Development Processes and Methodologies https://www.coursera.org/learn/software-Processes	University of Minnesota	25	4 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	1. GIS, mapping, and spacial analysis Specialization	University of Toronto	40	6 months
19	Internet of Things	BTCOE604 (B)	VI	Internet of Things Specialization	UC San Diego	40	6 Months
20	Development Engineering	BTCOE605 (A)	VI	Revolutionary Ideas: Utility, Justice, Equality, Freedom	Rutgers the State University of New Jersey	30	5 Weeks
21	Consumer Behaviour	BTCOE605 (C)	VI	Digital Marketing Specialization	Illinois	70	6 Months
22	Artificial Intelligence	BTCOC701	VII	Introduction to Artificial Intelligence (AI)	IBM	40	4 Weeks
23	Cloud Computing	BTCOE702	VII	Cloud Computing Applications, Part 1: Cloud Systems and Infrastructure	University of Illinois at Urbana-Champaign	70	4 Weeks
24	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics Capstone: Big Data in Biology	University of California San Diego	20	3 Weeks
25	Distributed System	BTCOE703 (B)	VII	Distributed Programming in Java	Rice University	30	4 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Information Security: Context and Introduction	Royal Holloway, University of London	40	4 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence Concepts, Tools, and Applications	University of Colorado System	30	5 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Edx Course	Name of Institute offering Course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	https://www.edx.org/course/advanced-algorithmics-and- graph-theory-with-python	IMT Atlantique, a french technological university	50	6 Weeks
2	Data Structures	BTCOC303	III	1) Foundations of Data Structures 2) Algorithms and Data Structures	1) IIT Bombay 2) UCSanDiego	1) 90 2) 70	1) 6 Weeks 2) 4 Weeks
3	Computer Architecture & Organization	BTCOC304	III	1. Computer Organization 2. Computer Architecture	1. MITx 2. MITx	1. 20 2. 20	10 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	Object-oriented Programming	IIT BombayX	53	4 Weeks
5	Design & Analysis of Algorithms	BTCOC401	IV	Algorithm Design and Analysis	University of Pennsylvania	40	4 Weeks
6	Probability & Statistics	BTBS402	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Operating Systems	BTCOC403	IV	Computer Hardware and Operating Systems	New York University	40	6 Weeks
8	Digital Electronics & Microprocessors	BTES405	IV	Computer System Design: Advanced Concepts of Modern Microprocessors	1) Edx Edge	10	6 Weeks
9	Database Systems	BTCOC501	V	Databases: SQL	Stanford Online	50	8 Weeks
10	Theory of Computations	BTCOC502	V	Automata Theory	Stanford University	60	7 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python: A Practical Introduction	IBM	50	5 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Human-Computer Interaction	Georgia Tech	30	12 Weeks
13	Economics and Management	BTHM505 (A)	V	Introduction to Managerial Economics	IIM Bangalore	30	6 Weeks
14	Business Communication	BTHM505 (B)	V	Effective Business Communication	IIM Bangalore	40	6 Weeks
15	Compiler Design	BTCOC601	VI	Compilers	Stanford University	45	10 Weeks

16	Computer Networks	BTCOC602	VI	Introduction to Networking	New York University	40	7 Weeks
17	Software Engineering	BTCOC603	VI	Software Engineering Essentials https://www.edx.org/course/software-engineering-essentials	TUMx	40	8 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	No Program available	NA	NA	NA
19	Internet of Things	BTCOE604 (B)	VI	Getting Started with the Internet of Things (IoT)	Microsoft	30	4 Weeks
20	Development Engineering	BTCOE605 (A)	VI	Human Rights, Human Wrongs: Challenging Poverty, Vulnerability and Social Exclusion	SDGAcademyX, Middlesex University	40	11 Weeks
21	Consumer Behaviour	BTCOE605 (B)	VI	Consumer Behaviour	IITMB	50	4 Weeks
22	Artificial Intelligence	BTCOC701	VII	CS50's Introduction to Artificial Intelligence with Python	Harvard University	35	7 Weeks
23	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics	University of Maryland	40	24 Weeks
24	Distributed Systems	BTCOE703 (B)	VII	Reliable Distributed Algorithms - Part 1	KTHx	30	5 Weeks
25	Cloud Computing	BTCOE703 (C)	VII	Cloud Computing Management	University of Maryland	20	8 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Cyber security	Rochester Institute of Technology	50	40 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence for IoT Solutions	Microsoft	20	4 Weeks
28	Block Chain	BTCOE704 (C)	VII	1. Block chain Technology 2. Block chain Fundamentals	Berkeley University Of California	60	14 Weeks
29	Virtual Reality	BTCOE705 (A)	VII	How Virtual Reality Works	Ucsan Diego	10	6 Weeks
30	Deep Learning	BTCOE705 (B)	VII	Deep Learning Fundamentals with Keras	IBM	15	5 Weeks

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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Telephone and Fax. 02140 - 275142
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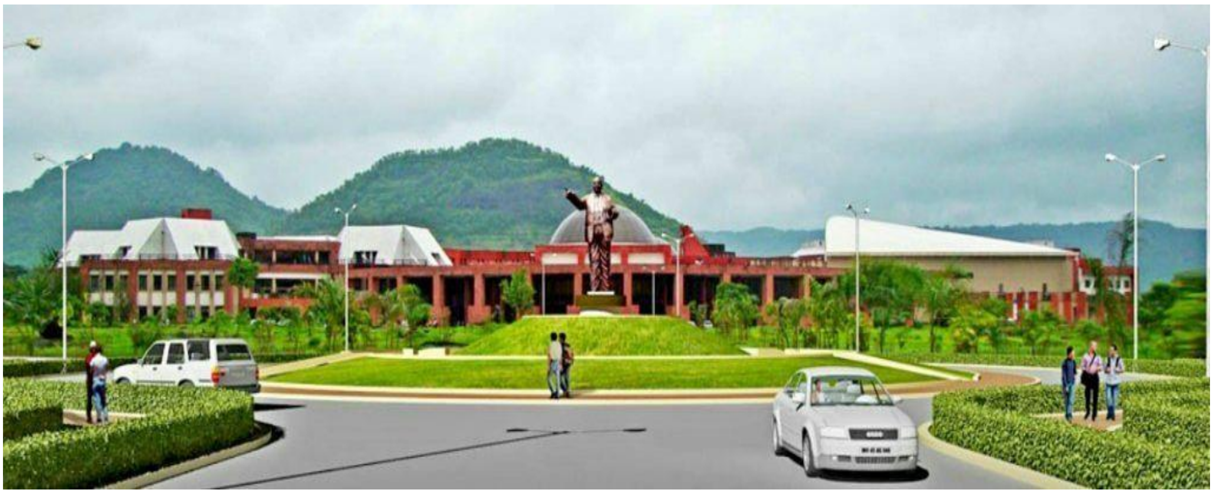
COURSE STRUCTURE AND SYLLABUS

For

Second Year

B. Tech. EXTC, EC AND EC (SANDWICH)

With effect from the Academic Year 2021-2022



Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well.For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PGProgramme:

A full time student of a particular UG/PGprogramme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PGprogramme as stipulated in the specific Regulations pertaining to that UG/PGprogramme.

2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
(c) Paid all required advance payments of the Institute and hostel for the current semester;
(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below has been implemented from academic year 2019-20,starting from I year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA $\geq$ 5.50 &<6.00	SecondClass
CGPA $\geq$ 6.00 &<7.50	First Class
CGPA $\geq$ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

	MidSemester Exam (MSE) Marks	20
	ContinuousAssesment Marks	20
	End SemesterExamination(ESE)Marks	60

4.A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assesment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, <u>with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.</u>

This has been implemented from the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where
'm' is the total number of subjects from the first semester onwards up to and including the semester S,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in ------- Engineering with Minor in ------ --Engineering.
(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Bachelor of Technology in Electronics and Telecommunication Engineering

Basic Science Course (BSC)

BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics - III	(3-1-0)4
BTBS404	Probability Theory and Random Processes	(3-0-0)3

Engineering Science Course (ESC)

BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES304	Electrical Machines and Instruments	(3-1-0)4

Humanities and Social Science including Management Courses (HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(3-0-0)3
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM706	Foreign Language Studies	Audit

Professional Core Course (PCC)

BTETC302	Electronic Devices & Circuits	(3-1-0)4
BTETC303	Digital Electronics	(3-1-0)4
BTETL305	Electronic Devices & Circuits Lab	(0-0-2)1
BTETL306	Digital Electronics Lab	(0-0-2)1
BTETC401	Network Theory	(3-1-0)4
BTETC402	Signals and Systems	(3-1-0)4
BTETL406	Network Theory Lab & Signals and Systems Lab	(0-0-4)2
BTETC501	Electromagnetic Field Theory	(3-1-0)4
BTETC502	Digital Signal Processing	(3-1-0)4
BTETC503	Analog Communication	(3-1-0)4
BTETL506	Digital Signal Processing Lab & Analog Communication Lab	(0-0-4)2
BTETC601	Antennas and Wave Propagation	(3-1-0)4

BTETC602	Digital Communication	(3-1-0)4
BTETL606	Digital Communication Lab and Professional Elective Course 3 Lab	(0-0-4)2
BTETC701	Microwave Engineering	(3-1-0)4
BTETL707	Microwave Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)

BTETPE405 (3-1-0)4

(A) Numerical Methods and Computer Programming

(B) Data Compression & Encryption

(C) Computer Organization and Architecture

(D) Introduction to MEMS

(E) Python Programming

BTETPE504 (3-1-0)4

(A)Analog Circuits

(B) Embedded System Design

(C) Digital System Design

(D) Automotive Electronics

(E) Mixed Signal Design

(F) Power Electronics

BTETPE603 (3-1-0)4

(A) Microprocessors and Microcontrollers

(B) CMOS Design

(C) Nano Electronics

(D) Advanced Digital Signal Processing

(E) Information Theory and Coding

(F) VLSI Signal Processing

(G) VLSI Design &Technology

BTETPE702 (3-1-0)4

(A) Digital Image Processing

(B) RF Circuit Design

(C) Satellite Communication

(D) Fiber Optic Communication

(E) Bio-medical Signal Processing

(F) Principles of Modern Radar Engineering

Open Elective Course (OEC)

BTETOE505 (3-1-0)4

(A) Control System Engineering

(B) Artificial Intelligence and Machine learning

(C) Optimization Techniques

(D) Project Management and Operation Research

(E) Augmented, Virtual and Mixed Reality

(F) Open Source Technologies

BTETOE604 (3-1-0)4

(A) IoT and Industry4.0

(B) Deep Learning

(C) Computer Network

(D) Industrial Drives and Control

(E) Robotics Design

(F) Patents and IPR

(G) Acoustic Engineering

BTETOE703	(A) Wireless Sensor Networks	(3-1-0)4
	(B) Block Chain Technology	
	(C) Cyber Security	
	(D) Mobile Computing	
	(E) Mobile Communication and Networks	
	(F) EMI and EMC	
BTETOE704	(A) Soft Computing	(3-1-0)4
	(B) Big Data Analytics	
	(C) Data Structure & Algorithms Using Java Programming	
	(D) Entrepreneurship Development	
	(E) Software Defined Radio	
	(F) E Waste Management	

Seminar/Mini Project/ Internship

BTES209S	Seminar	(0-0-2)1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time). (Internship – 1)	Audit
BTETS307	Seminar I	(0-0-4)2
BTETS407	Seminar II	(0-0-4)2
BTETP408	(Internship – 2)	Audit
BTETM507	Mini Project – 1	(0-0-4)2
BTETM607	Mini Project – 2	(0-0-4)2
BTETP608	(Internship–3)	Audit
BTETM708	Mini Project– 3	(0-0-4)2

Project (MP)

BTETP801	Project work /Internship	(0-0-24)12

Minor Courses (MC)

BTETC302	Electronic Devices& Circuits	(3-1-0)4
BTETC303	Digital Electronics	(3-1-0)4
BTETC402	Signals and Systems	(3-1-0)4
BTETPE603	(A) Microprocessors and Microcontrollers	(3-1-0)4
BTETC503	Analog Communication	(3-1-0)4

Suggested Plan of Study:

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTBS301	BTETC401	BTETC501	BTETC601	BTETC701	BTETP801 (Project/Internship)
2	BTBS102	BTBS202	BTETC302	BTETC402	BTETC502	BTETC602	BTETPE702 **(Elective)**	--
3	BTES103	BTES203	BTETC303	BTHM403	BTETC503	BTETPE603 **(Elective)**	BTETOE703 **(Elective)**	--
4	BTHM104	BTES204	BTES304	BTBS404	BTETPE504 **(Elective)**	BTETOE604 **(Elective)**	BTETOE704 **(Elective)**	--
5	BTES105	BTES205	BTETL305	BTETPE405 **(Elective)**	BTETOE505 **(Elective)**	BTHM605	BTHM705	--
6	BTES106	BTES206	BTETL306	BTETL406	BTETL507	BTETL606	BTHM706	--
7	BTBS107L	BTBS207L	BTETS307	BTETS407	BTETM508	BTETM607	BTETL707	--
8	BTES108L	BTES208L	BTES211P (Internship - 1 Evaluation)	BTETP408 (Internship – 2)	BTETP408 (Internship – 2 Evaluation)	BTETP608 (Internship – 3)	BTETM708	--
9	BTHM109L	BTES209S	--	--	--	--	BTETP608 (Internship – 3 Evaluation)	--
10	--	BTES211P (Internship - 1)	--	--	--	--	--	--

Degree Requirements:

Category of courses	**Minimum credits to be earned**
Basic Science Course (BSC)	**25**
Engineering Science Course (ESC)	**19**
Humanities and Social Science including Management Courses (HSSMC)	**12**
Professional Core Course (PCC)	**48**
Professional Elective Course (PEC)	**17**
Open Elective Course (OEC)	**16**
Seminar/Mini Project/ Internship/Major Project	**23**
Total	**160**

B. Tech in Electronics & Telecommunication Engineering
Program Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

Graduates will able to–

1. To equip graduates with a strong foundation in engineering sciences and Electronics & Telecommunication Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
2. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to Electronic Circuits, Embedded & wireless communication Systems and Signal Processing to solve engineering/ societal problems in the field of Electronics and Telecommunication Engineering.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirements.

B. Tech in Electronics & Telecommunication Engineering
Curriculum for Second Year

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTETC302	Electronic Devices & Circuits	3	1	-	20	20	60	100	4
PCC 2	BTETC303	Digital Electronics	3	1	-	20	20	60	100	4
ESC	BTES304	Electrical Machines and Instruments	3	1	-	20	20	60	100	4
LC	BTETL305	Electronic Devices & Circuits Lab	-	-	2	60	-	40	100	1
LC	BTETL306	Digital Electronics Lab	-	-	2	60	-	40	100	1
Seminar	BTETS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship – 1 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**12**	**4**	**8**	**260**	**80**	**360**	**700**	**20**
Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 3	BTETC401	Network Theory	3	1	-	20	20	60	100	4
PCC 4	BTETC402	Signals and Systems	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC 1	BTETPE405	(A) Numerical Methods and Computer Programming	3	1	-	20	20	60	100	4
		(B) Data Compression & Encryption								
		(C) Computer Organization and Architecture								
		(D) Introduction to MEMS								
		(E) Python Programming								
LC	BTETL406	Network Theory Lab & Signals and Systems Lab	-	-	4	60	-	40	100	2
Seminar	BTETS407	Seminar II	-	-	4	60	-	40	100	2
Internship	BTETP408 (Internship – 2)	Field Training /Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at onetime).	-	-	-	-	-	-	-	Audit (evaluation will be in V Sem.)
		Total	**15**	**3**	**8**	**220**	**100**	**380**	**700**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses.

Semester III

BTBS301 Engineering Mathematics-III 4 Credits

Second Year B. Tech Classes (Common to all Branches)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetics and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: Laplace Transform 09 Hours

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform **09 Hours**

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3:Fourier Transform **09 Hours**

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval‟s identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications **09 Hours**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange‟s linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation (), and one dimensional wave equation

Unit 5: Functions of Complex Variables **09 Hours**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functionsinCartesianform;Cauchy‟sintegraltheorem;Cauchy‟sintegralformula;Residues; Cauchy"s residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
2. A Text Book of Engineering Mathematics by PeterO"Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , NewYork.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

   The minimum number of assignments should be eight covering all topics.

BTETC302 Electronic Devices and Circuits 4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce Static characteristics of ideal two terminal and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results.

Course Outcomes:

On completion of the course, students will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.

3. Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feedback amplifiers and oscillators..

UNIT – 1 Bipolar Junction Transistor: **07 Hours**

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier , Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier, Emitter follower, Cascaded Amplifier, Need for multistage amplifiers and suitability of CE, CC and CB configurations in multistage amplifiers.

UNIT – 2 Junction Field Effect Transistor and MOSFET **07 Hours**

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET, The FET as VVR.

MOSFET: Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p - MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT – 3 Power amplifiers: **07 Hours**

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, efficiency, calculation of power output, power dissipation, cross over distortion and its elimination methods, need of heat sink and its design.

UNIT – 4 Feedback amplifiers: **07 Hours**

Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt, Current series, Current shunt types of Negative feedback, Typical transistor circuits effects of Negative feedback on Input and Output impedance, Voltage and Current gains, Bandwidth, Noise and Distortion

UNIT – 5 Oscillators & Voltage Regulator Circuits **07 Hours**

Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, RC, Clapp, Wien Bridge, Colpitt, Hartley, Tuned LC, UJT, Relaxation Oscillators.

T**ransistor application:** Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator

TEXT/REFERENCE BOOKS:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, “Electronics Devices & Circuits”, Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.

BTETC303 Digital Electronics 4 Credits

Course Objectives:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

On completion of the course, students will be able to:

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.
3. Design and implement hardware circuit to test performance and application.

4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT – 1 Combinational Logic Design: 07 Hours

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to - 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and De-multiplexers, Decoders.

UNIT – 2 Sequential Logic Design: 07 Hours

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops and Conversion of flip flops. Application of Flip- flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT – 3 State Machines: 07 Hours

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT – 4 Digital Logic Families: 07 Hours

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L and DCTL

UNIT – 5 Programmable Logic Devices, Semiconductor Memories and Introduction to VHDL: 07Hours

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM. Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India,2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd 2001 Edition.

BTES304 Electrical Machines and Instruments 4 Credits

Course Objectives:

1. Model and Analyze the performance of different types of DC machines
2. Learn the applications of DC generators
3. Analyze the performance of different types of DC motors
4. Analyze the performance of different types of Sensors and Transducers
5. Familiarize with the applications of DC machines
6. To prepare students to perform the analysis of any electromechanical system.
7. To empower students to understand the working of electrical equipment used in everyday life.

Course Outcomes:

On completion of the course, students will be able to:

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The skill to analyze the response of any electrical machine.

3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

UNIT – 1 DC Machines: **07 Hours**

DC machines construction, working principle (motor & generator), EMF equation of DC Machine (motor and generator), Types and its characteristics of DC machines (motor and generator), back emf, starters of dc machine, Speed control of DC motor Breaking of DC motor, applications of DC machines (motor and generator).

UNIT – 2 Induction Motor and Synchronous Motor: **07 Hours**

Induction Motor: Construction, working principle, types, torque equation, torque slip characteristics, power stages, losses and efficiency, starters speed control, breaking, applications.

Synchronous motor: Construction, working principle, starting methods, effect of load, hunting, V-curve, synchronous condenser, applications.

UNIT – 3 Special Purpose Machines: **07 Hours**

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

UNIT – 4 Sensors and Transducers: **07 Hours**

Classification selection of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types, interfacing techniques of transducers with microprocessor and controller.

UNIT – 5 Industrial Measurement and Industrial Applications: **07 Hours**

Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm, object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.

TEXT/REFERENCE BOOKS:

1. A course in Electrical and Electronic Measurement and Instrumentation" by A. K. Sawhney (Publisher name: Dhanpat Rai&Co.)
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGrawHill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai andpublication
4. Instrumentation Devices System edition C. S. Rajan, G. R.sharma
5. AbhijitChakrabarti&SudiptaDebnath, “Electrical Machines”, Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGrawHill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, “Electrical Machinery”, Tata McGraw-hill Publication 6thEdition.
8. I.J Nagarath & D.P Kothari, “Electrical Machines”, Tata McGraw-hill Publication 4th Edition.
9. T. J. E. Miller, “Brushless permanent-magnet and reluctance motor drives”, Oxford University Press(1989).
10. Ned Mohan, “Electric Machines and Drives”: A first course,Wiley.
11. B. L. Theraja, “Electrical technology” volume 2, S.Chand.

Semester IV

BTETC401 Network Theory 4 Credits

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

On completion of the course, students will be able to:

1. Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze thesame.
2. Design passive filters and attenuators theoretically and practically. To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
3. Identify issues related to transmission of signals, analyze different RLC networks.
4. Find technology recognition for the benefit of the society.

UNIT – 1 Network Theorems: 07 Hours

Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin"s, Norton"s and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

UNIT – 2 Transient Analysis and Frequency Domain Analysis: 07 Hours

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

UNIT – 3 Laplace transform and its circuit applications: 07 Hours

Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response.

UNIT – 4 Two Port Networks: 07 Hours

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

UNIT – 5 State Variable Analysis and RL & RC Network Synthesis: 07 Hours

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press.2003.
3. M.E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson2006.
4. M.E. Van Valkenburg, "Network Synthesis," PHI2007.
5. Kuo, F.F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.2008.
6. D Roy Choudary, "Network and Systems" 1st edition, New Age International,1988
7. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill,1982.
8. Royal Signal Handbook on Line Communication.

BTETC402 Signals and Systems 4 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

UNIT – 1 Introduction to Signals and Systems: 07 Hours

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding, Sampling Theorem and reconstruction of sampled signal, Concept of aliasing, examples on under sampled and over sampledsignals.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT – 2 Time domain representation of LTI System: **07 Hours**

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulseresponse.

UNIT – 3 Fourier Series: **07 Hours**

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties.

UNIT – 4 Fourier Transform: **07 Hours**

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of bandpass signals.

UNIT – 5 Laplace and Z-Transform: **07 Hours**

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI systemanalysis.

Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z-transform, Z-transform for discrete time system LTI analysis.

TEXT/REFERENCE BOOKS:

1. Alan V. *Oppenheim*. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, WileyIndia.
4. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.

5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press,2007.
6. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata McGraw Hill.
7. A. NagoorKanni "Signals and Systems", 2nd edition, McGrawHill.
8. NPTEL video lectures on Signals andSystems.
9. Roberts, M.J., "Fundamentals of Signals & Systems", Tata McGraw Hill.2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., "Signals and Systems: Continuous and Discrete", 4^{th} 2001 Ed., Pearson Education.

BTHM403 Basic Human Rights 3 Credits

Course Objectives:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

- Students will be able to understand the history of human rights.
- Students will learn to respect others caste, religion, region and culture.
- Students will be aware of their rights as Indian citizen.
- Students will be able to understand the importance of groups and communities in the society.
- Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

UNIT – 1

The Basic Concepts: - Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

UNIT – 2

Fundamental rights and economic programme. Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT – 3

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT – 4

Human rights in Indian constitution and law:-

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT – 5

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Reference books:

Shastry, T. S. N., *India and Human rights: Reflections*, Concept Publishing Company India (P Ltd.), 2005

Nirmal, C.J., *Human Rights in India: Historical, Social and Political Perspectives(Law in India)*, Oxford India

BTBS404 Probability Theory and Random Processes 3 Credits

Course Objectives:

1. To develop basic of probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT – 1 Introduction to Probability: 07 Hours

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes‟ rule and applications

UNIT – 2 Random variables: 07 Hours

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation;independent,

UNIT – 3 Random vector and distributions: 07 Hours

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; MultivariateGaussiandistribution,Vector-spacerepresentationofrandomvariables,linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT – 4 Sequence of random variables **07 Hours**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT – 5 Random process: **07 Hours**

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS:

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, DavidStirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John WilliamWoods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, PearsonEducation
5. A. Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBSPublishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, AcademicPress.

BTETPE405A Numerical Methods and Computer Programming 4 Credits

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

On completion of the course, students will be able to:

1. Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.
2. Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. Prepare them to write computer programs for the numerical computational techniques.
5. Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Understand procedure-oriented and object-oriented programming concepts.
7. Capable of writing C and C++ programs efficiently.

UNIT – 1 Introduction to Computational Methods and Errors: 07 Hours

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques.

Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT – 2 Solution of Transcendental / Polynomial Equations and System of Linear Equation: 07Hours

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT – 3 Interpolation and Polynomial Approximation: 07 Hours

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange"sinterpolation polynomials, Spline interpolation, Least square approximation.

UNIT – 4 Numerical Integration and Differentiation: 07 Hours

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, RungeKutta $2^{nd}$and 4^{th} order, Stability analysis of abovemethods.

UNIT – 5 Object Oriented Programming: 07 Hours

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor,Destructors.

TEXT/REFERENCE BOOKS:

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rdedition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rdEdition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi,1996.
4. D. Ravichandran, "Programming with C++",TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2ndEdition
6. YeshwantKanetkar, "Let us C++, BPB Pub.", Delhi, 2002,4thEdition.
7. StroupstrupBjarne, "C++ Programming Language", Addison Wesley, 1997, 3rdEdition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai,1998.

BTETPE405B Data Compression & Encryption 4 Credits

Course Objectives:

1. The concept of security, types of attack experienced.
2. Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT – 1 Data Compression and Encryption: 07 Hours

Need for data compression, Lossy /lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT – 2 Statistical Methods and Dictionary Methods: 07 Hours

Statistical Methods: Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPMmethod.

Dictionary Methods: String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT – 3 Image Compression: 07 Hours

Lossless techniques of image compression, gray codes, two-dimensional image transform, Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT – 4 Audio Compression: 07 Hours

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT – 5 Conventional Encryption: 07 Hours

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS:

1. Data compression- David Solomon Springer Verlagpublication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmannpublication.
4. The data compression book- Mark Nelson BPBpublication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc.,publications.

BTETPE405C Computer Organization and Architecture 4 Credits

Prerequisites: Digital Electronic Circuits.

Course Objectives:

1. To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
2. To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
3. Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
4. Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer‟sworking
3. analyze the performance ofcomputers
4. know how computers are designed and built.

UNIT – 1 Overview of computer organization: 07 Hours

Overview of computer organization – components and system buses; Concepts of assembly and machine language programs. Machine language program execution – instruction cycles, machine cycles and bus cycles. Overview of memory and I/O addressing; CPU organization – components and subsystems, register banks, internal bus structure, information flow;

UNIT – 2 Instruction set: 07 Hours

Instruction set – characteristics and functions, types of operation and operands. Addressing modes – various ways of addressing memory and input-output devices and their timing characteristics;

UNIT – 3 CISC and RISC architectures: 07 Hours

CISC and RISC architectures – examples; ALU – flags, logical operations, fixed point number representations and arithmetic, floating point number representations and arithmetic, exceptions. Control Unit – how it operates, hardwired control unit, concepts of micro programs and micro programmed control unit;

UNIT –4 Memory: 07 Hours

Memory hierarchy – main memory – types and interfacing; Cache memory – its organizations and operations, levels of caches; Memory management module – paging and segmentation, virtual memory; Disk memory, RAIDs. Back-up memory.

UNIT – 5 Interrupts and interrupt structures and DMA controller: 07 Hours

Interrupts and interrupt structures – interrupt cycles, handling multiple simultaneous interrupts, programmable interrupt controllers; I/O interfacing and modes of I/O data transfer. Direct memory access – DMA controller; Instruction level parallelism – instruction pipelining, pipeline hazards; Concepts of multiprocessor systems; Examples will be drawn from real life RISC and CISC processors.

TEXT/REFERENCE BOOKS:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization,” McGraw Hill, 2011.
2. D A Patterson and J L Hennessy, “Computer Architecture – A Quantitative Approach,” Morgan Kaufmann,2011.
3. W Stallings, “Computer Organization and Architecture – Designing for Performance,” Pearson,2013.
4. J. P. Hayes, “Computer Architecture and Organization,” McGraw-Hill,1998.
5. D A Patterson and J L Hennessy, “Computer Organization and Design – The Hardware/Software Interface,” ARM Edition, Morgan Kaufmann,2012.
6. S. Tannenbaum, “Structured Computer Organization,” EEE Ed., Prentice Hall,2013.

7. Mano, M.M., “Computer System Architecture” 3rd Ed., Prentice-Hall of 2004India.

BTETPE405D Introduction to MEMS 4 Credits

Course Objectives:

1. The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
2. This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
3. This will enable student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT – 1 Introduction to MEMS: 07 Hours

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT – 2 Control and Materials of MEMS: 07 Hours

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals,Polymers.

UNIT – 3 Review of Basic MEMS fabrication modules: 07 Hours

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT –4 Micromachining: 07 Hours

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT – 5 Mechanics of solids in MEMS/NEMS: 07 Hours

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes‟s law, Poisson effect,Linear Thermal Expansion, Bending, Energy methods. Overview of Finite Element Method, Modeling of Coupled ElectromechanicalSystems.

TEXT/REFERENCE BOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India,2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers,2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press,1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston,1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers,and Gyroscopes, Elsevier, New York,2000.

BTETPE405E Python Programming 4 Credits

Course Objectives:

1. Provide an understanding of the role computation can play in solving problems.
2. Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
3. Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes:

1. Experience with an interpreted Language.
2. To build software for real needs
3. Prior Introduction to testing software

UNIT –1Introduction: **07 Hours**

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT – 2 Types, Operators and Expressions: **07 Hours**

Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass.

Data Structures Lists – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions

UNIT – 3 Default Arguments: **07 Hours**

Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages.

UNIT – 4 Object-Oriented Programming OOP in Python: **07 Hours**

Classes, „self-variable‟, Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions.

UNIT – 5 Brief Tour of the Standard Library: **07 Hours**

Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing:

Why testing is required? Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

TEXT/REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Think Python, Allen Downey, Green Tea Press
4. Core Python Programming, W. Chun, Pearson
5. Introduction to Python, Kenneth A. Lambert, Cengage

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	SWAYAM / NPTEL COURSE	NAME OF THE INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential equations for engineers	IIT Madras	80%	12 WEEK
2		BTETC302	Electronic Devices & Circuits	Fundamentals of semiconductor devices	IISc Bangalore	80%	12 WEEK
3		BTETC303	Digital Electronics	Digital Circuits	IIT Madras	60%	14 WEEK
4		BTES304	Electrical Machines and Instruments	Electrical Machines - I	IIT Kharagpur	70%	12 WEEK
5	SEM-IV	BTETC401	Network Theory	Network Analysis	IIT Kharagpur.	80%	12 WEEK
6		BTETC402	Signals and Systems	Signals and Systems	IIT Bombay	90%	11 WEEK
7		BTHM403	Basic Human Rights	Human Rights, International Law and International Humanitarian Law	O.P. Jindal Global University	80%	08 WEEK
8		BTBS404	Probability Theory and Random Processes	Probability and Random rocesses(Video)	IIT Kharagpur.	90%	12 WEEK
9		BTETPE405A	(A) Numerical Methods and Computer Programming	Numerical Methods and Computations	IIT Delhi	60%	12 WEEK
		BTETPE405B	(B) Data Compression & Encryption	Multimedia Processing (Web)	IIT Kharagpur.	90%	09 WEEK
		BTETPE405C	(C) Computer Organization and Architecture	Computer Arcitecture and Organization	IIT Kharagpur.	80%	09 WEEK
		BTETPE405D	(D) Introduction to MEMS	MEMs and Microsystems	IIT Kharagpur.	90%	9 WEEK
		BTETPE405E	(E) Python Programming	Programming, Data Structures and Algorithms using Python	IIT Madras	40%	8 WEEK

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University (Established as a University of Technology in the State of Maharashtra) (under Maharashtra Act No. XXIX of 2014)

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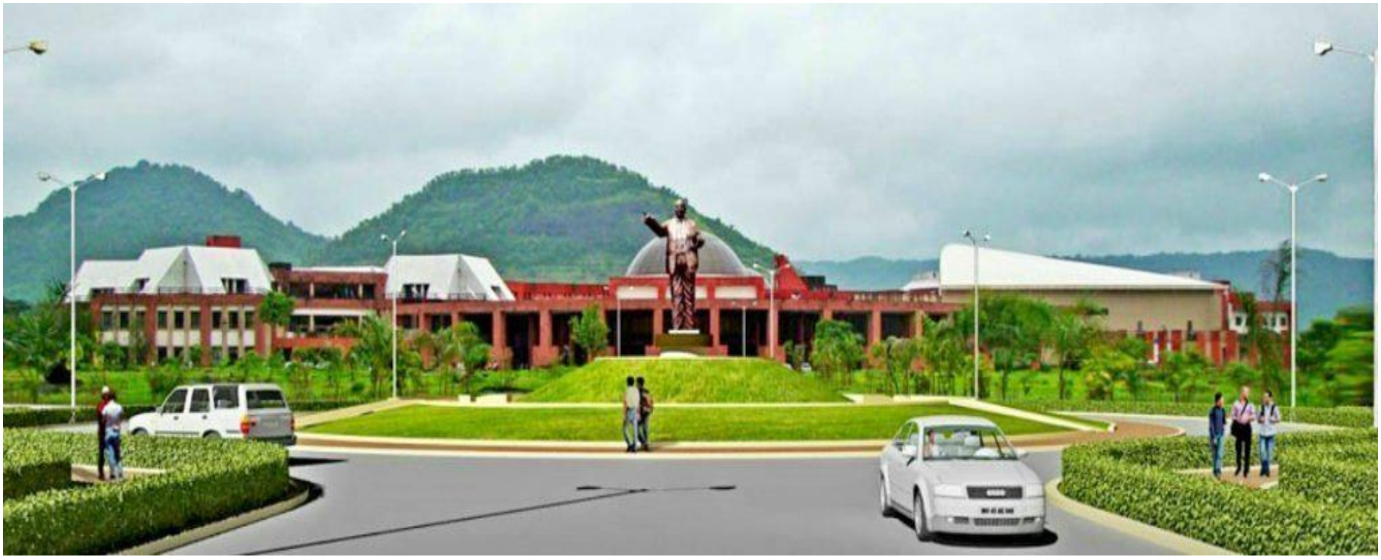
COURSE STRUCTURE AND SYLLABUS

For

Third and Final Year

B. Tech. Electronics and Telecommunication Engineering Programme

With effect from the Academic Year 2021-22



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B. Tech (Electronics & Telecommunication Engineering)
Proposed Curriculum for Semester V [Third Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC501	Professional Core Course 1	Electromagnetic Field Theory	2	1	0	20	20	60	100	3
2	BTEXC502	Professional Core Course 2	Control System Engineering	3	0	0	20	20	60	100	3
3	BTETC503	Professional Core Course 3	Computer Architecture	3	0	0	20	20	60	100	3
4	BTEXC504	Professional Core Course 4	Digital Signal Processing	2	1	0	20	20	60	100	3
5	BTEXC505	Professional Core Course 5	Microcontroller and its Applications	3	0	0	20	20	60	100	3
6	BTEXPE506A	Program Elective Course 1	Probability Theory and Random Processes	3	0	0	20	20	60	100	3
	BTEXPE506B		NSQF (Level 7 Course)								
	BTEXPE506C		Data Structure & Algorithms Using Java Programming								
	BTEXPE506D		Introduction to MEMS								
7	BTETL507	Control System Engineering Lab		0	0	2	--	30	20	50	1
8	BTETL508	Digital Signal Processing Lab		0	0	2	--	30	20	50	1
9	BTETL509	Microcontroller and its Applications Lab		0	0	2	--	30	20	50	1
10	BTETP510	Mini Project		0	0	2	--	30	20	50	1
11	BTETS511	Seminar		0	0	2	--	30	20	50	1
12	BTEXF412	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**16**	**2**	**10**	**120**	**270**	**510**	**900**	**24**

Dr. Babasaheb Ambedkar Technological University, Lonere.

B. Tech (Electronics & Telecommunication Engineering)

Proposed Curriculum for Semester VI [Third Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTETC601	Professional Core Course 1	Antennas and Wave Propagation	3	0	0	20	20	60	100	3
2	BTETC602	Professional Core Course 2	Computer Network & Cloud Computing	3	0	0	20	20	60	100	3
3	BTETC603	Professional Core Course 3	Digital Image Processing	3	0	0	20	20	60	100	3
4	BTETPE604A	Program Elective Course 2	CMOS Design	3	0	0	20	20	60	100	3
	BTETPE604B		Information Theory and Coding								
	BTETPE604C		Power Electronics								
	BTETPE604D		Nano Electronics								
	BTETPE604E		NSQF (Level 7 Course)								
	BTETPE604F		Android Programming								
5	BTETOE605A	Open Elective Course 1	Digital System Design	3	0	0	20	20	60	100	3
	BTETOE605B		Optimization Techniques								
	BTETOE605C		Project Management and Operation Research								
	BTETOE605D		Augmented, Virtual and Mixed Reality								
	BTETOE605E		Python Programming								
	BTETOE605F		Web Development and Design								

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
6	BTHM606	Humanities & Social Science including Management Courses	Employability & Skill Development	2	0	0	20	20	60	100	2
7	BTETL607	Computer Network & Cloud Computing Lab		0	0	2	--	30	20	50	1
8	BTETL608	Program Elective 2 Lab		0	0	2	--	30	20	50	1
9	BTETL609	Open Elective 1 Lab		0	0	2	--	30	20	50	1
10	BTETP610	Mini-project		0	0	2	--	30	20	50	1
11	BTETF611	Field Training/ Internship/ Industrial Training (Minimum 4 weeks)		--	--	--	--	--	--	--	1*
			Total	**17**	**0**	**8**	**120**	**240**	**440**	**800**	**21**

Dr. Babasaheb Ambedkar Technological University, Lonere.

B. Tech (Electronics & Telecommunication Engineering)
Proposed Curriculum for Semester VII [Final Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTETC701	Professional Core Course 1	Digital Communication	3	0	0	20	20	60	100	3
2	BTETPE702	Program Elective 3	Group A	3	0	0	20	20	60	100	3
3	BTETPE703	Program Elective 4	Group B	3	0	0	20	20	60	100	3
4	BTETPE704	Program Elective 5	Group C	3	0	0	20	20	60	100	3
5	BTHM705	Humanities & Social Science including Management Courses	Financial Management	2	0	0	20	20	60	100	2
6	BTETL706	Program Elective 3 Lab		0	0	2	--	30	20	50	1
7	BTETL707	Program Elective 4 Lab		0	0	2	--	30	20	50	1
8	BTETL708	Program Elective 5 Lab		0	0	2	--	30	20	50	1
9	BTETP709	Project Part I		0	0	8	--	50	50	100	4
10	BTETF611	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**14**	**0**	**14**	**100**	**240**	**460**	**800**	**22**

Program Elective- 5 (Group A)	**Program Elective- 5 (Group B)**	**Program Elective- 5 (Group C)**
(A) Microwave Theory & Techniques	(A) Embedded System Design	(A) Consumer Electronics
(B) RF Circuit Design	(B) Artificial Intelligence Deep learning	(B) Analog Integrated Circuit Design
(C) Satellite Communication	(C) VLSI Design & Technology	(C) Soft Computing
(D) Fiber Optic Communication	(D) Data Compression & Encryption	(D) Advance Industrial Automation-1
(E) Wireless Sensor Networks	(E) Big Data Analytics	(E) Mechatronics
(F) Mobile Computing	(F) Cyber Security	(F) Electronics in Smart City

B. Tech (Electronics & Telecommunication Engineering)

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	MSE	CA	ESE	Total	
• Introduction to Internet of Things • Computer Vision and Image Processing • Biomedical Signal Processing • Industrial Automation and Control • Cryptography and Network Security • Digital IC Design # Student to opt any two subjects from above list			3	-	--	20*	20*	60*	100	3
			3	-	--	20*	20*	60*	100	3
BTMEP803	Project Part-II or Internship*		--	--	30	--	--	100	150	15
		Total	--	--				220	350	21

** Six months of Internship in the industry*

**Students doing project at institute will have to appear for CA/MSE/ESE*
** Student doing project at Industry will give NPTEL examination / Examination conducted byuniversity i.e. CA/MSE/ESE*
 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source#

Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

 # Project Load: 2hrs/week/project.

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

No	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	Introduction to internet of things	12	IIT Kharagpur	Prof. Sudip Misra
2	Computer Vision and Image Processing	12	IIT Gandhinagar	Prof. M. K. Bhuyan
3	Biomedical Signal Processing	12	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4	Industrial Automation and Control	12	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay
5	Cryptography & Network Security	12	IIT Kharagpur	Prof. Sourav Mukhopadhyay
6	Digital IC Design	12	IIT Madras	Prof. Janakiraman

BTEXC501	Electromagnetic Field Theory	3 Credits

Course Objectives:

- Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
- To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
- To understand the boundary conditions for different materials /surfaces.
- To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
- To get the basics of microwave, transmission lines and antenna parameters.
- Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

UNIT - 1

Maxwell's Equations

Basics of Vectors, Vector calculus, Basic laws of Electromagnetic, Maxwell's Equations, Boundary conditions at Media Interface

UNIT - 2

Uniform Plane Wave

Uniform plane wave, Propagation of wave, Wave polarization, Poincare"s Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor.

UNIT - 3

Transmission Lines

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT - 4

Plane Waves at a Media Interface

Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

UNIT - 5

Wave propagation

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide

UNIT - 6

Radiation

Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna

TEXT/REFERENCE BOOKS

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, “Electromagnetics”, Prentice Hall.
5. Sadiku, "Elements of Electromagnetics", Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi, 1999.

8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", Wiley Eastern.

BTEXC502	Control System Engineering	3 Credits

Course Objectives:

- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.
- To introduce concepts of PID controllers and digital and control systems.
- To introduce concepts programmable logic controller.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

UNIT - 1

Introduction to control problem

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.

UNIT - 2

Time Response Analysis

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response.

UNIT - 3

Stability Analysis

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram,

UNIT - 4

Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response

UNIT - 5

Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and Bode Plot.

UNIT - 6

State variable Analysis

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigenvalues and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT/REFERENCE BOOKS

1. N. J. Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2009.
2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall of India, 7th Edition,1995.
3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
4. Schaum‟s Outline Series, “Feedback and Control Systems” Tata McGraw-Hill, 2007.
5. John J. D‟Azzo& Constantine H. Houpis, “Linear Control System Analysis and Design”, Tata McGraw-Hill, Inc., 1995.

6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

BTETC503	**Computer Architecture**	**3 Credits**

Course Objectives:

- To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
- To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
- Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
- Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer‟s working
3. analyze the performance of computers
4. know how computers are designed and built
5. Understand issues affecting modern processors (caches, pipelines etc.).

UNIT - 1

Basics of Computers

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Queues, Subroutines.

UNIT - 2

Processor organization

Processor organization, Information representation, number formats.

UNIT - 3

ALU design

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit.

UNIT - 4

Memory organization

Memory organization, device characteristics, RAMS, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

UNIT - 5

System organization

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces.

UNIT - 6

Parallel processing

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

TEXT/REFERENCE BOOKS

1. V.Carl Hammacher, “Computer Organisation”, Fifth Edition.
2. A.S.Tanenbum, “Structured Computer Organisation”, PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M.M.Mano, “Computer System Architecture”, Edition
5. C.W.Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
6. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

BTEXC504	Digital Signal Processing	3 Credits

Course Objectives:

- To introduce students with transforms for analysis of discrete time signals and systems.
- To understand the digital signal processing, sampling and aliasing.
- To use and understand implementation of digital filters.
- To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT - 1

DSP Preliminaries

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

UNIT - 2

Discrete Fourier Transform

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm

UNIT - 3

Z transform

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

UNIT - 4

IIR Filter Design

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Lowpass filter)

UNIT - 5

FIR Filter Design

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form.

UNIT - 6

Introduction to Multirate signal processing

Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988

BTEXC505	Microcontroller and its Applications	3 Credits

Course Objectives:

- Objective of this course is to introduce to the students the fundamentals of microcontroller.
- After learning Microprocessor course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
- The learner can microcontroller design based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
- The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
- The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.
- The students will get acquainted with recent trends in microcontroller like pipelining, cache memory etc.
- To understand the applications of Microcontrollers.
- To understand need of microcontrollers in embedded system.
- To understand architecture and features of typical Microcontroller.
- To learn interfacing of real world input and output devices.
- To study various hardware and software tools for developing applications.

Course Outcomes:

1. Learner gains ability to apply knowledge of engineering in designing different case studies.
2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Graduates will be able to design real time controllers using microcontroller based system.
4. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
5. Students can identify and formulate control and monitoring systems using microcontrollers.
6. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
7. Learners get acquainted with modern tools like Programmers, Debuggers, cross compilers and current IDE i.e. integrated development environment tools.

8. Learn importance of microcontroller in designing embedded application.
9. Learn use of hardware and software tools.
10. Develop interfacing to real world devices.

UNIT - 1

Fundamentals of Microcontrollers

Introduction to the general structure of 8 and 16 bit Microcontrollers Harward & Von Neumann architecture, RISC & CISC processors, Role of microcontroller in embedded system, Selection criteria of microcontroller Block diagram and explanation of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Sample programs (assembly): Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port.

UNIT - 2

Interfacing with 8051 PART I

Software and Hardware tools for development of microcontroller-based systems such as assemblers, compliers, IDE, Emulators, debuggers, programmers, development board, DSO, Logic Analyzer, Interfacing LED with and without interrupt, Keypads, Seven Segment multiplexed Display, LCD, ADC Interfacing. All Programs in assembly language and C.

UNIT - 3

Interfacing with 8051 PART II

8051 timer programming, serial port and its programming, interrupt programming, LCD and keyboard interfacing, ADC and DAC interfacing, interfacing to external memory Interfacing of DAC, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Opto-isolators. All programs in assembly and C

UNIT - 4

PIC Microcontroller Architecture

PIC 10, PIC12, PIC16, PIC18 series comparison, features and selection as per application PIC18FXX architecture, registers, memory Organization and types, stack, oscillator options, BOD, power down modes and configuration bit settings, timer and its programming, Brief summary of Peripheral support, Overview of instruction set, MPLAB IDE & C18 Compiler

UNIT - 5

Real World Interfacing Part I

Port structure with programming, Interrupt Structure (Legacy and priority mode) of PIC18F with SFRS, Interfacing of switch, LED, LCD (4&8 bits), and Key board, Use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP: All programs in embedded C.

UNIT - 6

Real World Interfacing Part II

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI &I2C), UART, Sensor interfacing using ADC, RTC (DS1306) with I2C and EEPROM with SPI. Design of PIC test Board, Home protection System: All programs in embedded C.

TEXT/REFERENCE BOOKS

1. Mazidi & Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearson edu.
2. Microprocessor and interfacing 8085, Douglas V Hall, Tata Mc Gram Hill.
3. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
4. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
5. ARM system-on-chip architecture, 2e pearson education.
6. Calcut, 8051 microcontrollers: Applications based introduction, Elsevier.
7. D V kodavade, S. Narvadkar, 8085-86 microprocessors Architecture progg and interfaces, wiley.
8. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
9. Han-way Huang, using The MCS-51 microcontroller, Oxford university press.
10. Ayala, 8051 microcontroller, cengage (Thomson).
11. Rout 8085 microcontroller-architecture, programming and application, 2ndedi, penram international.

BTEXPE506A	Probability Theory and Random Processes	3 Credits

Course Objectives:

- To develop basic of probability and random variables.
- The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT - 1

Introduction to Probability

Definitions, scope and history; limitation of classical and relative- frequency- based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.

UNIT - 2

Random variables

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf); probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables, Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables, mean, variance and moments of a random variable,

joint moments, conditional expectation; covariance and correlation, independent, uncorrelated and orthogonal random variables.

UNIT - 3

Random vector and distributions

Mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector- space representation of random variables, linear indepe ndence, inner product, Schwarz Inequality, Elements of estimation theory: linear minimum mean - square error and orthogonality principle in estimation; Moment - generating and characteristic functions and their applications, Bounds and approximations: Chebysev inequality and Chernoff Bound. .

UNIT - 4

Sequence of random variables and convergence

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT - 5

Random process

Random process: realizations, sample paths, discrete and continuous time processes, examples, Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance.

UNIT - 6

Spectral representation of a real WSS process

Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, Line ar time - invariant system with a WSS process as an input: sationarity of the output, auto -correlation and power - spectral density of the output; examples with white - noise as input; linear shift - invariant discrete- time system with a WSS sequence as input, Spe ctral factorization theorem, Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS

1. T. Veerrajan, "Probability, Statistics and Random Processes", Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

BTEXPE506C	Data Structure & Algorithms Using Java Programming	03 Credits

Prerequisites: Basic knowledge of C language is required.

Course Objectives:

- To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.
- To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
- To employ the different data structures to find the solutions for specific problems

Course Outcomes:

On completion of the course, student will be able to:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT - 1

Introduction

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT - 2

Stacks and Queues

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT - 3

Linked Lists

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT - 4

Trees

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT - 5

Sorting and Hashing

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

UNIT - 6

Graph

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT/REFERENCE BOOKS

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928.
4. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum"s Outlines, Tata Mc Graw Hill. ISBN-10: 1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10: 8120311779

BTEXPE506D	Introduction to MEMS	3 Credits

Course Objectives:

- The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
- This will enables student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT - 1

Introduction to MEMS

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT - 2

Control and Materials of MEMS

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT - 3

Review of Basic MEMS fabrication modules:

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching

UNIT - 4

Micromachining

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT - 5

Mechanics of solids in MEMS/NEMS

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes‟s law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods.

UNIT - 6

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TEXT/REFERENCE BOOKS

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

BTETC601	Antennas and Wave Propagation	3 Credits

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

UNIT - 1

Uniform Plane Waves

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

UNIT - 2

Wave Propagation

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth‟s curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth‟s magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT - 3

Antenna Fundamentals

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

UNIT - 4

Wire Antennas

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT - 5

Antenna Arrays

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT - 6

Antennas and Applications

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS

1. C. A. Balanis, “Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, “Antenna & Wave Propagation”, Satya Prakashan, New Delhi.
5. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill, 2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

BTETC602	Computer Network & Cloud Computing	3 Credits

Course Objectives:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Outcomes:

1. To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.
5. To be familiar with network tools and network programming.
6. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
7. For a given problem related TCP/IP protocol developed the network programming.
8. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

UNIT - 1

Physical Layer

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT - 2

Data Link Layer

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT - 3

Wireless LANS & Virtual Circuit Networks

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

UNIT - 4

Network Layer

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT - 5

Transport Layer

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT - 6

Application Layer

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

TEXT/REFERENCE BOOKS

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, Tata McGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

BTETC603	Digital Image Processing	3 Credits

Course Objectives:

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. Review the fundamental concepts of digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Categories various compression techniques.
4. Interpret image segmentation and representation techniques.

UNIT - 1

Concept of Visual Information

Introduction, Digital Image definitions, Common Values, Characteristics of Image Operations, Types of Operations, Types of neighborhoods, Video parameters, Tools, 2D convolution, Properties of 2D convolution, 2D Fourier Transforms, Properties of 2D Fourier Transforms, Importance of phase and magnitude, Circularly Symmetric Signals, Examples of 2D Signals and transforms, Statistical Description of Images

UNIT - 2

Image Perception

Statistical Description of Images, Perception, Brightness Sensitivity, Wavelength Sensitivity, Stimulus Sensitivity, Spatial Frequency Sensitivity, Psychophysics of Color vision, Perceived color, Color metrics, CIE chromaticity coordinates, Spatial effects in color vision, Optical illusions.

UNIT - 3

Image Sampling

Two dimensional Sampling theory, Extensions of sampling theory, Non rectangular Grid sampling, Hexagonal sampling, Optimal sampling, Image Quantization: The optimum Mean Square Lloyd-Max quantiser, Optimum mean square uniform quantiser for non-uniform densities, Analytic Models for practical quantiers, Visual quantization, Vector Quantization

UNIT - 4

Image Transforms

Two dimensional orthogonal and unitary transforms, Separable unitary transforms, Basis images, Dimensionality of Image Transforms, Discrete linear orthogonal, DFT, WHT, KLT, DCT and SVD, Quantisation of Transform coefficients, Transform Coding of Color images

UNIT - 5

Image Enhancement

Contrast and dynamic Range Modification, Histogram-based operations, Smoothing operations, Edge Detection-derivative based operation, Image Interpolation and Motion Estimation, Pseudo coloring

UNIT - 6

Image Restoration

Image Restoration, Degradation Estimation, Reduction of Additive Noise, Reduction of Image Blurring, Simultaneous reduction of noise and blurring, Reduction of Signal dependent noise, Temporal filtering.

TEXT/REFERENCE BOOKS

1. Rafael C. Gonzalez and Woods, "Digital Image Processing", Addison Wesley, 1998

2. A. K. Jain, "Digital Image Processing", PHI, New Delhi, 1997

3. Pratt W.K., "Digital Image Processing", 2nd Edition, John Wiley, New York, 2001

4. Edward R. Dougherty, "Random Processes for Image and Signal Processing", PHI-2001

BTETPE604A	**CMOS Design**	**3 Credits**

Course Objectives:

- To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
- To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

UNIT - 1

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, Transistor as a switch. Inverter characteristics

UNIT - 2

Integrated Circuit Layout: Design Rules, Parasitics

UNIT - 3

Delay: RC Delay model, linear delay model, logical path efforts

UNIT - 4

Power, interconnect and Robustness in CMOS circuit layout

UNIT - 5

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic

UNIT - 6

Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

TEXT/REFERENCE BOOKS

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

BTETPE604B	Information Theory and Coding	3 Credits

Course Objectives:

- To provide in-depth understanding of principles and applications of information theory.
- To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
- To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy
2. Understand Shannon‟s theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

UNIT - 1

Theory of Probability and Random Processes

Concept of probability, random variables, random process, power spectral density of a random process, probability models, statistical averages, central limit theorem, correlation, linear mean square estimation

UNIT - 2

Noise in Communication Systems

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT - 3

Information Theory

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT - 4

Error Correcting Codes

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ

UNIT - 5

Markov sources

Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels

UNIT - 6

Speech Coding

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

TEXT/REFERENCE BOOKS

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering (2^{nd} Edition), TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Inter science.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2^{nd} Edition), Pearson India.
7. N. Abramson, Information and Coding, McGraw Hill, 1963.
8. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

BTETPE604C	Power Electronics	3 Credits

Course Objectives:

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT - 1

Characteristics of Semiconductor Power Devices

Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

UNIT - 2

Controlled Rectifiers

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT - 3

Choppers

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

UNIT - 4

Single-phase inverters

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

UNIT - 5

Switching Power Supplies

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

UNIT - 6

Applications

Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive. P M Stepper motor Drive

TEXT/REFERENCE BOOKS

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V. R. Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

BTETPE604D	Nano Electronics	3 Credits

Course Objectives:

- To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
- Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.
- This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
- Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
- The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT - 1

Overview Nano Technology

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

UNIT - 2

Basics of Quantum Mechanics

Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones

UNIT - 3

MOS Scaling theory

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT - 4

Nano electronics Semiconductor devices

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

UNIT - 5

Properties of Nano devices

Vertical transistors, Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

UNIT - 6

Characterization techniques for Nano materials

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self-assembly.

TEXT/REFERENCE BOOKS

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

BTETPE604F	Android Programming	3 Credits

Course Objectives:

Android Application Development course is designed to quickly get you up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle

Course Outcomes:

At the end of the course, students will demonstrate the ability to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.

UNIT - 1

Introduction to Mobile Operating Systems and Mobile Application Development

Introduction to Mobile OS:

Palm OS, Windows CE, Embedded Linux, J2ME (Introduction), Symbian (Introduction), Overview of Android: Devices running android, Why Develop for Android, Features of android, Architecture of Android, Libraries

How to setup Android Development Environment: Android development Framework - Android-SDK, Eclipse, Emulators – What is an Emulator / Android AVD? , Creating & setting up custom Android emulator, Android Project Framework, My first android application.

UNIT - 2

Android Activities, UI Design and Database

Understanding Intent, Activity, Activity Lifecycle and Manifest, Form widgets, Text Fields, Layouts: Relative Layout ,Table Layout, Frame Layout, Linear Layout, Nested layouts.

UI design: Time and Date, Images and media, Composite, Alert Dialogs & Toast, Popup.

Menu: Option menu, Context menu, Sub menu.

Database: Introducing SQLite, SQLite Open Helper, SQLite Database, Cursor,

Content providers: defining and using content providers, example- Sharing database among two different applications using content providers, Reading and updating Contacts, Reading bookmarks.

UNIT - 3

Preferences, Intents and Notifications

Preferences: Shared Preferences, Preferences from xml, Intents:Explicit Intents, Implicit intents. Notifications: Broadcast Receivers, Services (Working in background) and notifications, Alarms.

UNIT - 4

Telephony, SMS and Location Based Services

Telephony: Accessing phone and Network Properties and Status, Monitoring Changes in Phone State, Phone Activity and data Connection.

SMS: Sending SMS and MMS from your Application, sending SMS Manually, Listening for incoming SMS

Location based Services: Using Location Based Services, Working with Google Maps, Geocoder.

UNIT - 5

Accessing Android Hardware

Networking: An overview of networking, checking the network status, communicating with a server socket, Working with HTTP, Web Services.

Bluetooth: Controlling local Bluetooth device, Discovering and bonding with Bluetooth devices, Managing Bluetooth connections, communicating with Bluetooth

UNIT - 6

Audio Video Handling

Playing Audio and Video, Recording Audio and Video, Using Camera and Taking Picture

TEXT/REFERENCE BOOKS

1. Reto Meier “Professional Android™ Application Development”, Wrox Publications.
2. Lauren Dercy and Shande Conder “Sams teach yourself Android application development” , Sams publishing
3. Hello Android, Introducing Google‟s Mobile Development Platform, Ed Burnette, Pragmatic Programmers, ISBN: 978-1-93435-617-3

BTETOE605A	Digital System Design	3 Credits

Course Objectives:

- The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
- The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
- This course will explore the basic concepts of digital electronics.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

UNIT - 1

Logic Simplification and Combinational Logic Design

Review of Boolean algebra and De Morgan‟s Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

UNIT - 2

MSI devices

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

UNIT - 3

Sequential Logic Design

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

UNIT - 4

Logic Families and Semiconductor Memories

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing.

UNIT - 5

Memory Elements

Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices

UNIT - 6

VLSI Design flow

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

TEXT/REFERENCE BOOKS

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition, 2006.
4. D.V. Hall, “ Digital Circuits and Systems” , Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

BTETOE605B	Optimization Techniques	3 Credits

Course Objectives:

- Introduction to optimization techniques using both linear and non-linear programming
- The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization.

Course Outcomes:

1. After completion of this course students will be able to

2. Cast engineering minima/maxima problems into optimization framework
3. Learn efficient computational procedures to solve optimization problems

UNIT - 1

Introduction and Basic Concepts

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques

UNIT - 2

Optimization using Calculus

Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples

UNIT - 3

Linear Programming

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar‟s projective scaling method

UNIT - 4

Dynamic Programming

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP

UNIT - 5

Integer Programming

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples

UNIT - 6

Advanced Topics in Optimization

Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search

TEXT/REFERENCE BOOKS

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International, New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

BTETOE605C	Project Management and Operation Research	3 credits

Course Objectives:

- To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
- To introduce students to framework that are useful for diagnosing problems involving human behavior.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.

- To teach students about networking, inventory, queuing, decision and replacement models.
- To introduce students to research methods and current trends in Operations Research.

Course Outcomes:

Student will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.

2. Solve transportation problems using various OR methods.

3. Illustrate the use of OR tools in a wide range of applications in industries.

4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.

5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT - 1

Definition, need and importance of organizational behaviour , nature and scope , frame work , organizational behaviour models.

UNIT - 2

Organization structure , formation , groups in organizations , influence , group dynamics , emergence of informal leaders and working norms , group decision making techniques , interpersonal relations , communication , control.

UNIT - 3

Evolution of Management thoughts, Contribution of Selected Management Thinkers, Various approaches to management, contemporary management practice, Managing in global environment, Managerial functions.

UNIT - 4

Importance of planning , Types of planning , decision making process , Approaches to decision making , Decision models , Pay off Matrices , Decision trees , Break Even Analysis.

UNIT - 5

Departmentation, Span of Control, Delegation, Centralisation and Decentralisation, Commitees, Line and Staff relationships , Recent trends in organization structures.

UNIT - 6

Process of Recruitment, Selection, Induction Training, Motivation, Leading, Leadership styles and qualities, Communication, process and barriers. Managements control systems, techniques, Types of control.

TEXT/REFERENCE BOOKS

1. Bateman Snell, Management: Competing in the new era, McGraw,Hill Irwin, 2002.

2. Chandan J.S., Management Concepts and Strategies, Vikas Publishing House, 2002.

3. Hellriegel, Jackson and Slocum, Management: A Competency,Based Approach, South Western, 9th edition, 2002.

4. Koontz, Essentials of Management, Tata McGraw,Hill, 5th Edition, 2001.

5. Stephen P. Robbins and David A. Decenzo, Fundamentals of Management, Pearson Education, Third Edition, 2001.

6. Tim Hannagan, Management Concepts and Practices, Macmillan India Ltd., 1997.

BTETOE605D	Augmented, Virtual and Mixed Reality	3 Credits

Course Objectives:

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. To develop 3D virtual environments.
2. To develop 3D interaction techniques and immersive virtual reality applications.

UNIT - 1

Introduction & Geometry of Virtual Worlds

Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view Geometric modeling, Transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, Viewport transform

UNIT - 2

Light and Optics

Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

UNIT - 3

Visual Physiology & Visual Perception

Photoreceptors, Sufficient resolution for VR, light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision, Depth perception, Depth perception, Motion perception, Frame rates and displays, Frame rates and displays

UNIT - 4

Tracking Systems & Visual Rendering

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach,Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

UNIT - 5

Audio & Interfaces

Physics and physiology, auditory perception, Auditory localization, Rendering , Spatialization and display, combining other senses, Interfaces, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

UNIT - 6

Augmented Reality

System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment

TEXT/REFERENCE BOOKS

1. http://msl.cs.uiuc.edu/vr/

2. George Mather, Foundations of Sensation and Perception:Psychology Press; 2 edition, 2009.

3. Peter Shirley, MichaelAshikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition, 2009.

BTETOE605E	Python Programming	3 Credits

Course Objective:

- Provide an understanding of the role computation can play in solving problems.
- Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
- Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes:

1. Experience with an interpreted Language.
2. To build software for real needs
3. Prior Introduction to testing software

UNIT - 1

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation

UNIT - 2

Types, Operators and Expressions: Types – Integers, Strings, Booleans; Operators-Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass

UNIT - 3

Data Structures Lists – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions

UNIT - 4

Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT - 5

Object-Oriented Programming OOP in Python: Classes, „self-variable", Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions

UNIT - 6

Brief Tour of the Standard Library – Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

TEXT/REFERENCE BOOKS

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Think Python, Allen Downey, Green Tea Press
4. Core Python Programming, W.Chun, Pearson
5. Introduction to Python, Kenneth A. Lambert, Cengage

BTETOE605F	Web Development and Design	3 Credits

Course Objectives:

- Define the principle of Web page design
- Define the basics in web design
- Visualize the basic concept of HTML.
- Recognize the elements of HTML.
- Introduce basics concept of CSS.

- Develop the concept of web publishing

Course Outcomes:

On completion of the course, student will be able to:

1. Develop the skill & knowledge of Web page design
2. Understand the knowhow and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors.

UNIT - 1

Web Design Principles , Basic principles involved in developing a web site , Planning process , Five Golden rules of web designing , Designing navigation bar , Page design, Layout of pages , Design Concept

UNIT - 2

Basics in Web Design , Brief History of Internet , What is World Wide Web , Why create a web site , Web Standards , Audience requirement

UNIT - 3

Introduction to HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading, Paragraphs, Line Breaks, HTML Tags

UNIT - 4

Elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia Working with Forms and controls

UNIT - 5

Introduction to Cascading Style Sheets, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) , CSS Color , Creating page Layout and Site Designs

UNIT - 6

Introduction to Web Publishing or Hosting , Creating the Web Site ,Saving the site, Working on the web site, Creating web site structure, Creating Titles for web pages, Themes, Publishing web sites

TEXT/REFERENCE BOOKS

1. J. N. Robbins, Learning Web Design, O'Reilly Media, 4th Edition, 2012
2. Steven M. Schafer, HTML, XHTML, and CSS Bible, Wiley India, 5th Edition, 2010
3. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India, 3rd Edition, 2009
4. Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication, 3rd Edition, 2015
5. E. Robson, E. Freeman, Head First HTML & CSS, O‟Reilly Media, nd Edition, 2012.

BTHM606	Employability & Skill Development	2 Credits

Course Objectives:

- To develop analytical abilities.
- To develop communication skills.
- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- To expose the students to leadership and team-building skills.

Course Outcomes:

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT - 1

Soft Skills & Communication basics

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT - 2

Arithmetic and Mathematical Reasoning

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

UNIT - 3

Analytical Reasoning and Quantitative Ability

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy)

UNIT - 4

Grammar and Comprehension

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing

UNIT - 5

Skills for interviews

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time

UNIT - 6

Problem Solving Techniques

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chand publications.

2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum‟s Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. Mc Murrey, "A Guide to Writing as an Engineer", ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

BTETC701	Digital Communication	3 Credits

Course Objectives:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

Course Outcomes:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

UNIT - 1

Digital Transmission of Analog Signal

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speech synthesis.

UNIT - 2

Baseband Digital Transmission

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

UNIT - 3

Random Processes

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT - 4

Baseband Receivers

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT - 5

Passband Digital Transmission

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

UNIT - 6

Spread Spectrum Techniques

Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS

1. Simon Haykin, "Digital Communication Systems", John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, "A First Course in Digital Communication", Cambridge University Press.
4. B P Lathi, Zhi Ding "Modern Analog and Digital Communication System", Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications" Second Edition, Pearson Education.
6. Taub, Schilling, "Principles of Communication System", Fourth Edition, McGraw Hill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTETPE702A	Microwave Theory and Techniques	3 Credits

Course Objectives:

- To lay the foundation for microwave engineering.
- To understand the applications of microwave engineering.
- Carryout the microwave network analysis.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes.

4. Understand the working principles of all the solid state devices.
5. Choose a suitable microwave tube and solid state device for a particular application.
6. Carry out the microwave network analysis.
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

UNIT - 1

Transmission Lines and Waveguides:

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands. Applications of Microwave, General solution for TEM, TE and TM waves, Parallel plate waveguide, and rectangular waveguide, Wave guide parameters, Introduction to coaxial line, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT - 2

Microwave Components:

Multi-port junctions: Construction and operation of E-plane, H-plane, Magic Tee and Directional couplers. Ferrites components: - Ferrite Composition and characteristics, Faraday rotation, Construction and operation of Gyrator, Isolator and Circulator.

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

UNIT - 3

Microwave Network Analysis

Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix Scattering Matrix:- Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Related problems.

UNIT - 4

Microwave Tubes

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation. O type tubes Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications. Slow wave devices Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

UNIT - 5

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

UNIT - 6

Microwave Measurements

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

TEXT/REFERENCE BOOKS

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010
2. Microwave Devices and circuits- Liao / Pearson Education
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition , McGraw- Hill Education Pvt. Ltd., 2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn, 2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTETPE702B	RF Circuit Design	3 Credits

Course Objectives:

- To study RF issues related to active and passive components.
- To study circuit design aspects at RF
- To learn design and modeling of circuits at RF.

Course Outcomes:

After successfully completion of the course students will be able to

1. Understand behavior of passive components at high frequency and modeling of HF circuit.
2. Design HF amplifiers with gain bandwidth parameters.
3. Understand Mixer types and characteristics.
4. Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

UNIT - 1

RF Behavior of Passive Components

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

UNIT - 2

Bandwidth Estimation

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC τs, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

UNIT - 3

High Frequency Amplifier Design

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni lateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations, Stabilization methods.

UNIT - 4

Low Noise Amplifier Design

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

UNIT - 5

Oscillators

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

UNIT - 6

Mixers

Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

TEXT/REFERENCE BOOKS

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design Theory and Applications”, Pearson Education.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, “Devices modeling for analog and RF COMS circuits design”, John Wiley publication.
4. Calvin Plett, “Radio frequency Integrated Circuits Design”, Artech house.

BTETPE702C	Satellite Communication	3 Credits

Course Objectives:

- To provide students with good depth of knowledge in radar and Satellite communication.
- Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
- This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT - 1

Basic Principles

General features, frequency allocation for satellite services, properties of satellite communication systems.

Earth Station: Introduction, earth station subsystem, different types of earth stations.

UNIT - 2

Satellite Orbits

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbitalcapacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

UNIT - 3

Satellite Construction (Space Segment)

Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

UNIT - 4

Satellite Links

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

UNIT - 5

The Space Segment Access and Utilization

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

UNIT - 6

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons.
2. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed. 2001.
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc., NJ.
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY.
5. Robert Gagliardi , "Satellite Communication" , CBS Publication.
6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley and Sons.

BTETPE702D	Fiber Optic Communication	3 Credits

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
- Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Understand the properties of optical fiber that affect the performance of a communication link.
- Understand basic optical amplifier operation and its effect on signal power and noise in the system.
- Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers

UNIT - 1

Introduction

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

UNIT - 2

Types of optical fibers

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT - 3

Optical sources

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties

UNIT - 4

Optical switches

Coupled mode analysis of directional couplers, electro-optic switches.

UNIT - 5

Optical amplifiers

EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT - 6

Nonlinear effects in fiber optic links

Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

TEXT/REFERENCE BOOKS

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997

7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

BTETPE702E	Wireless Sensor Networks	3 Credits

Course Objectives:

- To introduce the emerging research areas in the field of wireless sensor networks
- To understand different protocols and there uses in WSN.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

UNIT - 1

Introduction

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT - 2

Networks

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT - 3

Protocols

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT - 4

Dissemination protocol

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT - 5

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

UNIT - 6

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS

1. Waltenegus Dargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks Theory And Practice" , By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Networks" , Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009.

BTETPE702F	Mobile Computing	3 Credits

Course Objectives:

- To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services.
- To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
- To appreciate the social and ethical issues of mobile computing, including privacy.

Course Outcomes:

1. At the end of the course, the student will be able to demonstrate:
2. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
3. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.

4. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
5. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

UNIT - 1

Mobile Computing, Mobile Computing vs. wireless Networking, Mobile Computing Applications, Characteristics of Mobile computing, Structure of Mobile Computing Application.

UNIT - 2

MAC Protocols, Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes.

UNIT - 3

Overview of Mobile IP, Features of Mobile IP, Key Mechanism in Mobile IP, route Optimization. Overview of TCP/IP, Architecture of TCP/IP- Adaptation of TCP Window, Improvement in TCP Performance.

UNIT - 4

Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS).

UNIT - 5

Ad-Hoc Basic Concepts , Characteristics , Applications , Design Issues , Routing , Essential of Traditional Routing Protocols ,Popular Routing Protocols , Vehicular Ad Hoc networks (VANET) , MANET vs. VANET , Security.

UNIT - 6

Mobile Device Operating Systems , Special Constrains & Requirements , Commercial Mobile Operating Systems , Software Development Kit: iOS, Android, BlackBerry, Windows Phone , M Commerce , Structure , Pros & Cons , Mobile Payment System , Security Issues.

TEXT/REFERENCE BOOKS

1. Principles of Mobile Computing, 2^{nd} Edition, Uwe Hansmann, Lothar Merk, Martin Nicklous, Thomas Stober, Springer

2. Mobile Computing, Tomasz Imielinski, Springer.

BTETPE703A	Embedded System Design	3 Credits

Course Objectives:

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
4. Get to know the hardware – software co design issues and testing methodology for embedded system.

UNIT - 1

Introduction to Embedded Computing

The concept of embedded systems design, Characteristics of Embedding Computing Applications, Concept of Real time Systems

UNIT - 2

Design Process

Requirements, Specifications, Architecture Design, Designing of Components, Embedded microcontroller cores, embedded memories. Examples of embedded systems

UNIT - 3

Technological aspects of embedded systems

Interfacing between analog and digital blocks, signal conditioning, digital signal processing, subsystem interfacing, interfacing with external systems, user interfacing.

UNIT - 4

Design tradeoffs

Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems

UNIT - 5

Operating System

Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.

UNIT - 6

Scheduling and Inter-process Communication

Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling Signals, Shared Memory Communication, Message-Based Communication

TEXT/REFERENCE BOOKS

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

BTETPE703B	Artificial Intelligence Deep Learning	3 Credits

Course Objectives:

- Apply AI techniques to solve the given problems.
- Implement trivial AI techniques on relatively large system
- Explain uncertainty and Problem solving techniques.
- Compare various learning techniques.

Course Outcomes:

This course will enable students to

1. Identify the AI based problems.
2. Apply techniques to solve the AI problems.
3. Define learning and explain various logic inferences.
4. Discuss different learning techniques.

UNIT - 1

Introduction:

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The “laws of thought” approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behaviour: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

UNIT - 2

Search Techniques:

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyon Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT - 3

Game Playing:

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT - 4

Logic and inference:

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic , Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, Planning Graphs.

UNIT - 5

Learning:

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation-Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

TEXT/REFERENCE BOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. III Edition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem Solving”, Fourth Edition, Pearson Education, 2002.
5. N.P. Padhy “Artificial Intelligence and Intelligent Systems” , Oxford UniversityPress-2015.

BTETPE703C	VLSI Design & Technology	3 Credits

Course Objectives:

- To study HDL based design approach.
- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.
- To realize importance of testability in logic circuit design.
- To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications

UNIT - 1

VHDL Modeling

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

UNIT - 2

PLD Architectures

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

UNIT - 3

SoC & Interconnect

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

UNIT - 4

Digital CMOS Circuits

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

UNIT -5

Analog CMOS Design

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier, Operational amplifier

UNIT - 6

Testability

Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS

1. Charles H. Roth, “Digital systems design using VHDL”, PWS.
2. Wyane Wolf, “Modern VLSI Design (System on Chip)”, PHI Publication.
3. Allen Holberg, “Analog CMOS Design”, Oxford University Press.
4. Neil H. E. Weste, David Money Harris, “CMOS VLSI Design: A Circuit & System Perspective”, Pearson Publication.

BTETPE703D	Data Compression & Encryption	3 Credits

Course Objectives:

- The concept of security, types of attack experienced.
- Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT - 1

Data Compression and Encryption:

Need for data compression, Lossy/lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT - 2

Statistical Methods:

Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPM method.

UNIT - 3

Dictionary Methods:

String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT - 4

Image Compression:

Lossless techniques of image compression, gray codes, two dimensional image transform ,Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT - 5

Audio Compression:

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT - 6

Conventional Encryption:

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS

1. Data compression- David Solomon Springer Verlag publication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmann publication.
4. The data compression book- Mark Nelson BPB publication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc., publications.

BTETPE703E	Big Data Analytics	3 Credits

Course Objectives:

- To provide an overview of an exciting growing field of Big Data analytics.
- To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.

- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
- To introduce to the students several types of big data like social media, web graphs and data streams
- To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data.

UNIT - 1

Big Data Platforms

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

UNIT - 2

YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

UNIT - 3

Fog Computing

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

UNIT - 4

Web Enhanced Building

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements.

UNIT - 5

Technologies for Healthcare

Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

UNIT - 6

Sustainability Data and Analytics

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

TEXT/REFERENCE BOOKS

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and the Internet of Things Enterprise Information Architecture for A New Age”, Apress, 2015. 2. Dr. John Bates, “Thingalytics - Smart Big Data Analytics for the Internet of Things”, john Bates, 2015.
2. Dr. John Bates, “Thingalytics - Smart Big Data Analytics for the Internet of Things”, john Bates, 2015.

BTETPE703F	Cyber Security	3 Credits

Course Objectives:

- For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
- The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still more complicated
- To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

Course Outcomes:

Students should be able to understand.

1. The difference between threat, risk, attack and vulnerability.
2. How threats materialize into attacks.
3. Where to find information about threats, vulnerabilities and attacks.
4. Typical threats, attacks and exploits and the motivations behind them.

UNIT - 1

Introduction to Cyber Security

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT - 2

Cyber Security Vulnerabilities and Cyber Security Safeguards

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT - 3

Securing Web Application, Services and Servers

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

UNIT - 4

Intrusion Detection and Prevention

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT - 5

Cryptography and Network Security

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT - 6

Cyberspace and the Law, Cyber Forensics

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

TEXT/REFERENCE BOOKS

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015

2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015.
1. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.

BTETPE704A	**Consumer Electronics**	**3 Credits**

Course Objectives:

- To acquaint students with the practical knowledge of designing and developing consumer electronic systems and products and introduce the latest trends and technologies.

Course Outcomes:

Students will be able to:

1. List technical specification of electronics Audio system (microphone and speaker)
2. Trouble shoots consumer electronics products like TV, washing machine and AC.
3. Identify and explain working of various color TV transmission blocks.
4. Adjust various controls of color TV receiver and troubleshoot it.
5. Use various functions of Cam coder and shoot a video and take snapshots and save them in appropriate format.

UNIT - 1

Communication devices

Mobile handsets, Android technology, 2G, 3G Mobiles, i-phone, EPABX

UNIT - 2

Mass Communication devices

Color Television, Antenna, HDTV, LCD TV,LED TV, 3D Technology In TV, Interactive TV, DTHTV, Plasma TV, Video Conferencing, FAX Machine, PA System, Dolby Digital Systems, Gesture Technology In TV.

UNIT - 3

Household e1cctronics devices

Washing Machine, Microwave Oven, Types Applications, Electronics Weighing Balance, Air Conditioner, Vacuum Cleaner.

UNIT - 4

Printing and recording devices

LASER printer, Inkjet Printers, Photocopiers, Scanner, DVD/CD Player, Blue ray DVD Player.

UNIT - 5

Special purpose machines

Electronic Voting Machine, CFL, LED Lamps, Application and Advantages. Solar lamp, Water Purifier, Electronic Calculator, DVD Player, ATM

Security devices

Biometric attendance Monitoring System, Working, Biometric Sensors, Home Automation System.

UNIT - 6

Compliance:

Product safety and liability issues, standards related to electrical safety and standards related to fire hazards, e.g., UL and VDE. EM1/EMC requirements and design techniques for compliance, e.g. ESD, RF interference and immunity, line current harmonics and mains voltage surge.

TEXT/REFERENCE BOOKS

1. Television &Video Engineering-A. M. Dhake, TMH Publication.
2. Monochrome and Color TV - R. R. Gulati, Wiley Eastern publication.
3. Video demystified -Keith Jack, PI publication
4. Audio &Video Systems-R.G.Gupta
5. Audio and Video system - Principles, maintenance and Troubleshooting by R. Gupta
6. Arora C. P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 1994
7. Color TV Theory &Practice -S. P. Bali. TMG Hill Publication.
8. Basic TV &Video Systems-Bernard Grobb.
9. Electronic Communication Systems, Kennedy, TMH.
10. Principles of Communication Engineering- Anokh Singh-TMH.
11. C. M. Wintzer, International Commercial EMC Standards, Interference Control Techno1ologies 1988.

12. P. A. Chatterton and M. A. Houlden, EMC: Electromagnetic Theory to Practical Design. Wiley, 1992.
13. J. A. S. Angus, Electronic Product Design, Chapman and Hall, 1996.
14. Y. J. Wind, Product Policy: Concepts, Methods, and Strategy, Addison-Wesley Pub. Co. 1982.

BTETPE704B	Analog Integrated Circuit Design	3 Credits

Course Objectives:

- Introduction to Circuit Simulation & EM Simulations.
- Deep Understanding of MOS Device Physics & Modeling.
- Understanding of few transistor circuits like common gate, common source & common drain amplifiers with their frequency response.
- Understanding of Operational Amplifier Design & Trade-offs.
- Advanced Op-Amps and OTAs.
- Temperature Compensated Biasing Schemes.

Course Outcomes:

After the successful completion of this course, Students will be able to:

1. Describe the models for active devices in MOS and Bipolar IC technologies.
2. Describe layout considerations for active and passive devices in analog ICs.
3. Analyze and design IC current sources and voltage references.
4. Describe the noise sources and models applicable to ICs.
5. Understand and appreciate the importance of noise and distortion in analog circuits.
6. Analyze integrated circuit noise performance.
7. Analyze and design IC operational amplifiers.

UNIT - 1

Introduction to Simulations

Introduction to Advanced Design System and Cadence Virtuoso, DC Simulations, AC Simulations, Harmonic Balance, Envelope Simulation, Electromagnetic Simulations- FEM, MOM, FDTD, Circuit Net listing.

UNIT - 2

MOSFET Device Physics & Modeling

MOSFET Structure, Threshold Voltage, Drain Current Equation, Transfer & Output Characteristics, Weak/Moderate/Strong Inversion, Linear/Triode/Saturation Region of Operation, Device Leakages and Losses, Short Channel Effects, High Frequency Small Signal Model of MOSFET, Cubic, BSIM and Materka Models of MOSFET.

UNIT - 3

Few Transistor Circuits

Current Mirrors, Common Source/Common Gate/Common Drain Amplifiers, Design and Analysis of CS/CG/CD Amplifiers, Cascode Amplifiers, Differential Gain Stage, Frequency Response & Design Trade-offs, Telescopic Cascode and Wide Swing Cascode Current Mirrors, PTAT, CTAT & Bandgap Bias Circuits.

UNIT - 4

Operational Amplifiers & OTAs

Design of Classical Op-Amps, Op-Amp Characteristics, Analysis and Trade-offs, Wideband Op-Amps, High Speed Op-Amps, Very High Gain Op-Amps, Operational Transconductance Amplifiers, Ultra Low Power OTAs for Medical Implants, Folded Cascode Op-Amps.

UNIT - 5

Biasing Schemes

Voltage and Current References, Vt reference bias, PTAT Current Reference, CTAT and Bandgap Voltage References, High Precision Voltage References, Voltage Level Shifters.

UNIT - 6

Non-Linear Circuits

Single and Balanced Diode Mixers, Translinear Cell, Gilbert Cell Mixers, Power Amplifiers, Even & Odd Order Mixing, In-Modulation (AM, PM Conversions) Distortions, Intermodulation Distortions, Intermodulation Products, ACPR & EVM.

TEXT/REFERENCE BOOKS

1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, “Analog Integrated Circuit

2. Design", John Wiley & Sons
3. Keliu Shu, Edgar Sanchez-Sinencio, "CMOS PLL Synthesizers", Springer
4. Jose Carlos Pedro, Nuno Borges Carvalho, "Intermodulation Distortion in Microwave and Wireless Circuits", Artech House
5. Stephen A. Maas, "Microwave Mixers", Artech House.

BTETPE704C	**Soft Computing**	**3 Credits**

Course Objectives:

- Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
- Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
- To create awareness of the application areas of soft computing technique.
- Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT - 1

Artificial Neural Network –I:

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch- Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitations Draft.

UNIT - 2

Artificial Neural Network-II:

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self- organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover"s theorem, mapping functions(Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associative memories.

UNIT - 3

Fuzzy Logic –I:

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T-conorm) o Fuzzy if-then rules.

UNIT - 4

Fuzzy Logic –II:

Fuzzification, Membership Value Assignment techniques, De-fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

UNIT - 5

Fuzzy Control Systems:

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

UNIT - 6

Adaptive Neuro-Fuzzy Inference Systems (ANFIS):

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene Fausett, Pearson Education, Inc, 2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons, 2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall International Inc-1999.
7. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag, 2007.

BTETPE704D	Advance Industrial Automation-1	3 Credits

Course Objectives:

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity.

- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.

Course Outcomes:

After the successful completion of this course, the student will be able:

1. To identify suitable automation hardware for the given application.
2. To recommend appropriate modeling and simulation tool for the given manufacturing application.

UNIT - 1

Introduction:

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines).

UNIT - 2

Material handling and Identification Technologies:

Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods (SLE: Material Identification Methods).

UNIT - 3

Automated Manufacturing Systems:

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

UNIT - 4

Control Technologies in Automation:

Industrial Control Systems, Process Industries versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms, (SLE: Sensors, Actuators and other Control System Components).

UNIT - 5

Computer Based Industrial Control:

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems (SLE: Display Systems in Process Control Environment).

UNIT - 6

Modeling and Simulation for Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants. (SLE: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications).

TEXT/REFERENCE BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th edition, 2009.
2. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk.
4. Performance Modeling of Automated Manufacturing Systems,-Viswanandham, PHI, 1st edition, 2009.

BTETPE704E	Mechatronics	3 Credits

Course Objectives:

- Understand key elements of Mechatronics system, representation into block diagram.
- Understand concept of transfer function, reduction and analysis.
- Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller.

- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.
- Understand the system modelling and analysis in time domain and frequency domain.
- Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications.

Course Outcomes:

1. Identification of key elements of mechatronics system and its representation in terms of block diagram.
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Time and Frequency domain analysis of system model (for control application).
5. PID control implementation on real time systems.
6. Development of PLC ladder programming and implementation of real life system.

UNIT - 1

Introduction to Sensors & Actuators

Introduction to Mechatronics, Measurement characteristics: -Static and Dynamic Sensors: Position Sensors: -Potentiometer, LVDT, Encoders; Proximity sensors:-Optical, Inductive, Capacitive; Motion Sensors:-Variable Reluctance; Temperature Sensor: RTD, Thermocouples; Force / Pressure Sensors:-Strain gauges; Flow sensors: -Electromagnetic Actuators: Stepper motor, Servo motor, Solenoids.

UNIT - 2

Block Diagram Representation

Open and Closed loop control system, identification of key elements of mechatronics systems and represent into block diagram (Electro-Mechanical Systems), Concept of transfer function, Block diagram reduction principles, Applications of mechatronics systems:-Household, Automotive, Shop floor (industrial).

UNIT - 3

Data Acquisition & Microcontroller System

Interfacing of Sensors / Actuators to DAQ system, Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency, ADC (Successive Approximation), DAC (R-2R), Current and Voltage Amplifier.

UNIT - 4

PLC

Programming Introduction, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming, and Introduction to SCADA system.

UNIT - 5

Modelling and Analysis of Mechatronics System

System modelling (Mechanical, Thermal and Fluid), Stability Analysis via identification of poles and zeros, Time Domain Analysis of System and estimation of Transient characteristics: % Overshoot, damping factor, damping frequency, Rise time, Frequency Domain Analysis of System and Estimation of frequency domain parameters such as Natural Frequency, Damping Frequency and Damping Factor.

UNIT - 6

Control System

P, I and D control actions, P, PI, PD and PID control systems, Transient response:-Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning (manual).

TEXT/REFERENCE BOOKS

1. K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008
2. Bolton, Mechatronics -A Multidisciplinary approach, 4th Edition, Prentice Hall, 2009.
3. Alciatore & Histand, Introduction to Mechatronics and Measurement system, 4thEdition, McGraw Hill publication, 2011.
4. Bishop (Editor), Mechatronics –An Introduction, CRC Press, 2006.
5. Mahalik, Mechatronics –Principles, concepts and applications, Tata Mc - Graw Hill publication, New Delhi.

6. C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi.

BTETPE704F	Electronics in Smart City	3 Credits

Course Objectives:

Course Outcomes:

UNIT - 1

Necessity of SMART CITY

The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework in GCC.

UNIT - 2

SMART CITY and IOT

Introduction to Internet of Things, applications in smart city & their distinctive advantages - smart environment, smart street light and smart water & waste management. What is an IOT? Role and scope of IOT in present and future marketplace.

UNIT - 3

SMART Objects

Smart objects, Wired – Cables, hubs, etc., Wireless – RFID, WiFi, Bluetooth, etc. Different functional building blocks of IOT architecture

UNIT - 4

Smart Cities: Distributed Intelligence and Central Planning

On the Interplay between Humans and Smart Devices, Theoretical Tools, Intelligence-Artificial Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamics and Allometry in Smart Cities.

UNIT - 5

Wireless Protocols for Smart Cities

IPv6 over Low-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking

Basics, Wireless Networking Assumptions, Bluetooth Low Energy, Constrained Application Protocol, Message Queue Telemetry Protocol.

UNIT - 6

Leveraging Smart City Projects for Benefitting Citizens: The Role of ICTs

Smart City and ICT: Using Technologies to Improve the Citizens‟ Quality of Life, Smart City Goals: The Impact on Citizens‟ Well-Being and Quality of Life, Critical Dimensions: Urbanization, Local Climate Change, and Energy Poverty, Environmental Issues: The Role of Local and Global Climate Chang.

TEXT/REFERENCE BOOKS

Dr. Babasaheb Ambedkar Technological ftniversity, Lonere.

BTHM705	Financial Management	2 Credits

Course Objectives:

- To help the students to deve lop cognizance of the importa nce of Financ ial Management in corporate valuation
- To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.
- To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow
- To enable students to synthesize related information and eva luate options for most logical and optima l solution such that they would be able to predict and control Debt Equity incurrence and improve results.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. The students would be able to understand and define basic terminology used in finance and accounts
2. The students would be able to prepare& appraise Financial Statements and evaluate a company in the light of different measurement systems.
3. The students would be able to analyze the risk and return of alternative sources of financing.
4. Estimate cash flows from a project, inc luding operating, net working capital, and capita l spending.
5. To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calc ulate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
6. To describe and illustrate the important elements in project finance Using fina ncia l calculator and Excel in a variety of problems.

UNIT - 1

Introduction to Financial Accounting, Book keeping & Recording: Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

UNIT - 2

Financial Statement Preparation, analysis & Interpretation: Preparation of financial statement and Profit & Loss Account, Balance Sheet. , Ratio Analysis - classification of various ratios.

UNIT - 3

Introduction To Financial Management: Concept of business finance, Goals & objectives of financial management, Sources of financing, Long Term financing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility). Short Term Financing- bank finance, commercial paper, trade credit

UNIT - 4

Working Capital Management: Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financing approaches for working capital, Methods of forecasting working capital requirements, Methods of Forecasting.

UNIT - 5

Time Value of Money & Capital Budgeting: Concept of time value of money, Compounding & discounting; Future value of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

UNIT - 6

Proje ct Financing: Details of the company, its promoters and project fina nces required, profitability etc., Loan documentation-Appra isal of terms loans by financ ial institutions. Basic components of project finance.

TEXT & REFERENCE BOOKS

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw Hill Publication 5th Edition.

2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5th Edition.

3. Taxman's Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.

4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy, Himalaya Publishing House

5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2nd Edition.

Department of Electronics and Telecommunication Engineering

COURSE STRUCTURE AND SYLLABUS

For

Bachelor of Technology

In

Electronics and Telecommunication Engineering

With effect from the Academic Year

2020-2021 (First Year), 2021-2022 (Second Year),
2022-2023 (Third Year), 2023-2024 (Final Year).

Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra Telephone and Fax. 02140 – 275142
www.dbatu.ac.in

Vision Statement of the University

The University is committed to becoming a leading 'Center of Excellence' in the field of Engineering, Technology and Science as a seat of learning with a national character and international...

Mission Statement of the University

The University is committed to provide quality technical education, research and development services to meet the needs of industry, business, service sector and the society, at large.

About the University

Dr. Babasaheb Ambedkar Technological University, with its headquarters situated at Lonere, is now a statutory State Technical University established by Government of Maharashtra through special Dr. Babasaheb Ambedkar Technological University Act. The university has been accorded the status of an ‘affiliating’ university of the entire State of Maharashtra from March 2, 2016, by the Maharashtra Act No. XXIX of 2014.

Vision Statement of the Department

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology for development of society.

Mission Statement of the Department

The Electronics and Telecommunication Engineering Department constantly aims at providing quality education and works towards the fulfillment of the goal and objectives in pace with the modern scientific and technological development.

About the Department

The department of Electronics and Telecommunication Engineering was established in the year 1995 initially with B. Tech. programme with intake of 60 students. In 2001, M. Tech. programme in Electronics & Telecommunication Engineering with an intake of 18 students was introduced. From academic year 2008-2009, intake of B. Tech. has been increased to 120 students. The department has started Ph.D. programme from the academic year 2003, presently 20 research scholars are working in the research area of Signal Processing, Computer Network and Microwave Communication. Department is also offering fellowship to M. Tech. and Ph.D. students under TEQIP project. The curriculum designed is a perfect blend of Electronics, Communication and Computing Technologies. The focus of the department is to produce graduates & post graduates with strong fundamentals in Electronics and Communication domain. The department has received handful amount of funding from AICTE, UGC, TEQIP and State Government for various research projects. The department has state of the art laboratories to cater for curricular requirements as well as projects and research. The faculty members are having strong background of research in the current issues of the discipline. The budding graduates from this discipline have very good job opportunities in VLSI Technologies, Embedded Systems, Signal Processing, Radio Frequency (RF) Communication, Mobile communication and in Software Engineering. Many of our students placed in industries like Infosys, TCS, Cognizant, Persistent, Siemens, Huawei, Reliance Communication, Prayas Software Ltd, JSW ISPAT, RCF, Videocon, ONGC, BHEL, BEL, GE, L & T, Sasken, MBT, Texas, Accenture, Mahagenco, Motorola, CapGemini, Flextronicx, NVIDIA, Patney Computers, Reliance Jio, Hexaware, Tataelxsi, BSE, City bank, etc. and got admitted for higher education (M. Tech. / Ph. D. programme) in institute of high repute such as IIMs, IITs and NITs. As an essential part of the academic schedule, the students have to undergo industrial training at the end of second and third year.. To get an industrial exposure the department also arranges Industrial Visits to reputed industries. There is an overwhelming participation of students in conferences, seminars, workshops, paper publications, annual sports. The department regularly organizes workshops, training, seminars, expert lectures and conference in the emerging areas of electronics and communication engineering.

Program Educational Objectives (PEOs)

Graduates will able to–

1. To equip graduates with a strong foundation in engineering sciences and Electronics & Telecommunication Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
2. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to Electronic Circuits, Embedded & wireless communication Systems and Signal Processing to solve engineering/ societal problems in the field of Electronics and Telecommunication Engineering.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirement.

Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

   (a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination

   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

   (c) Paid all required advance payments of the Institute and hostel for the current semester;

   (d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2019-20,starting from I year B.Tech.

Percentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awarded based on CGPA of all eight semester of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPA up to <5.50	Pass class
CGPA ≥ 5.50 &<6.00	Second-class
CGPA ≥ 6.00 &<7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

1.	Mid-Semester Exam (MSE) Marks	20
2.	Continuous Assessment Marks	20
3.	End Semester Examination(ESE) Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assessment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, <u>with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.</u>

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20.

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.

EE Grade: The 'EE' grade stands for minimum passing grade.

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.

If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

   (A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

Where

'n' is the number of subjects for the semester,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.

-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

Where

'm' is the total number of subjects from the first semester onwards up to and including the semester S,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honors

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross- discipline research.

A. <u>Eligibility Criteria for Majors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B.Tech (Honors) Degree.

B. <u>Eligibility Criteria for Minors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in -------Engineering with Minor in----------Engineering.

(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honors and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

B. Tech in Electronics & Telecommunication Engineering

Curriculum for First Year

Teaching and Evaluation Scheme for First Year B. Tech. (All Branches)

Group A

Semester I									
Course Code	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
		L	T	P	CA	MSE	ESE	Total	Credit
Mandatory	**Induction Program**	**3-weeks duration in the beginning of semester.**							
BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BTBS102	Engineering Physics	3	1	-	20	20	60	100	4
BTES103	Engineering Graphics	2	-	-	20	20	60	100	2
BTHM104	Communication Skills	2	-	-	20	20	60	100	2
BTES105	Energy and Environment Engineering	2	-	-	20	20	60	100	2
BTES106	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BTBS107L	Engineering Physics Lab	-	-	2	60	-	40	100	1
BTES108L	Engineering Graphics Lab	-	-	4	60	-	40	100	2
BTHM109L	Communication Skills Lab.	-	-	2	60	-	40	100	1
	Total	**14**	**2**	**8**	**330**	**100**	**420**	**850**	**18**
Semester II									
BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BTBS202	Engineering Chemistry	3	1	-	20	20	60	100	4
BTES203	Engineering Mechanics	2	1	-	20	20	60	100	3
BTES204	Computer Programming in C	2	-	-	20	20	60	100	2
BTES205	Workshop Practices	-	-	4	60	-	40	100	2
BTES206	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
BTBS207L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
BTES208L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
BTES209L	Computer Programming Lab	-	-	2	60	-	40	100	1
BTES210S	Seminar	-	-	2	60	-	40	100	1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluat e d in III Sem.
	Total	**12**	**3**	**12**	**430**	**80**	**440**	**950**	**19**
		27							

Group B

Semester I									
Course Code	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
		L	T	P	CA	MSE	ESE	Total	Credit
Mandatory	**Induction Program**	**3-weeks duration in the beginning of semester.**							
BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BTBS102	Engineering Chemistry	3	1	-	20	20	60	100	4
BTES103	Engineering Mechanics	2	1	-	20	20	60	100	3
BTES104	Computer Programming in C	2	-	-	20	20	60	100	2
BTES105L	Workshop Practices	-	-	4	60	-	40	100	2
BTES106	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
BTBS107L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
BTES108L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
BTES109L	Computer Programming Lab	-	-	2	60	-	40	100	1
	Total	**12**	**3**	**10**	**370**	**80**	**400**	**850**	**18**
		25							

Semester II									
BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BTBS202	Engineering Physics	3	1	-	20	20	60	100	4
BTES203	Engineering Graphics	2	-	-	20	20	60	100	2
BTHM204	Communication Skills	2	-	-	20	20	60	100	2
BTES205	Energy and Environment Engineering	2	-	-	20	20	60	100	2
BTES206	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BTBS207L	Engineering Physics Lab	-	-	2	60	-	40	100	1
BTES208L	Engineering Graphics Lab	-	-	4	60	-	40	100	2
BTHM209L	Communication Skills Lab.	-	-	2	60	-	40	100	1
BTES210S	Seminar	-	-	2	60	-	40	100	1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time)	-	-	-	-	-	-	-	Credits To be evaluated in III Sem.
	Total	**14**	**2**	**10**	**390**	**100**	**460**	**950**	**19**
		26							

Semester III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTETC302	Electronic Devices & Circuits	3	1	-	20	20	60	100	4
PCC 2	BTETC303	Digital Electronics	3	1	-	20	20	60	100	4
ESC	BTES304	Electrical Machines and Instruments	3	1	-	20	20	60	100	4
LC	BTETL305	Electronic Devices & Circuits Lab	-	-	2	60	-	40	100	1
LC	BTETL306	Digital Electronics Lab	-	-	2	60	-	40	100	1
Seminar	BTETS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship – 1 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**12**	**4**	**8**	**260**	**80**	**360**	**700**	**20**

Semester IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 3	BTETC401	Network Theory	3	1	-	20	20	60	100	4
PCC 4	BTETC402	Signals and Systems	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC 1	BTETPE405	(A) Numerical Methods and Computer Programming	3	1	-	20	20	60	100	4
		(B) Data Compression & Encryption								
		(C) Computer Organization and Architecture								
		(D) Introduction to MEMS								
		(E) Python Programming								
LC	BTETL406	Network Theory Lab & Signals and Systems Lab	-	-	4	60	-	40	100	2
Seminar	BTETS407	Seminar II	-	-	4	60	-	40	100	2
Internship	BTETP408 (Internship – 2)	Field Training /Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at onetime).	-	-	-	-	-	-	-	Audit (evalua t ion will be in V Sem.)
		Total	**15**	**3**	**8**	**220**	**100**	**380**	**700**	**22**

B. Tech in Electronics & Telecommunication Engineering

Curriculum for Third Year

SEMESTER-V

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 5	BTETC501	Electromagnetic Field Theory	3	1	-	20	20	60	100	4
PCC 6	BTETC502	Digital Signal Processing	3	1	-	20	20	60	100	4
PCC 7	BTETC503	Analog Communication	3	1	-	20	20	60	100	4
PEC 2	BTETPE504	Group A	3	1	-	20	20	60	100	4
OEC 1	BTETOE505	Group B	3	1	-	20	20	60	100	4
LC	BTETL506	Digital Signal Processing Lab & Analog Communication Lab	-	-	4	60	-	40	100	2
Project	BTETM507	Mini Project – 1	-	-	4	60	-	40	100	2
Internship	BTETP408	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
Total			**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

SEMESTER-VI

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 8	BTETC601	Antennas and Wave Propagation	3	1	-	20	20	60	100	4
PCC 9	BTETC602	Digital Communication	3	1	-	20	20	60	100	4
PEC 3	BTETPE603	Group A	3	1	-	20	20	60	100	4
OEC 2	BTETOE604	Group B	3	1	-	20	20	60	100	4
HSSMC	BTHM605	Employability and Skill Development	3	-	-	20	20	60	100	3
LC	BTETL606	Digital Communication Lab & Professional Elective Course 3 Lab	-	-	4	60	-	40	100	2
Project	BTETM607	Mini Project – 2	-	-	4	60	-	40	100	2
Internship	BTETP608 (Internship – 3)	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Audit (evalua t ion will be in VII Sem.)
Total			**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Semester V

BTETPE504 Program Elective 2 (Group A)	BTETOE505 Open Elective 1 (Group B)
(A) Analog Circuits	(A) Control System Engineering
(B) Embedded System Design	(B) Artificial Intelligence and Machine learning
(C) Digital System Design	(C) Optimization Techniques
(D) Automotive Electronics	(D) Project Management and Operation Research
(E) Mixed Signal Design	(E) Augmented, Virtual and Mixed Reality
(F) Power Electronics	(F) Open Source Technologies

Semester VI

BTETPE603 Program Elective 3 (Group A)	BTETOE604 Open Elective 2 (Group B)
(A) Microprocessors and Microcontrollers	(A) IoT and Industry 4.0
(B) CMOS Design	(B) Deep Learning
(C) Nano Electronics	(C) Computer Network
(D) Advanced Digital Signal Processing	(D) Industrial Drives and Control
(E) Information Theory and Coding	(E) Robotics Design
(F) VLSI Signal Processing	(F) Patents and IPR
(G) VLSI Design & Technology	(G) Acoustic Engineering

B. Tech in Electronics & Telecommunication Engineering

Curriculum for Final Year

Semester VII

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTETC701	Microwave Engineering	3	1	-	20	20	60	100	4
PEC 4	BTETPE702	Group A	3	1	-	20	20	60	100	4
OEC 3	BTETOE703	Group B	3	1	-	20	20	60	100	4
OEC 4	BTETOE704	Group C	3	1	-	20	20	60	100	4
HSSMC	BTHM705	Engineering Economics and Financial Mathematics	3	-	-	20	20	60	100	3
HSSMC	BTHM706	Foreign Language Studies	-	-	-	-	-	-	-	Audit
LC	BETTL707	Microwave Engineering Lab	-	-	2	60	-	40	100	1
Project	BTETM708	Mini Project – 3	-	-	4	60	-	40	100	2
Internship	BTETP608	Internship – 3 Evaluation	-	-	-	-	-	-	-	Audit
Total			**15**	**4**	**6**	**220**	**100**	**380**	**700**	**22**

Semester VIII

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
Project/ Internship	BTETP801	Project work/ Internship	-	-	24	60	-	40	100	12
Total			**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

BTETPE702 Program Elective 4 (Group A)	BTETOE703 Open Elective 3 (Group B)	BTETOE704 Open Elective 4 (Group C)
(A) Digital Image Processing	(A) Wireless Sensor Networks	(A) Soft Computing
(B) RF Circuit Design	(B) Block Chain Technology	(B) Big Data Analytics
(C) Satellite Communication	(C) Cyber Security	(C) Data Structure & Algorithms Using Java Programming
(D) Fiber Optic Communication	(D) Mobile Computing	(D) Entrepreneurship Development
(E) Bio-medical Signal Processing	(E) Mobile Communication and Networks	(E) Software Defined Radio
(F) Principles of Modern Radar Engineering	(F) EMI and EMC	(F) E Waste Management

Guide to Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- **Physical Activity** This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labor yields fruits from nature.
- **Creative Arts** Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.
- **Universal Human Values:** It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through dos and don’ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.
- **Literary:** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
- **Proficiency Modules:** This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.
- **Lectures by Eminent People:** This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.
- **Visits to Local Area** A couple of visits to the landmarks of the city, or a hospital or orphanage could

be organized. This would familiarize them with the area as well as expose them to the under privileged.

- **Familiarization to Dept./Branch & Innovations :** The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

Schedule

The activities during the Induction Program would have an ***Initial Phas***e, a ***Regular Phase*** and a ***Closing Phase***. The Initial and Closing Phases would be two days each.

Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do pre-allotment)
Day 1	
9.00 AM to 3.00 PM	Academic Registration
4.30 PM to 6.00 PM	Orientation
Day 2	
9.00 AM to 10.00 AM	Diagnostic test (for English etc.)
10.15 AM to 12.25 PM	Visits to Respective Departments
12.30 PM to 2.00 PM	Lunch time
2.00 PM to 3.00 PM	Director's Speech
3.00 PM to 4.00 PM	Interaction with Parents
4.00 PM to 5.30 PM	Mentor-Mentee groups- Introduction within group

Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Session	Time	Activity	Remark
Day 3 Onwards			
I	9.00 AM to 11.00 AM	Creative Arts / Universal Human Values	Half the groups will do creative arts
II	11.00 AM to 1.00 PM	Universal Human Values/ Creative Arts	Complementary Alternate
Lunch Time			
IV	2.00 PM to 4.00PM	Afternoon Session	See below
V	4.00 PM to 5.00PM	Afternoon Session	See below

Sundays are off. Saturdays have the same schedule as above or have outings.

Afternoon Activities (Non-Daily) : The following five activities are scheduled at different times of the Induction Program, and are not held daily for everyone

1. Familiarization to Dept./Branch &Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Closing Phase

Time	Activity
Last But one day	
9.00 AM to 12.00 PM	Discussions and finalizations of presentations within each group
2.00 PM to 5.00 PM	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations if any

Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological 6etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline Here we list some important suggestions which have come up and which have been experimented with.

- **Follow Up after Closure – Same Semester:** It is suggested that the groups meet with their facultymentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walked.)
- **Follow Up – Subsequent Semesters:** It is extremely important that continuity be maintained insubsequent semesters. It is suggested that at the start of the subsequent semesters (up to fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution. The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students, who get de-motivated to study engineering or their branch, also lose interest in learning.

The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Values component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and 4

We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept. 7nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seek help.

References:

Motivating UG Students Towards Studies, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

Semester I and Semester II

BTBS101EngineeringMathematics-I 4 Credits

Course Objectives:

1. To know the application of the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem
2. To know and apply the concept partial derivatives and their applications to Maxima/ Minima , series expansion of multi valued functions.
3. To understand Computation of Jacobian of functions of several variables and their applications to engineering problems
4. To identify and sketch of curves in various coordinate system.
5. To evaluate multiple integrals and their applications to area and volume.

Course Outcomes:

Students will be able to :

1. Apply the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem
2. Demonstrate the concept partial derivatives and their applications to Maxima/ Minima , series expansion of multi valued functions.
3. Compute Jacobian of functions of several variables and their applications to engineering problems
4. Identify and sketch of curves in various coordinate system.
5. Evaluate multiple integrals and their applications to area and volume.

Unit 1: Linear Algebra- Matrices [07 Hours]

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non- homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of Eigen values and Eigen vectors (without proofs); Cayley-Hamilton's theorem (without proof) and its applications.

Unit 2: Partial Differentiation [07 Hours]

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

Unit 3: Applications of Partial differentiation [07Hours]

Jacobians - properties; Taylor's and Maclaurin's theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers.

Unit 4: Reduction Formulae and Tracing of Curves

Reduction formulae for $\int_0^{\frac{\pi}{2}} sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} cos^n x\, dx$, $\int_0^{\frac{\pi}{2}} sin^m x\, cos^n x\, dx$; Tracing of standard curves given in Cartesian, parametric & polar forms.

Unit 5: Multiple Integration [08 Hours]

Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area.

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

- The tutorial classes in Engineering Mathematics-I are to be conducted batch wise. Each class should be divided into three batches for the purpose.
- The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
- The minimum number of assignments should be eight covering all topics.

BTBS102/202 Engineering Physics 4 Credits

Course Objectives:

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.
2. To understand and study the Physics principles behind the developments of Engineering materials.

Course Outcomes:

Students will be able to:

1. Explain & apply the concept of types of Oscillation, Dielectric properties & ultrasonic
2. Explain & compare between Interference & Polarization of light ,working Principle of Lasers & Fiber optics Interpreter, apply &demonstrate principle of motion of charged particles in EF&MF, Bainbridge Mass spectrograph &G M counter
3. Identify Types of crystals & crystal planes using Miller indices, Experimental approach.

Unit I: Oscillation and Ultrasonic's: (07 Hrs)

Free oscillation, damped oscillation, Forced oscillation and Resonance, differential wave equation, Ultrasonic waves, production of ultrasonic's (Piezoelectric effect, Magnetostriction effect) and its applications

Unit II: Optics, Fibre Optics and Laser: (07 Hrs)

Interference of light in thin film, wedge shaped film, Newton's rings, polarization of light, methods for production of polarized light(Reflection, Refraction& Double refraction), Huygens's theory of double refraction, Principle and structure of optical fiber, acceptance angle, acceptance cone, numerical aperture. Principle of laser, Types of laser – Ruby and He-Ne laser and their applications.

Unit III: Electron Optics, Nuclear and Quantum Mechanics:(07 Hrs)

Motion of electron in Electric field (parallel and perpendicular), Motion of electron in magnetic field, motion of electron in combined effect, Bainbridge mass spectrograph, G. M counter, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent wave equations, physical significance of wave function.

Unit IV: Crystal Structure, X-rays and Electrodynamics (07 Hrs)

Unit cell, Bravais lattice, cubic system, number of atoms per unit cell, coordination number, atomic radius, packing density, relation between lattice constant and density, lattice planes and Miller indices, X-ray diffraction, Line and Continuous Spectrum of X-ray, Introduction of Maxwell equations (no derivation).

Unit V: Magnetic, Superconducting and Semiconducting materials: (07 Hrs)

Types of magnetic materials (Diamagnetic, Paramagnetic and Ferromagnetic), B-H curve, Superconductivity, types of superconductors, Meissen effect, properties and applications of superconductor, Band theory of solids, conductivity of semiconductors, Hall effect.

Expected Outcome:-

1. The student will be able to understand Engineering problems based on the principle of Oscillation, Ultrasonic's, Optics, Laser, Fiber optics, Nuclear physics, Quantum mechanics.
2. The student will be able to understand Fundamental of Electrodynamics, Semiconductor, Dielectric, Magnetic and Superconducting materials which forms the base of many modern devices and technologies.

Text books:

1. Engineering Physics M.N. Avadhanulu and P.G. Kshirsagar. S.Chand and Company LTD.
2. Engineering Physics – Dr. L. N. Singh. Synergy Knowledgeware-Mumbai.
3. Engineering Physics - R.K. Gaur and S. L. Gupta. Dhanpat Rai Publications Pvt. Ltd.-NewDelhi.
4. Fundamental of Physics - Halliday and Resnik. Willey Eastern Limited.

Reference books:

1. Introduction to Electrodynamics –David R.Griffiths.
2. Concept of Modern Physics – Arthur Beizer.TataMcGraw-Hill Publishing Company Limited.
3. Optics – Ajoy Ghatak, MacGraw Hill Education (India) Pvt.Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age International Pvt.Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India–Limited.
6. The Feynman Lectures on Physics VolI,II,III.
7. Introduction to solid state physics – Charles Kittel. John Willey and Sons

Engineering physics Lab

At least 10 experiments should be performed from the following list

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polari meter - Determination of specific rotation of optically active material
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. G.M. Counter - Determination of operating voltage of G.M. tube
7. Crystal Plane – Study of planes with the help of models related Miller Indices
8. Hall Effect - Determination of Hall Coefficient
9. Four Probe Method - Determination of resistivity of semiconductor
10. Measurement of Band gap energy of Semiconductors
11. Study of I-V characteristics of P-N junction diode
12. Experiment on fibre optics
13. Ultrasonic's Interferometer
14. B-H Curve Experiment
15. Susceptibility measurement experiment

BTES103/203 Engineering Graphics 2 Credits

Course Objectives:

1. To make use of drawing instruments effectively for drawing and dimensioning.
2. To understand the conventions and methods of engineering drawing.
3. To know the concept of projections of points, lines, planes, solids and section of solids.

4. To understand the Construction isometric and orthographic views of given objects.

Course Outcomes:

Students will be able to :

1. Use of drawing instruments effectively for drawing and dimensioning.
2. Explain conventions and methods of engineering drawing.
3. Apply concept of projections of points, lines, planes, solids and section of solids.
4. Construct isometric and orthographic views of given objects.

Unit 1: Drawing standards and geometrical construction: 4 hrs

Drawing standard SP: 46, Type of lines, lettering, dimensioning, scaling conventions. Geometrical construction: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and a hexagon.

Unit 2: Orthographic Projections and Projections of Points: 4hrs

Introduction to orthographic projection, drawing of orthographic views of objects from their isometric views. Projection of points lying in four quadrants.

Unit 3: Projections of Straight Lines and Planes and their Traces: 4hrs

Projections of lines parallel and perpendicular to one or both planes, projections of lines inclined to one or both planes. Traces of lines. Projections of planes parallel and perpendicular to one or both planes, projection of planes inclined to one or both planes.

Unit 4: Projections of Solids 4hrs

Types of solids, projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes. Projections of spheres touching each other.

Unit5:Sectioning of Solids, Isometric Projections 4hrs

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Reference/Text Books:

1. N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 46th Edition,2003.
2. K. V. Nataraajan, *A text book of Engineering Graphic*, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, *Engineering Graphics*, New Age International (P) Ltd, 2008.
4. DhananjayA.Jolhe,*EngineeringDrawingwithanIntroductiontoAutocad*,McGrawHill Education, 2017

BTES108L Engineering Graphics Lab

Practical Scheme:	Examination Scheme:
Practical: 3 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

List of Experiment

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points and straight lines
5. Projections of planes.
6. Projections of solids.
7. Section of solids.
8. Isometric Projections

BTHM104/204 Communication Skills 2 Credits

Course Objectives:

1. To know and apply speaking and writing skills in professional as well as social situations
2. To Overcome Mother Tongue Influence and demonstrate neutral accent while exercising English
3. To know and apply communication skills for Presentations, Group Discussion and interpersonal interactions.
4. To know and apply grammar correctly during Speaking and Writing situations especially in context with Presentations, Public Speaking, Report writing and Business Correspondence

Course Outcomes:

Students will be able to:

1. Apply speaking and writing skills in professional as well as social situations
2. Overcome Mother Tongue Influence and demonstrate neutral accent while exercising English
3. Apply communication skills for Presentations, Group Discussion and interpersonal interactions.
4. Apply grammar correctly during Speaking and Writing situations especially in context with Presentations, Public Speaking, Report writing and Business Correspondence

Unit 1: Communication and Communication Processes (04 hrs)

Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension. Listening : Importance of Listening, Types of Listening, Barriers to Listening.

Unit 2: Verbal & Non-verbal Communication (04 hrs)

Use of Language in Spoken Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Extempore , Elocution.

Unit 3: Study of Soundsin English (02 hrs)

Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English.

Unit 4:English Grammar (05 hrs)

Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors.

Unit 5: Writing Skills, Reading Skills & Listening Skills (04 hrs)

Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Technical Reports: Report Writing: Format, Structure and Types Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

Text book:

Mohd. Ashraf Rizvi, *Communication Skills for Engineers*, Tata McGraw Hill

Reference Books:

1. Sanjay Kumar, Pushp Lata, *Communication Skills*, Oxford University Press,2016
2. Meenakshi Raman, Sangeeta Sharma, *Communication Skills*, Oxford University Press,2017
3. Teri Kwal Gamble, Michael Gamble, *Communication Works*, Tata McGraw Hill Education, 2010
4. Anderson, Kenneth. Joan Maclean and Tossny Lynch. Study Speaking: A Course inSpoken
5. English for Academic Purposes. Cambridge: CUP, 2004.
6. Aswalthapa, K. *Organisational Behaviour*, Himalayan Publication, Mumbai(1991).
7. Atreya N and Guha, *Effective Credit Management*, MMC School of Management, Mumbai (1994).
8. Balan,K.R. and Rayudu C.S., *Effective Communication*, Beacon New Delhi(1996).
9. Bellare, Nirmala. *Reading Strategies*. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.
10. Bhasker, W.W.S & Prabhu, N. S.: *English through Reading*, Vols. 1 and 2. Macmillan, 1975.

11. Black, Sam. *Practical Public Relations*, E.L.B.S. London(1972).
12. Blass, Laurie, Kathy Block and Hannah Friesan. *Creating Meaning*. Oxford: OUP,2007.
13. Bovee Courtland,L and Thrill, John V. *Business Communication*, Today McGraw Hill, New York, Taxman Publication(1989).

Communication Skill Lab:

At least 10 experiments should be performed from the following list

1) How to introduce oneself?
2) Introduction to Phonemic symbols
3) Articulation of sounds in English with proper manner
4) Practice and exercises on articulation of sounds
5) Read Pronunciations/transcriptions from the dictionary
6) Practice and exercises on pronunciations of words
7) Introduction to stress and intonation
8) Rapid reading sessions
9) Know your friend
10) How to introduce yourself
11) Extempore
12) Group discussion
13) Participating in a debate
14) Presentation techniques
15) Interview techniques

BTES105/205 Energy and Environment Engineering 2 Credits

Course Objectives:

1. To identify conventional, non conventional energy sources.
2. To understand the power consuming and power developing devices for effective utilization and power consumption
3. To identify various sources of air, water pollution and its effects.
4. To understand noise, soil, thermal pollution and Identify solid, biomedical and hazardous waste.

Course Outcomes:

Students will be able to:

1. Identify conventional, non conventional energy sources.
2. Know and discuss power consuming and power developing devices for effective utilization and power consumption
3. Identify various sources of air, water pollution and its effects.
4. Know and discuss noise, soil, thermal pollution and Identify solid, biomedical and hazardous waste.

Unit 1: Conventional Power Generation: (4 hours)

Steam power station, Nuclear power plant – Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo electric and thermionic generators, Environmental aspects for selecting the sites and locations of power plants.

Unit 2: Renewable Power Generation: (4 hours)

Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Fuel cell, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantages and disadvantages.

Unit 3: Energy conservation (4 hours)

Scope for energy conservation and its benefits Energy conservation Principle– Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers., lighting techniques.

Unit 4: Air Pollution (4 hours)

Environment and Human health - Air pollution: sources- effects- control measures - Particulate emission, air quality standards, and measurement of air pollution.

Unit 5: Water Pollution (4 hours)

Water pollution- effects- control measures- Noise pollution –effects and control measures, Disposal of solid wastes, Bio-medical wastes-Thermal pollution – Soil pollution -Nuclear hazard.

Reference/Text Books:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, A Text book of Power System Engineering, Dhanpat Rai Publication.
2. Rai. G. D., Non Conventional Energy Sources, Khanna Publishers, Delhi,2006.
3. Rao S., Parulekar B.B., Energy Technology-Non conventional, Renewable And Conventional, Khanna Publishers, Delhi,2005.
4. Glynn Henry J., Gary W. Heinke, Environmental Science and Engineering, Pearson Education, Inc,2004.
5. J. M. Fowler, Energy and the Environment, McGraw-Hill, 2 nd Edition,1984.
6. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall,2003.

BTES106/206Basic Civil and Mechanical Engineering Audit

Course Objectives:

1. To identify various Civil Engineering materials and choose suitable material among various options.
2. To know and apply principles of surveying to solve engineering problem
3. To Identify various Civil Engineering structural components and select appropriate structural system among various options
4. To Explain and define various properties of basic thermodynamics, materials and manufacturing processes.
5. To know and discuss the working principle of various power consuming and power developing devices

Course Outcomes:

Students will be able to:

1. Identify various Civil Engineering materials and choose suitable material among various options.
2. Apply principles of surveying to solve engineering problem
3. Identify various Civil Engineering structural components and select appropriate structural system among various options
4. Explain and define various properties of basic thermodynamics, materials and manufacturing processes.
5. Know and discuss the working principle of various power consuming and power developing devices

Part I Basic Civil Engineering

Module 1: Introduction to civil engineering (4hrs)

Various Branches, role of civil engineer in various construction activities, basic engineering properties and uses of materials: earth, bricks, timber, stones, sand, aggregates, cement, mortar, concrete, steel, bitumen, glass, FRP, composite materials.

Module 2: Building Components & Building Planning (4 hrs)

Foundation and superstructure, functions of foundation, types of shallow and deep foundations, suitability in different situation, plinth, walls, lintels, beams, columns, slabs, roofs, staircases, floors, doors, windows, sills, Study of Building plans, ventilation, basics of plumbing and sanitation

Module3: Surveying **(4 hrs)**

Principles of survey, elements of distance and angular measurements, plotting of area, base line and offsets, introduction to Plane table surveying, introduction to leveling, concept of bench marks, reduced level, contours

Part II Basic Mechanical Engineering

Unit 1: Introduction to Mechanical Engineering: **(4 hrs)**

Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, IC Engines: Classification, Applications, Basic terminology, 2 and 4 stroke IC engine working principle, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, Nuclear power plant, Automobiles: Basic definitions and objectives

Unit 2: **(4 hrs)**

Design Basics, Machine and Mechanisms, Factor of safety, Engineering Materials: types and applications, basics of Fasteners Machining and Mach inability, Introduction to Lathe machine, Drilling machine, Milling machine, basics of machining processes such as turning, drilling and milling, Introduction to casting

Text Books

1. Anurag Kandya, “Elements of Civil Engineering”, Charotar Publishing,Anand
2. M. G. Shah, C. M. Kale, and S. Y. Patki, “Building Drawing”,Tata McGrawHill
3. Sushil Kumar, “Building Construction”, Standard PublishersDistributors
4. M. S. Palani Gamy, “Basic Civil Engineering”, Tata Mc-Graw Hill Publication
5. Kanetkar T. P. and Kulkarni S. V., “Surveying and Levelling”, Vols. I, II and III, Vidyarthi Gruh Prakashan,Pune
6. B. C. Punmia, “Surveying”, Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
7. G. K. Hiraskar, “Basic Civil Engineering”, Dhanpat RaiPublications
8. Gopi Satheesh, “Basic Civil Engineering”, PearsonEducation
9. P. K. Nag “Engineering Thermodynamics”, Tata McGraw Hill, New Delhi 3rd ed.2005
10. Ghosh, A K Malik, “Theory of Mechanisms and Machines”, Affiliated East West Press Pvt. Ltd. NewDelhi.
11. Serope Kalpakaji and Steven R Schimd “ Amanufacturing Engineering and Techology” Addision Wsley Laongman India 6th Edition2009
12. V. B. Bhandari, “ Deisgn of Machine Elements”, Tata McGraw Hill Publications, NewDelhi.

BTBS201Engineering Mathematics – II 4 Credits

Course Objectives:

1. To know and discuss the need and use of complex variables to find roots ,to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. To understand and solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.
3. To determine Fourier series representation of periodic functions over different intervals.
4. To Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. To know and apply the principles of vector integration to transform line integral to surface integral, surface to volume integral &vice versa using Green’s , Stoke’s and Gauss divergence theorems.

Course Outcomes:

Students will be able to:

1. Discuss the need and use of complex variables to find roots ,to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. Solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.
3. Determine Fourier series representation of periodic functions over different intervals.
4. Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. Apply the principles of vector integration to transform line integral to surface integral ,surface to volume integral &vice versa using Green's , Stoke's and Gauss divergence theorems.

Unit 1: Complex Numbers **[07 Hours]**

Definition and geometrical representation ; De-Moivre's theorem(without proof) ; Roots of complex numbers by using De-Moivre's theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complex quantities.

Unit 2: Ordinary Differential Equations of First Order and First Degree and Their Applications

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems.

Unit 3: Linear Differential Equations with Constant Coefficients **[07 Hours]**

Introductory remarks - complementary function, particular integral; Rules for finding complementary functions and particular integrals ; Method of variation of parameters ; Cauchy's homogeneous and Legendre's linear equations.

Unit 4: Fourier Series **[07 Hours]**

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion - Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions expansions of odd and even periodic functions ; Half-range series.

Unit 5: Vector Calculus **[07 Hours]**

Scalar and vector fields: Gradient , divergence and curl ; Solenoid and irrotational vector fields; Vector identities (statement without proofs) ; Green's lemma , Gauss' divergence theorem and Stokes' theorem (without proofs)

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledge ware,Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-II are to be conducted batch wise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

BTBS102/202Engineering Chemistry 4 Credits

Course Objectives:

1. To know the demonstration of knowledge of chemistry in technical fields.
2. To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
3. To understand and develop the importance of water in industrial and domestic usage.
4. To identify the concepts of Chemistry to lay the ground work for subsequent studies in various engineering fields.
5. To examine a fuel and suggest alternative fuels.

Course Outcomes:

Students will be able to:

1. Demonstrate knowledge of chemistry in technical fields.
2. Bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
3. Develop the importance of water in industrial and domestic usage.
4. Identify the concepts of Chemistry to lay the ground work for subsequent studies in various engineering fields.
5. Examine a fuel and suggest alternative fuels.

Unit 1: Water Treatment (07 Hours)

Introduction , hard and soft water, softening of water – Zeolite process, Ion exchange process, Hot Lime –Soda process, water characteristics- Hardness and its determination by EDTA method, Dissolve oxygen (DO) and its determination by Winkler's method.

Unit 2: Phase Rule (07 Hours)

Phase Rule, statement, Explanation of the terms – Phase, Components, Degrees of freedom. One component system – Water and Sulphur. Reduced phase rule equation, Two components alloy system-Phase diagram of Silver- Lead alloy system.

Unit3: Metallurgy (07 Hours)

Introduction, Occurrence of metals, types of ores, concentration of ores by physical methods- Crushing and Sizing, Froth- Flotation, Magnetic Separation, Gravity separation method. Chemical methods-Calcinations, Roasting, Reduction of Ore- by Pyrolysis, Chemical reductions, Electrolytic Refining of Metals.

Unit 4: Fuels and Lubricants (07 Hours)

Fuels: Introduction, classification of fuel, Calorific value of a fuel, characteristics of a good fuel, solid fuel- Coal , Various types of Coal, Analysis of coal- Proximate and Ultimate analysis, liquid fuel-Refining of Petroleum Lubricants: Introduction, classification of lubricants - Solid, Semi –solid and Liquid Lubricants , properties of lubricants ,Physical properties – Viscosity, Viscosity index, surface tension, Flash point and Fire point. Chemical properties – Acidity, Saponification.

Unit5: Electrochemistry (07 Hours)

Introduction - Basic concepts: Definition and units of Ohm's law, Specific resistance, Specific Conductance, Equivalent conductance, Molecular conductance, Method of conductance measurement by Wheatstone bridge method, Cell constant.

Debye- Hackle theory of strong electrolyte, Conduct metric titrations, Ostwald's theory of acid- base indicator, Quinonoid theory, Glass electrode.

Text books:

1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai & Sons, Delhi,1992.
2. Bhal &Tuli, Text book of Physical Chemistry (1995), S. Chand &Company, NewDelhi.
3. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, NewDelhi.
4. S. S. Dara, A textbook of Engineering Chemistry, McGraw-Hill Publication, NewDelhi.

Reference books:

1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, NewDelhi.

2. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers -2015.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi2014.
4. Atkins, Physical chemistry.

Engineering Chemistry Lab:

At least 10 experiments should be performed from the following list

1. Determination of hardness of water sample by E.D.T.A. method.
2. Determination of chloride content in water sample by precipitation titration method.
3. Determination of Viscosity of a given sample of liquid by using Ostwald's Viscometer.
4. Determination of Acid value of an Oil sample.
5. Conduct metric Titration (Acid Base titration).
6. Determination of dissolved oxygen present in given water sample by Iodometric method (Winkler's Method).
7. To determine alkalinity of water sample.
8. To determine the percentage of available Chlorine in bleaching powder.
9. To determine acidity of water sample.
10. To determine the surface tension of given liquid at room temperature by drop number method.
11. pH –metric Titration (Acid Base titration).
12. To determine calorific value of a fuel.
13. Determination of saponification value of an oil sample.
14. Experiment on water treatment by using ion exchange resins.
15. To find out P-T curve diagram of steam

BTES103/203Engineering Mechanics 3 Credits

Course Objectives:

1. To know and apply fundamental Laws of Engineering Mechanics
2. To know and apply Conditions of static equilibrium to analyze given force system
3. To compute Centre of gravity and Moment of Inertia of plane surfaces
4. To compute the motion characteristics of a body/particle for a Rectilinear and Curvilinear Motion
5. To know and discuss relation between force and motion characteristics

Course Outcomes:
Students will be able to:

1. Apply fundamental Laws of Engineering Mechanics
2. Apply Conditions of static equilibrium to analyze given force system
3. Compute Centre of gravity and Moment of Inertia of plane surfaces
4. Compute the motion characteristics of a body/particle for a Rectilinear and Curvilinear Motion
5. Know and discuss relation between force and motion characteristics

Module1: Basic Concepts (7Lectures)

Objectives of Engineering Analysis and Design, Idealization of Engineering Problems, Simplification of real 3D problems to 2-D and 1-D domain, Basis of Assumptions, types of supports, types of load, free body diagram, Laws of Motion, Fundamental principles, Resolution and composition of a forces, Resultant, couple, moment, Varignon's theorem, force systems, Centroid of composite shapes, moment of inertia of planer sections and radius of gyration

Module2: Equilibrium **(7 Lectures)**

Static equilibrium, analytical and graphical conditions of equilibrium, Lami's theorem, equilibrium of coplanar concurrent forces, coplanar non concurrent forces, parallel forces, beams reactions Simple trusses (plane and space), method of joints for plane trusses, method of sections for plane trusses Friction: Coulomb law, friction angles, wedge friction, sliding friction and rolling resistance

Module3:Kinematics **(7 Lectures)**

Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, relative motion, motion under gravity, study of motion diagrams, angular motion, tangential and radial acceleration, projectile motion, kinematics of rigid bodies, concept of instantaneous center of rotation, concept of relative velocity,

Module4:Kinetics **(6 Lectures)**

Mass moment of inertia, kinetics of particle, D'Alembert's principle:applications in linear motion, kinetics of rigid bodies, applications in translation, applications in fixed axisrotation

Module5: Work, Power, Energy **(6 Lectures)**

Principle of virtual work, virtual displacements for particle and rigid bodies, work done by a force, spring, potential energy, kinetic energy of linear motion and rotation, work energyequation, conservation of energy, power, impulse momentum principle, collision of elasticbodies.

Text Books

1. S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill,1995.
2. Tayal A. K., "Engineering Mechanics", Umesh Publications,2010.
3. Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2ndEdition.
4. Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw HillCompany Publication, 7th edition,1995.
5. Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourthedition, 2003.
6. McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, N.Delhi, Publication.
7. Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub.York.
8. Khurmi R. S., "Engineering Mechanics", S. Chand Publications, N.Delhi

Engineering Mechanics Lab:

At least 10 experiments should be performed from the following list

1. .Polygon law of coplanar forces
2. Bell crank lever.
3. Support reaction for beam.
4. Problems on beam reaction by graphics statics method
5. Simple / compound pendulum.
6. Inclined plane (to determine coefficient of friction).
7. Collision of elastic bodies (Law of conservation of momentum).
8. Moment of Inertia of fly wheel
9. Verification of law of Machine using Screw jack
10. Assignment based on graphics statics solutions
11. Any other innovative experiment relevant to Engineering Mechanics.
12. Centroid of irregular shaped bodies.
13. Verification of law of Machine using Worm and Worm Wheel
14. Verification of law of Machine using Single and Double Gear Crab.
15. Application of Spreadsheet Program for concepts like law of moments, beam reactions, problems in kinematics, etc

BTES104/204Computer Programming in C 2 Credits

Course Objectives:

1. To give a broad perspective about the uses of computers in engineering industry and C Programming.
2. To develop the basic concept of algorithm, algorithmic thinking and flowchart.
3. To apply the use of C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.
4. To make familiar the more advanced features of the C language.
5. To identify tasks in which the numerical techniques learned are applicable and apply them to write programs and hence use computers effectively to solve the task.

Course Outcomes:
Students will be able to:

1. Gain a broad perspective about the uses of computers in engineering industry and C Programming.
2. Develop the basic concept of algorithm, algorithmic thinking and flowchart.
3. Apply the use of C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.
4. Use the more advanced features of the C language.
5. Identify tasks in which the numerical techniques learned are applicable and apply them to write programs and hence use computers effectively to solve the task.

Unit 1: Process of programming: (4 Lectures)
Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms. (4 Lectures)

Unit 2: Types, Operators and Expressions: (4 Lectures)
Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

Unit 3: Control Flow: (4 Lectures)
Statements and Blocks. If-else, else-if switch Loops while and for, do-while break and continue go to and Labels. Functions and Program Structure: Basic of functions, functions returning non- integers external variables scope rules.

Unit 4: Arrays in C: (4 Lectures)
Initializing arrays, initializing character arrays, multidimensional arrays.

Unit 5: Structures C: (4 Lectures)
Basics of structures, structures and functions array so structures, Pointer in C. Pointers to integers, characters, floats, arrays, structures.

Special Note: <u>Topic of Pointers in C</u> is only for lab exercises and not for end semester examinations.

Reference/Text Books:

1. Brain W. Kernighan & Dennis Ritchie, The C Programming Language, Prentice Hall, 2nd Edition, 1988.
2. R. S. Bichkar, Programming with C, Orient Blackswan, 1st Edition,2012.
3. Herbert Schildit, C the Complete Reference, McGraw-Hill Publication,2000.
4. Balguruswamy, Programming in C,PHI.
5. Yashwant Kanitkar, Let Us C,PHI

Computer Programming in C Lab:

At least 10 experiments should be performed from the following list
1. Assignment on Flow Chart.
2. A Simple program to display a message “Hello world” on screen.
3. A Program to take input from user and display value entered by user on screen.
4. Basic example for performing different C Operations using operator. (With and without using scanf ()).
5. Basic Program on Operator. (Using scanf()).
a) Program to find and print area, perimeter and volume of geometric objects.
b) Program to check a number entered by user is Perfect number or not.
6. Program to find maximum and minimum between two numbers given by user using if-else and conditional Operators.
7. Program to swap two numbers.
8. Program to print square and factorial of an entered number using while loop.
9. Program to check a number is Palindrome number or not.
10. Program to check Armstrong number.
11. Program to check and generate prime numbers up to n.
12. Program to find GCD of two entered numbers.
13. Program to find maximum and minimum from n entered numbers.
14. Program to print alternate numbers from n entered numbers.
15. Program to search an element in an Array using linear and binary search.
16. Program to print entered numbers in ascending order using sorting.
17. Program to print addition, subtraction and multiplication of Matrices.
18. Program to find length of string. (With and without using library function).
19. Programs demonstrating use of Structures, Arrays of Structures and Structure containing arrays.
20. Programs demonstrating use of pointers to integers, floats, char, strings, structures and arrays.

BTES106/206Basic Electrical and Electronics Engineering Audit

Course Objectives:
1. To know and apply basic ideas and principles of electrical engineering.
2. To identify protection equipment and energy storage devices.
3. To differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. To acquire knowledge of digital electronics
5. To design simple combinational and sequential logic circuits.

Course Outcomes:
Students will be able to:
1. Apply basic ideas and principles of electrical engineering.
2. Identify protection equipment and energy storage devices.
3. Differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. Acquire knowledge of digital electronics
5. Design simple combinational and sequential logic circuits.

Unit 1: Elementary Electrical Concepts: [07 Hours]
Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources,

transmission, distribution and utilization,Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unityfactor.

Unit 2: Measurement of Electrical Quantities: [07 Hours]

Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium- ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit 3: Diodes and Circuits: [07 Hours]

The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for $I_{DC}V_{DC}$ V_{RMS}, I_{RMS}, Efficiency and RippleFactor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor InputFilter(Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED,Photodiode

Unit 4: Semiconductor Devices and Applications: [07 Hours]

Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.

Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-HillPublication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledgeware Mumbai, 2017.ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition,2011.
4. Boylstad, Electronics Devices and Circuits Theory, PearsonEducation.
5. Edward Hughes, Electrical Technology, PearsonEducation.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication,2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited,2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication,2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design &Technology,WalterC. Bosshart, McGraw-Hill Publication.
12. Note: Students are advised to use internet resources whenever required

BTES206L Workshop Practice

Teaching Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Instruction to Students:

Each student is required to maintain a „workshop diary" consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job.

List of Practical: (any six)

1. Wood sizing exercises in planning, marking, sawing, chiseling and grooving to make half lap joint and cross lapjoint.
2. A job involving cutting, filing to saw cut, filing all sides and faces, corner rounding, drilling and tapping on M. S.plates.
3. A job on use of plumbing tools and preparation of plumbing line involving fixing of water

tap and use of elbow, tee, union and coupling, etc.

4. Making a small parts using GI sheet involving development, marking, cutting, bending, brazing and soldering operations- i)Tray ii) Funnel and similar articles.
5. Exercise in Arc welding (MMAW) to make a square butt joint.
6. Exercise in Resistance (Spot) welding to make a lap joint.
7. Arousing power operated tools related to sheet metal work, Welding, Fitting, Plumbing, Carpentry and patternmaking.
8. A job on turning of a Mild Steel cylindrical job using center lathe.

Contents:

1. **Carpentry:** Technical Terms related to wood working, Types of wood, Joining materials, Types of joints - Mortise and Tenon, Dovetail, Half Lap, etc., Methods of preparation and applications, Wood working lathe, safety precautions.
2. **Welding:** Arc welding - welding joints, edge preparation, welding tools and equipment, Gas welding - types of flames, tools and equipment, Resistance welding - Spot welding, joint preparation, tools and equipment, safety precautions.
3. **Fitting and Plumbing:** Fitting operation like chipping, filing, right angle, marking, drilling, tapping etc., Fitting hand tools like vices, cold chisel, etc. Drilling machine and its operation, Different types of pipes, joints, taps, fixtures and accessories used in plumbing, safety precautions.
4. **Sheet Metal Work:** Simple development and cutting, bending, Beading, Flanging, Lancing and shearing of sheet metal, Sheet metal machines - Bending Machine, Guillotine shear, Sheet metal joints, Fluxes and their use.
5. **Machine shop**: Lathe machine, types of lathes, major parts, cutting tool, turning operations, safety precautions

R**eference/Text Books:**

1. K. C. John, Mechanical Workshop Practice, Prentice Hall Publication, New Delhi,2010.
Hazra and Chaudhary, Workshop Technology-I, Media promoters & Publisher private limited

Semester III

BTBS301 Engineering Mathematics-III 4 Credits

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetics and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:
On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: Laplace Transform 09 Hours

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform 09 Hours

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3:Fourier Transform 09 Hours

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications 09 Hours

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange‟s linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation (), and one dimensional wave equation

Unit 5: Functions of Complex Variables **09 Hours**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functionsinCartesianform;Cauchy‟sintegraltheorem;Cauchy‟sintegralformula;Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (VolIII) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
2. A Text Book of Engineering Mathematics by PeterO'Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , NewYork.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
   The minimum number of assignments should be eight covering all topics.

BTETC302 Electronic Devices and Circuits 4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce Static characteristics of ideal two terminal and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results.

Course Outcomes:

On completion of the course, students will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.
3. Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feeback amplifiers and oscillators..

UNIT – 1 Bipolar Junction Transistor: **07 Hours**

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier , Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier, Emitter follower, Cascaded Amplifier, Need for multistage amplifiers and suitability of CE, CC and CB configurations in multistage amplifiers.

UNIT – 2 Junction Field Effect Transistor and MOSFET **07 Hours**

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET, The FET as VVR.

MOSFET: Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p -MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT – 3 Power amplifiers: **07 Hours**

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, efficiency, calculation of power output, power dissipation, cross over distortion and its elimination methods, need of heat sink and its design.

UNIT – 4 Feedback amplifiers: **07 Hours**

Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt, Current series, Current shunt types of Negative feedback, Typical transistor circuits effects of Negative feedback on Input and Output impedance, Voltage and Current gains, Bandwidth, Noise and Distortion

UNIT – 5 Oscillators & Voltage Regulator Circuits **07 Hours**

Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, RC, Clapp, Wien Bridge, Colpitt, Hartley, Tuned LC, UJT, Relaxation Oscillators.

Transistor application: Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator

TEXT/REFERENCE BOOKS:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, “Electronics Devices & Circuits”, Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.

BTETC303 Digital Electronics 4 Credits

Course Objectives:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

On completion of the course, students will be able to:

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.

3. Design and implement hardware circuit to test performance and application.
4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT – 1 Combinational Logic Design: 07 Hours

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to - 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and De- multiplexers, Decoders.

UNIT – 2 Sequential Logic Design: 07 Hours

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops and Conversion of flip flops. Application of Flip- flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT – 3 State Machines: 07 Hours

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT – 4 Digital Logic Families: 07 Hours

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L and DCTL

UNIT – 5 Programmable Logic Devices, Semiconductor Memories and Introduction to VHDL: 07Hours

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM. Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India,2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd 2001 Edition.

BTES304 Electrical Machines and Instruments 4 Credits

Course Objectives:

1. Model and Analyze the performance of different types of DC machines
2. Learn the applications of DC generators
3. Analyze the performance of different types of DC motors
4. Analyze the performance of different types of Sensors and Transducers
5. Familiarize with the applications of DC machines
6. To prepare students to perform the analysis of any electromechanical system.

7. To empower students to understand the working of electrical equipment used in everyday life.

Course Outcomes:

On completion of the course, students will be able to:

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The skill to analyze the response of any electrical machine.
3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

UNIT – 1 DC Machines: 07 Hours

DC machines construction, working principle (motor & generator), EMF equation of DC Machine (motor and generator), Types and its characteristics of DC machines (motor and generator), back emf, starters of dc machine, Speed control of DC motor Breaking of DC motor, applications of DC machines (motor and generator).

UNIT – 2 Induction Motor and Synchronous Motor: 07 Hours

Induction Motor: Construction, working principle, types, torque equation, torque slip characteristics, power stages, losses and efficiency, starters speed control, breaking, applications.

Synchronous motor: Construction, working principle, starting methods, effect of load, hunting, V-curve, synchronous condenser, applications.

UNIT –3 Special Purpose Machines: 07 Hours

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

UNIT –4 Sensors and Transducers: 07 Hours

Classification selection of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types, interfacing techniques of transducers with microprocessor and controller.

UNIT – 5 Industrial Measurement and Industrial Applications: 07 Hours

Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm, object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.

TEXT/REFERENCE BOOKS:

1. A course in Electrical and Electronic Measurement and Instrumentation" by A. K. Sawhney (Publisher name: Dhanpat Rai&Co.)
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGrawHill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai andpublication
4. Instrumentation Devices System edition C. S. Rajan, G. R.sharma
5. AbhijitChakrabarti&SudiptaDebnath, “Electrical Machines”, Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGrawHill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, “Electrical Machinery”, Tata McGraw-hill Publication 6thEdition.
8. I.J Nagarath & D.P Kothari, “Electrical Machines”, Tata McGraw-hill Publication 4th Edition.
9. T. J. E. Miller, “Brushless permanent-magnet and reluctance motor drives”, Oxford University Press(1989).
10. Ned Mohan, “Electric Machines and Drives”: A first course,Wiley. B. L. Theraja, “Electrical technology”

volume 2, S.Chand.

Semester IV

BTETC401 Network Theory 4 Credits

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

On completion of the course, students will be able to:

1. Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze thesame.
2. Design passive filters and attenuators theoretically and practically. To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
3. Identify issues related to transmission of signals, analyze different RLC networks.
4. Find technology recognition for the benefit of the society.

UNIT – 1 Network Theorems: 07 Hours

Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin"s, Norton"s and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

UNIT – 2 Transient Analysis and Frequency Domain Analysis: 07 Hours

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

UNIT – 3 Laplace transform and its circuit applications: 07 Hours

Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response.

UNIT –4 Two Port Networks: 07 Hours

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

UNIT – 5 State Variable Analysis and RL & RC Network Synthesis: 07 Hours

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, “Engineering Circuit Analysis”, 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., “Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches”, Oxford University Press.2003.
3. M.E. Van Valkenburg, “Network Analysis”, 3rd ed., Pearson2006.

4. M.E. Van Valkenburg, "Network Synthesis," PHI2007.
5. Kuo, F.F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.2008.
6. D Roy Choudary, "Network and Systems" 1st edition, New Age International,1988
7. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill,1982.
8. Royal Signal Handbook on Line Communication.

BTETC402 Signals and Systems 4 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

UNIT – 1 Introduction to Signals and Systems: 07 Hours

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding, Sampling Theorem and reconstruction of sampled signal, Concept of aliasing, examples on under sampled and over sampled signals.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT – 2 Time domain representation of LTI System: 07 Hours
System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulse response.
UNIT – 3 Fourier Series: 07 Hours
Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties. **UNIT – 4 Fourier Transform: 07 Hours**
Fourier Transform (FT) representation of a periodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of band pass signals.
UNIT – 5 Laplace and Z-Transform: 07 Hours
Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI system analysis. Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z- transform, Z-transform for discrete time system LTI analysis.
TEXT/REFERENCE BOOKS:

1. Alan V. *Oppenheim*. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, WileyIndia.
4. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.
5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press,2007.
6. Peyton Peebles, “Probability, Random Variable, Random Processes”, 4th Edition, Tata McGraw Hill.
7. A. NagoorKanni “Signals and Systems”, 2nd edition, McGrawHill.
8. NPTEL video lectures on Signals andSystems.
9. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw Hill.2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th 2001 Ed., Pearson Education.

BTHM403 Basic Human Rights 3 Credits

Course Objectives:
1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:
1. Students will be able to understand the history of human rights.

2. Students will learn to respect others caste, religion, region and culture.
3. Students will be aware of their rights as Indian citizen.
4. Students will be able to understand the importance of groups and communities in the society.
5. Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

UNIT – 1

The Basic Concepts: - Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

UNIT – 2

Fundamental rights and economic programme. Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT – 3

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT – 4

Human rights in Indian constitution and law:-

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT – 5

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Reference books:

1. Shastry, T. S. N., *India and Human rights: Reflections*, Concept Publishing Company India (P Ltd.), 2005
2. Nirmal, C.J., *Human Rights in India: Historical, Social and Political Perspectives(Law in India)*, Oxford India.

BTBS404 Probability Theory and Random Processes 3 Credits

Course Objectives:

1. To develop basic of probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT – 1 Introduction to Probability: 07 Hours
Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes" rule and applications

UNIT – 2 Random variables: 07 Hours
Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation; independent,

UNIT – 3 Random vector and distributions: 07 Hours
Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector- space representation of random variables, linear independence, inner product, Schwarz Inequality, Moment- generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT – 4 Sequence of random variables 07 Hours
Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT – 5 Random process: 07 Hours
Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationary: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto-correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS:

1. T. Veerrajan, "Probability, Statistics and Random Processes", Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, DavidStirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John WilliamWoods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, PearsonEducation
5. A. Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBSPublishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, AcademicPress.

BTETPE405A Numerical Methods and Computer Programming 4 Credits

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in

research institutes.

2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

On completion of the course, students will be able to:

1. Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.
2. Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. Prepare them to write computer programs for the numerical computational techniques.
5. Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Understand procedure-oriented and object-oriented programming concepts.
7. Capable of writing C and C++ programs efficiently.

UNIT – 1 Introduction to Computational Methods and Errors: 07 Hours

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques. Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT – 2 Solutions of Transcendental / Polynomial Equations and System of Linear Equation: 07Hours

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT – 3 Interpolations and Polynomial Approximation: 07 Hours

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange‟sinterpolation polynomials, Spline interpolation, Least square approximation.

UNIT – 4 Numerical Integration and Differentiation: 07 Hours

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, RungeKutta $2^{nd}$and 4^{th} order, Stability analysis of above methods.

UNIT –5 Object Oriented Programming: 07 Hours

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors.

TEXT/REFERENCE BOOKS:

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rdedition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rdEdition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi,1996.
4. D. Ravichandran, "Programming with C++",TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2ndEdition
6. YeshwantKanetkar, "Let us C++, BPB Pub.", Delhi, 2002,4thEdition.
7. StroupstrupBjarne, "C++ Programming Language", Addison Wesley, 1997, 3rdEdition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai,1998.

BTETPE405B Data Compression & Encryption 4 Credits

Course Objectives:

1. The concept of security, types of attack experienced.
2. Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT – 1 Data Compression and Encryption: 07 Hours

Need for data compression, Lossy /lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT – 2 Statistical Methods and Dictionary Methods: 07 Hours

Statistical Methods: Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PP Mmethod.

Dictionary Methods: String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT – 3 Image Compression: 07 Hours

Lossless techniques of image compression, gray codes, two-dimensional image transform, Discrete cosine transform and its application in lossy image compression, quantization, Zig- Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT – 4 Audio Compression: 07 Hours

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT – 5 Conventional Encryption: 07 Hours

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS:

1. Data compression- David Solomon Springer Verlagpublication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmannpublication.
4. The data compression book- Mark Nelson BPBpublication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc., publications.

BTETPE405C Computer Organization and Architecture 4 Credits

Prerequisites: Digital Electronic Circuits.

Course Objectives:

1. To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
2. To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
3. Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
4. Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer working
3. analyze the performance of computers
4. know how computers are designed and built.

UNIT –1 Overview of computer organization: 07 Hours

Overview of computer organization – components and system buses; Concepts of assembly and machine language programs. Machine language program execution – instruction cycles, machine cycles and bus cycles. Overview of memory and I/O addressing; CPU organization – components and subsystems, register banks, internal bus structure, information flow;

UNIT – 2 Instruction set: 07 Hours

Instruction set – characteristics and functions, types of operation and operands. Addressing modes – various ways of addressing memory and input-output devices and their timing characteristics;

UNIT –3 CISC and RISC architectures: 07 Hours

CISC and RISC architectures – examples; ALU – flags, logical operations, fixed point number representations and arithmetic, floating point number representations and arithmetic, exceptions. Control Unit – how it operates, hardwired control unit, concepts of micro programs and micro programmed control unit;

UNIT –4 Memory: 07 Hours

Memory hierarchy – main memory – types and interfacing; Cache memory – its organizations and operations, levels of caches; Memory management module – paging and segmentation, virtual memory; Disk memory, RAIDs. Back-up memory.

UNIT – 5 Interrupts and interrupt structures and DMA controller: 07 Hours

Interrupts and interrupt structures – interrupt cycles, handling multiple simultaneous interrupts, programmable interrupt controllers; I/O interfacing and modes of I/O data transfer. Direct memory access – DMA controller; Instruction level parallelism – instruction pipelining, pipeline hazards; Concepts of multiprocessor systems; Examples will be drawn from real life RISC and CISC processors.

TEXT/REFERENCE BOOKS:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization," McGraw Hill, 2011.
2. D A Patterson and J L Hennessy, "Computer Architecture – A Quantitative Approach," Morgan Kaufmann,2011.
3. W Stallings, "Computer Organization and Architecture – Designing for Performance," Pearson,2013.
4. J. P. Hayes, "Computer Architecture and Organization," McGraw-Hill,1998.
5. D A Patterson and J L Hennessy, "Computer Organization and Design – The Hardware/Software Interface," ARM Edition, Morgan Kaufmann,2012.
6. S. Tannenbaum, "Structured Computer Organization," EEE Ed., Prentice Hall,2013.
7. Mano, M.M., "Computer System Architecture" 3rd Ed., Prentice-Hall of 2004India

BTETPE405D Introduction to MEMS 4 Credits

Course Objectives:

1. The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
2. This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
3. This will enable student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of Microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT – 1Introduction to MEMS: 07 Hours

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT –2 Control and Materials of MEMS: 07 Hours

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT – 3 Review of Basic MEMS fabrication modules: 07 Hours

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT –4 Micromachining: **07 Hours**

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT – 5 Mechanics of solids in MEMS/NEMS: **07 Hours**

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes"s law, Poisson effect,Linear Thermal Expansion, Bending, Energy methods. Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TEXT/REFERENCE BOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India,2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers,2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press,1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston,1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers,and Gyroscopes, Elsevier, New York,2000.

BTETPE405E Python Programming 4 Credits

Course Objectives:

1. Provide an understanding of the role computation can play in solving problems.
2. Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
3. Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes:

1. Experience with an interpreted Language.
2. To build software for real needs
3. Prior Introduction to testing software

UNIT –1Introduction: **07 Hours**

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT – 2 Types, Operators and Expressions: **07 Hours**

Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass.

Data Structures Lists – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions

UNIT – 3 Default Arguments: **07 Hours**

Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via

PIP, Using Python Packages.

UNIT – 4 Object-Oriented Programming OOP in Python: 07 Hours

Classes, self-variable‟, Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions.

UNIT – 5 Brief Tour of the Standard Library: 07 Hours

Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required? Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

TEXT/REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Think Python, Allen Downey, Green Tea Press
4. Core Python Programming, W. Chun, Pearson
5. Introduction to Python, Kenneth A. Lambert, Cengage.

Semester V

BTETC501 Electromagnetic Field Theory 4 Credits

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
3. To understand the boundary conditions for different materials/surfaces.
4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
5. To get the basics of microwave, transmission lines and antenna parameters.
6. Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

Unit -1 Mathematical Fundamentals and Static Electric Fields:

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density.

Unit -2 Steady Electric Currents and Static Magnetic Fields:

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, ContinuityEquationandKirchhoff‟sCurrentLaw,PowerDissipationandJoule'sLaw,Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

Unit -3 Time Varying Field &Maxwell's Equations

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

Unit -4 Transmission Lines:

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Unit -5 Electromagnetic Waves:

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Pointing theorem and vector.

TEXT/REFERENCE BOOKS

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India,2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall,1997.
4. David Cheng, "Electromagnetics", PrenticeHall.
5. Sadiku, "Elements of Electromagnetics",Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi,1999.
8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", WileyEastern.

BTETC502 Digital Signal Processing 4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems.
2. To understand the digital signal processing, sampling and aliasing.
3. To use and understand implementation of digital filters.
4. To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real-world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT – 1 DSP Preliminaries:

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

UNIT – 2 Discrete Fourier Transform:

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm

UNIT – 3 Z transform:

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

UNIT – 4 IIR Filter Design:

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Low pass filter)

UNIT – 5 FIR Filter Design and introduction to MDSP:

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form. Introduction to Multirate signal processing: Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter banks, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS:

1. S. K. Mitra, Digital Signal Processing: A computer-based approach,TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall,1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall,1992.
5. J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall,1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTETC503 Analog Communication 4Credits

Course Objectives:

1. To introduce the concepts of analog communication systems.
2. To equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
3. To understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase)

Course Outcomes:

On completion of the course, students will be able to:

1. Understand and identify the fundamental concepts and various components of analog communication systems.
2. Understand the concepts of modulation and demodulation techniques.
3. Design circuits to generate modulated and demodulated wave.
4. Equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
5. Understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase).
6. Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.
7. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

UNIT – 1 Introduction to Communication System

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation, sampling theorem and pulse analog modulation, multiplexing: TDM, FDM.

UNIT – 2 Amplitude Modulation

Introduction, Mathematical analysis and expression for AM, Modulation index, Frequency spectrum and bandwidth of AM, Power calculations, Generation of AM using nonlinear property, Low and high level modulation, Balance Modulator.Types of AM: DSB-FC, DSB-SC, SSB-SC, ISB and VSB, their generation methods and comparison.

UNIT – 3 Angle Modulation

Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct and indirect methods of FM generation, Pre emphasis and de-emphasis, Comparison of AM, FM and PM.

UNIT – 4 Radio Receivers and Demodulators

Introduction, Performances characteristic of receivers: Sensitivity, Selectivity, Fidelity, Image frequency and IFRR, Tracking and Double spotting, TRF, Super heterodyne receivers, RF amplifier, Local oscillator and mixer, IF amplifier, AGC.

UNIT – 5 AM and FM Detectors and noise

AM Detectors: Envelop detector and practical diode detector. FM Detectors: Slope detector, phase discriminator and ratio detector. Noise: Introduction, Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.

TEXT/REFERENCE BOOKS:

1. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4th Edition.
2. Anokh Singh, "Principles of communication engineering"S.Chand
3. Roddy&Coolen, "Electronic communication"PHI
4. Taub & Schilling "Principles of communication systems" Tata Mc GrawHill
5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.
6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.
7. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill NewDelhi-2008.

BTETPE504A Analog Circuits 4 Credits

Course Objectives:

1. To understand characteristics of IC and Op-Amp and identify the internal structure.
2. To introduce various manufacturing techniques.
3. To study various op-amp parameters and their significance for Op-Amp.
4. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
5. To analyze and identify linear and nonlinear applications of Op-Amp.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand the characteristics of IC and Op-Amp and identify the internal structure.
2. Understand and identify various manufacturing techniques.
3. Derive and determine various performances-based parameters and their significance forOp-Amp.
4. Verify parameters after exciting IC by any stated method.
5. Analyze and identify the closed loop stability considerations and I/O limitations.
6. Analyze and identify linear and nonlinear applications of Op-Amp.

7. Understand and verify results (levels of V & I) with hardware implementation.
8. Implement hardwired circuit to test performance and application for what it is being designed.

UNIT – 1 Introduction to operational Amplifiers:
Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots.
Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.
UNIT – 2 linear applications of operational amplifiers:
Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.
UNIT – 3 Non-linear applications of operational amplifiers:
Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.

UNIT –4 Oscillators:
Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square- triangle oscillators
UNIT – 5 Analog and Digital interface circuits:
Analog and Digital interface circuits: Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc., V-F, I-V and V-I converter.

TEXT/REFERENCE BOOKS:

1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York,1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill,1988.
3. P.Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.
4. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, EditionIV.
5. Paul R. Gray & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rdEdition.
6. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
7. Salivahanan and KanchanaBhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India2008.
8. George Clayton and Steve Winder, “Operational Amplifiers”, 5th EditionNewnes.
9. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGrawHill.
10. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

BTETPE504B Embedded System Design 4 Credits

Prerequisites: Good understanding of the concepts of basic electronics such as circuits, logic gates, Number systems, fundamentals of C programming

Course Objectives:

1. To understand Embedded Design Specification.
2. Understand the ARM Design Philosophy
3. Understand the ARM architecture and the pipeline structure
4. Understand the instruction sets of ARM Processor

Course Outcomes:

1. The student will study ARM Processor based Embedded System design
2. The student will be able to do programming in Embedded programming in C,C++
3. The student will understand Linux operating system and device driver
4. The student will demonstrate the knowledge of Real Time Operating System

UNIT – 1 INTRODUCTION TO EMBEDDED SYSTEMS

Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip. Embedded system design and development: Embedded system design, Life-Cycle Models, Problem solving, The design process, Requirement identification, Formulation of requirements specification. Development tools. System design specifications: System specifications versus system requirements, Partitioning and decomposing a system, Functional design, Architectural design, Functional model versus architectural model, Prototyping, Other considerations, Archiving the project

UNIT – 2 ARM PROCESSOR FUNDAMENTALS AND INSTRUCTION SET

Registers, Current Program Status Registers(CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM-Thumb Interworking, other branch instructions, Data Processing instructions, Stack instructions, Single -register load -store instruction, multiple -register load- store instruction, software interrupt instructions

UNIT – 3 EMBEDDED LINUX

Embedded Linux: System architecture, BIOS versus boot-loader, Booting the kernel, Kernel initialization, Space initialization, Boot loaders, Storage considerations

Linux kernel construction: Kernel build system, Obtaining a custom Linux kernel, File systems, Device drivers, Kernel configuration.

UNIT – 4 COMMUNICATION PROTOCOLS

Use of communication protocols in embedded systems, Serial communication basics, synchronous/asynchronous interfaces, UART Protocol, I2C protocol, SPI protocol, USB Protocol, SPI protocol, CAN Protocol, 1 Wire protocol

UNIT – 5 REAL TIME OPERATING SYSTEMS

RTOS fundamentals, Multitasking in small embedded systems, Memory management, Task management, Queue management, software timer management, interrupt management, resource management, event, Task notification

TEXT BOOKS:

1. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Pearson EducationPublication
2. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", WILEY Student EditionPublication
3. Andrew N. Sloss, "ARM system developer's guide", Morgan Kaufmannelsevier.com
4. Tammy Noergaard, "Embedded Systems Architecture", ElsevierPublication
5. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Pearson EducationPublication
6. "Real -Time System Design and analysis -Tools for the practioner " By Phillip A Laplante (WileyPublication)

REFERENCE BOOKS:

1. Mastering the Free RTOS Real time Kernel A hands on tutorial guide by Richard Barry
2. The Free RTOS Reference manual API functions and configuration options

BTETPE504C Digital System Design 4 Credits

Course Objectives:

1. The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
2. The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
3. This course will explore the basic concepts of digital electronics.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

UNIT – 1 Introduction to VHDL: 07 Hours

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, and VHDL data types, concurrent and sequential statements.

UNIT –2 Subprograms: 07 Hours

Subprograms – Functions, Procedures, attributes, generic, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration.

UNIT – 3 Combinational logic circuit design and VHDL implementation: 7 Hours

Combinational logic circuit design and VHDL implementation of following circuits – first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, multiplier, divider.

UNIT – 4 Synchronous sequential circuits design: 07 Hours

Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT – 5 Asynchronous sequential circuit designs: 07Hours

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like meta stability, synchronizers, clock skew and timing considerations, Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD (Xilinx / Altera)

TEXT/REFERENCE BOOKS:

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition,2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition,2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI,2nd edition, 2006.
4. D.V. Hall, “ Digital Circuits and Systems” , Tata McGraw Hill,1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.
6. Bhasker J, “VHDL Primer” Prentice-Hall of India Pvt. Ltd 3rdEdition.

BTETPE504D Automotive Electronics 4 Credits

Course Objectives:

1. To understand the concepts of Automotive Electronics and it‟s evolution and trends automotive systems & subsystems overview.
2. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
3. To understand, design and model various automotive control systems using Model based development technique.
4. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
5. To describe various communication systems, wired and wireless protocols used in vehicle
6. To understand Safety standards, advances in towards autonomous vehicles.
7. To understand vehicle on board and off board diagnostics.

Course Outcomes:

1. At the end of the course, students will be able to:
2. Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today’s automotive industry.
3. Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.
4. Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the subsystems.
5. Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

UNIT – 1 Automotive Fundamentals Overview: **07 Hours**
Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System , Starter Battery –Operating principle

UNIT – 2 The Basics of Electronic Engine Control: **07 Hours**
Motivation for Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

UNIT – 3 Automotive Sensors and Actuators: **07 Hours**
Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor, Solenoid, Fuel Injector, EGR Actuator, Ignition System

UNIT – 4 Digital Engine Control Systems: **07 Hours**
Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics

UNIT – 5 Vehicle Motion Control: **07 Hours**
Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System(ABS)

TEXT/REFERENCE BOOKS:

1. William B. Ribbens, ―Understanding Automotive Electronics‖, 6th Edition, Elsevier Publishing.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc.,2007.

BTETPE504E Mixed Signal Design 4 Credits

Course Objectives:

1. To introduce how to handle the practical situations where mixed signal analysis is required.
2. To analyze and handle the inter-conversions between signals.
3. To introduce the students how to design systems involving mixed signals.

Course Outcomes:

1. At the end of the course, students will demonstrate the ability to:
2. Understand the practical situations where mixed signal analysis is required.
3. Analyze and handle the inter-conversions between signals.
4. Design systems involving mixed signals.

UNIT – 1 Analog and discrete-time signal processing: **07 Hours**
Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters. Basics of analog discrete-time filters and Z-transform.

UNIT – 2 Switched-capacitor filters: **07 Hours**
Switched-capacitor filters- Non idealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

UNIT – 3 Basics of data converters: **07 Hours**
Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT – 4 Mixed-signal data transmission: **07 Hours**
Mixed-signal layout, Interconnects and data transmission, Voltage-mode signaling and data transmission, Current-mode signaling and data transmission.

UNIT –5 PLLs: **07 Hours**
Introduction to frequency synthesizers and synchronization, Basics of PLL, Analog PLLs, Digital PLLs, DLLs.

TEXT/REFERENCE BOOKS:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint2008.
2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill,2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition,IEEE press, and2008.
4. Rudy V. de Plassche, CMOS Integrated ADCs and DACs, Springer, Indian edition,2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill,1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (ornew era editions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETPE504F Power Electronics 4Credits

Course Objectives:

1. To introduce students to different power devices to study their construction,characteristics and turning on circuits.
2. To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
3. To studythe different motor drives, various power electronics applications like UPS,SMPS, etc. and some protection circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design-controlled rectifier, DC to DC converters, DC to AC inverters.
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT – 1 Characteristic of Semiconductor Power Devices: **07 Hours**
Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics,

operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

UNIT – 2 Controlled Rectifiers: 07 Hours

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT –3 Choppers: 07 Hours

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

UNIT – 4Single-phaseinverters: 07 Hours

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

UNIT – 5 Switching Power Supplies and Applications: 07 Hours

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, load resonant converter - series loaded half bridge DC-DC converter. **Applications:** Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive. P M Stepper Motor Drive.

TEXT/REFERENCE BOOKS:

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand&Co.
4. V. R. Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE,USA.

BTETOE505A Control System Engineering 4 Credits

Course Objectives:

1. To introduce the elements of control system and their modeling using various Techniques.
2. To introduce methods for analyzing the time response, the frequency response and thestability of systems.
3. To introduce the concept of root locus, Bode plots, Nyquist plots.
4. To introduce the state variable analysis method.
5. To introduce concepts of PID controllers and digital and control systems.

6. To introduce concepts programmable logic controller.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the modeling of linear-time-invariant systems using transfer function andstate-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

UNIT – 1 Introduction to control problem: 07 Hours
Industrial Control examples, Mathematical models of physical systems, Control hardware andtheir models, Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.
UNIT – 2 Time Response Analysis and Stability Analysis: 07 Hours
Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response. Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram.
UNIT – 3 Frequency-response analysis: 07 Hours
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.
UNIT – 4 Introduction to Controller Design: 07 Hours
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and Bode Plot.
UNIT – 5 State variable Analysis: 07 Hours
Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigen values and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete- time systems.

TEXT/REFERENCE BOOKS:
1. N. J. Nagrath and M. Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition,2009.
2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall ofIndia, 7thEdition,1995.
3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition,2012.
4. Schaum"sOutlineSeries,“FeedbackandControlSystems”TataMcGraw-Hill,2007.
5. John J. D"Azzo& Constantine H. Houpis, “Linear Control System Analysis andDesign”, Tata McGraw-Hill, Inc.,1995.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

BTETOE505B Artificial Intelligence and Machine Learning 4 Credits

Course Objectives:

1. Apply AI techniques to solve the given problems.
2. Implement trivial AI techniques on relatively large system
3. Explain uncertainty and Problem-solving techniques.
4. Compare various learning techniques.

Course Outcomes:

1. This course will enable students to
2. Identify the AI based problems.
3. Apply techniques to solve the AI problems.
4. Define learning and explain various logic inferences.
5. Discuss different learning techniques.

UNIT –1 Introduction: 07 Hours

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behavior: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

UNIT – 2 Search Techniques: 07 Hours

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real- world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyon Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT – 3 Game Playing: 07 Hours

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT – 4 Logic and inference: 07 Hours

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, **Backtracking** Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, Planning Graphs.

UNIT –5 Learning: 07 Hours

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation- Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

TEXT/REFERENCE BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. IIIEdition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGrawHill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemSolving", Fourth Edition, Pearson Education,2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford University Press-2015

BTETOE505C Optimization Techniques 4 Credits

Course Objectives:

1. Introduction to optimization techniques using both linear and non-linear programming
2. The focus of the course is on convex optimization though some techniques will becovered for non-convex function optimization.

Course Outcomes:

After completion of this course students will be able to

1. Cast engineering minima/maxima problems into optimization framework.
2. Learn efficient computational procedures to solve optimization problems.

UNIT – 1 Introduction and Basic Concepts **07 Hours**

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques.

UNIT – 2 Optimization using Calculus: **07 Hours**

Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples.

UNIT – 3 Linear Programming:

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar‟s projective scaling method.

UNIT – 4 Dynamic Programming:

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

UNIT – 5 Integer Programming and Advanced Topics in Optimization **07 Hours**

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples. Advanced Topics in Optimization: Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search.

TEXT/REFERENCE BOOKS:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International, New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hallof India Pvt. Ltd., New Delhi,1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

BTETOE505D Project Management and Operation Research 4 Credits

Course Objectives:

1. To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
2. To introduce students to framework those are useful for diagnosing problems involving human behavior.
3. To enable the students apply mathematical, computational and communication skillsneeded for the practical utility of Operations Research.
4. To teach students about networking, inventory, queuing, decision and replacement models.
5. To introduce students to research methods and current trends in Operations Research.

Course Outcomes:

Student will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
2. Solve transportation problems using various OR methods.
3. Illustrate the use of OR tools in a wide range of applications in industries.
4. Analyze various OR models like Inventory, Queuing, Replacement, Simulation, Decision etc and apply them for optimization.
5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT– 1 **07 Hours**

Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases and applications. Optimization models and their classifications

Linear Models: Formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP. .

UNIT– 2 **07 Hours**

Replacement Models:

Replacement of items that deteriorates with time, Value of money changing with time and not changing with time, Optimum replacement policy , Individual and group replacement.**Introduction:** Solution methods, Variations of the assignment problem, Traveling salesman problem

UNIT– 3 **07 Hours**

Transportation Problems: Introduction, Methods for finding initial solution, Test of optimality, Maximization and Minimization Transportation problems, Transshipment problems, Degeneracy. **Queuing Theory:** Queuing models – queuing systems and structures – notation –parameter –single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.**Game Theory:** Introduction, Two-person zero-sum game, Minimum and Maximum principle, Saddle point, Methods for solving game problems with pure and mixed strategies

UNIT– 4 **07 Hours**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models, Processing 'n' jobs on 'm' machines. Processing of two jobs on machines with each having different processing order.**Inventory Models:** Types of Inventory- EOQ –ERL- Deterministic inventory problems, Price breaks, stochastic inventory problems, Selective inventory control techniques..

UNIT– 5 **07 Hours**

Network Models: Introduction to PERT/CPM & its importance in project management. Concept & construction of network diagrams. Critical path & project duration, floats, network crashing, optimum project duration & cost, PERT activity, time estimate, probability of completion of a project on or before specified time.

TEXT/REFERENCE BOOKS:

1. Wayne. L. Winston, Operations research applications and algorithms, Thomson learning,4thedition 2007.
2. Taha H.A, “Operation Research”, Pearson Education sixth edition, 2003
3. S. D. Sharma, “Introduction to Operations Research”, Discovery Publishing House, New Delhi
4. P. K. Gupta, D. S. Hira, “Operations Research”, S Chand and Co. Ltd., ISBN 81-219-0281-9.

BTETOE505E **Augmented, Virtual and Mixed Reality** **4 Credits**

Course Objectives:

1. An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. To develop 3D virtual environments.
2. To develop 3D interaction techniques and immersive virtual reality applications.

UNIT – 1 Introduction & Geometry of Virtual Worlds: **07 Hours**

Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view Geometric modeling, transforming models, Matrix algebra and 2D rotations, 3D rotations andyaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, View port transform

UNIT – 2 Light and Optics: 07 Hours

Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

UNIT – 3 Visual Physiology &Visual Perception: 07 Hours

Photoreceptors, Sufficient resolution for VR, light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision, Depth perception, Depth Perception, Motion perception, Frame rates and displays, Frame rates and displays

UNIT – 4 Tracking Systems &Visual Rendering: 07 Hours

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

UNIT – 5 Audio & Interfaces and Augmented Reality: 07 Hours

Physics and physiology, auditory perception, Auditory localization, Rendering, Specializationand display, combining other senses, Interfaces, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.Augmented Reality: System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

TEXT/REFERENCE BOOKS:

1. http://msl.cs.uiuc.edu/vr/
2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition,2009.
3. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of ComputerGraphics, A K Peters/CRC Press; 3 edition,2009.

BTETOE505F Open Source Technologies 4 Credits

Course Objectives:

1. Understand the difference between open source softwareand commercial software.
2. Familiarity with Linux operating system.
3. Understanding and development of web applications using open source web technologies

Course Outcomes:

Student will be able to

1. Define the development model of Open source software, and tell about the open-source licensing
2. Understand the difference between open source software and commercial software.
3. To get acquainted with Linux OS by understanding configuration and troubleshooting of LinuxOperating System.
4. Identify, install and implementation of open source technologies.

UNIT– 1 Fundamentals of Open Source Technology 07 Hours

History of Open Source Software, Introduction – Need and Advantage of Open-Source Software, Open Source Movement- Open Source Licensing Certification, Comparing OSS with other

Software-OSS Licenses.

UNIT– 2 Introduction to Open source operating system - Linux OS 07 Hours

Introduction & types of OS, Interfaces of OS: CLI, GUI, Brief history of Linux, Architecture of Linux, Features of Linux, Difference between Linux and other OS, Linux Distributions, Boot process & run levels, Major application areas of Linux..

UNIT– 3 Linux Basics Usage 07 Hours

User & password management & Logging into the system, GNOME and KDE desktop environment, Basic desktop operations, Text editors: vi and gedit, File system, File system architecture, File types, File attributes, File naming conventions, Shell as interpreter, Types of shell, Command line, Command syntax, Running commands and getting help, Basic commands, File-directory handling commands, Locating Files, File access permissions

UNIT– 4 Open Source Operating System (SHELL PROGRAMMING): 07 Hours

Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Handling signals, creating functions, working sed and gawk, working with web using shell script: Downloading web page, Converting Web page content to a text file, parsing data, working URL.

UNIT– 5 Open Source Database And Application: 07 Hours

MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. **PHP MySQL Application Development:** Connecting to MySQL with PHP, Inserting data with PHP, Retrieving data with PHP.

TEXT/REFERENCE BOOKS:

1. Linux the complete reference' by Richard Mathews, McGraw Hill Publication. Sixth Edition, 2008
2. Linux with Operating System Concepts' by Richard Fox, CRC Press Publication. Second Edition ,2006
3. PHP6 and MySQL Bible by Steve Suehring and Joyce Park Wiley-India, New Delhi 2000.

SEMESTER-VI

BTETC601 Antennas and Wave Propagation 4Credit

Course Objectives:

1. To understand the applications of electromagnetic engineering.
2. To formulate and solve the Helmholtz wave equation and solve it for Uniform PlaneWave.
3. To analyze and understand the Uniform plane wave propagation invarious media.
4. To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communicationsystem.

UNIT – 1 Wave Propagation: 07 Hours

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT – 2 Antenna Fundamentals and Wire Antennas: 07 Hours

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.Wire Antennas: Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, andfinite length dipole half wave length dipole, small circular loop antenna. Complete Analyticaltreatment of all these elements.

UNIT – 3 Antenna Arrays: 07 Hours

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, non-uniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, YagiUda Antenna Array.

UNIT – 4 Concepts of Smart Antennas: 07 Hours

Introduction, Smart Antenna Analogy, Cellular Radio System Evolution, benefits and drawbacks of smart antennas, fixed weight beam forming basics, Antenna beam forming

UNIT – 5 Antennas and Applications: 07 Hours

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Micro strip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS:

1. C. A. Balanis, "Antenna Theory - Analysis and Design",JohnWiley.

2. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford UniversityPress.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd
4. Edition, the McGraw Hill Companies.
5. K. D. Prasad, “Antenna & Wave Propagation”, Satya Prakashan, NewDelhi.
6. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill,2010.
7. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

BTETC602 **Digital Communication** **4 Credits**

Course Objectives:

1. To understand the building blocks of digital communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a digital communication system.
4. To analyze error performance of a digital communication system in presence ofnoise and other interferences.
5. To understand concept of spread spectrum communication system.

Course Outcomes:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digitalcommunication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

UNIT – 1 Digital Transmission of Analog Signal: **07 Hours**

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speech synthesis.

UNIT – 2 Baseband Digital Transmissions: **07 Hours**

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter- symbol interference, Equalization.

UNIT – 3 Random Processes: **07 Hours**

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT – 4 Baseband Receivers: **07 Hours**

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT – 5 Pass band Digital Transmission & Spread Spectrum Techniques: **07 Hours**

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non- coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.**Spread Spectrum Techniques:** Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS:

1. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, FourthEdition.
2. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, “A First Course in Digital Communication”, Cambridge University Press.
4. B P Lathi, Zhi Ding “Modern Analog and Digital Communication System”, Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications” Second Edition, Pearson Education.
6. Taub, Schilling, “Principles of Communication System”, Fourth Edition, McGrawHill.
7. P RamkrishnaRao, Digital Communication, Mc Graw Hill Publication.

BTETPE603A Microprocessors and Microcontrollers 4 Credits

Course Objectives:

1. Objective of this course is to introduce to the students the fundamentals ofmicroprocessor and Microcontrollers.
2. After learning Microprocessors and Microcontrollers course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
3. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
4. The students will get acquainted with recent trends in microprocessor like pipelining, cache memories.
5. To understand the applications of Microprocessors and Microcontrollers.
6. To learn interfacing of real-world input and output devices.
7. The learner can microcontroller design-based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.

Course Outcomes:

1. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
2. Students get ability to interface mechanical system to function in multidisciplinarysystem like in robotics, Automobiles.
3. Students can identify and formulate control and monitoring systems usingmicroprocessors.
4. Learn use of hardware and software tools.
5. Develop interfacing to real world devices.
6. Graduates will be able to design real time controllers using microcontroller-basedsystem.
7. Learn importance of microcontroller in designing embedded application.

UNIT– 1 **07Hours**

CISC and RISC Processor Architectures. Harvard and Von Neumann memory architectures. Introduction to 8085 Microprocessor based System: Architecture, Pin Description. Addressing modes. Instruction set and assembler directives. Timing Diagram.

UNIT– 2 **07 Hours**

Introduction to 8085 Assembly language programming. Programming examples using Data Transfer, Arithmetic, Logical, Branching and control instructions. Stacks and subroutine related programs. Serial data transfer. Interrupts.

UNIT– 3 **07 Hours**

Introduction to 8051 Microcontroller based System: Architecture, Pin Description, Internal Memory Organization. Addressing modes. Instruction set and assembler directives. Assembly Language Programming examples. I/O port structure and programming. Embedded C Programming with I/O port programming examples.

UNIT– 4 **07Hours**

Introduction to 8051 Timers. Timer programming in assembly and C. Introduction to 8051 serial communication. Serial Programming in assembly and C. Introduction to 8051 interrupts. Interrupt Programming in assembly and C.

UNIT– 5 **07Hours**

Interfacing of 8255, 8254, 8259 with 8085 microprocessor. External memory interfacing with8085 microprocessor and 8051 microcontroller. Interfacing of LED, 7 Segment display, LCD, Keypad, ADC, DAC, DC Motor, Stepper Motor, Temperature sensors, Motion detectors, Relay, Buzzer, Opto-isolators with 8051microcontroller.

TEXT/REFERENCE BOOKS:

1. Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition,1992.
2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
3. M. A. Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearsonedu.
4. Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing,Cengage Learning, Jan2011.
5. David Calcutt, 8051 microcontrollers: Applications based introduction,Elsevier.
6. Udayashankara V., MallikarjunaSwamy, 8051 microcontroller,TMH.
7. K. J. Ayala, 8051 microcontroller, Cenage (Thomson)

BTETPE603B **CMOS Design** **4 Credits**

Course Objectives:

1. Model the behaviour of a MOS Transistor
2. Design combinational and sequential circuits using CMOSgates.
3. Analyze SRAM cell and memoryarrays.
4. To develop an understanding of design different CMOS circuits using various logicfamilies along with their circuitlayout.
5. To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Identify the sources of power dissipation in a CMOS circuit.
3. Analyze SRAM cell and memory arrays
4. Use tools for VLSI IC design.

UNIT– 1 **07 Hours**

MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Fabrication, Packaging, and Testing, MOS transistor Theory, Long Channel I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics

UNIT– 2 **07 Hours**

CMOS Processing Technology, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Technology-Related CAD Issues, Manufacturing Issues, Circuit Simulation, A SPICE Tutorial, Device Models, Device Characterization, Circuit Characterization, Interconnect Simulation. Combinational Circuit Design, Circuit Families, Silicon-On- Insulator Circuit Design, Sub Threshold Circuit Design. Sequential Circuit Design, Circuit Design of Latches and Flip- Flops, Static Sequencing Element Methodology, Sequencing Dynamic Circuits, Synchronizers, Wave Pipelining

UNIT– 3 **07 Hours**

Power, Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures, Robustness, Variability, Reliability, Scaling, Statistical Analysis of Variability, Variation-Tolerant Design. Delay, Transient Response, RCDelay Model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding, Shifters, Multiplication

UNIT– 4 **07 Hours**

Array Subsystems, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays, Robust Memory Design, Special- Purpose Subsystems.

UNIT– 5 **07 Hours**

Packaging and Cooling, Power Distribution, Clocks, PLLs and DLLs, I/O, High-Speed Links, Random Circuits, Design Methodology and Tools, Testing, Debugging, and Verification.

TEXT/REFERENCE BOOKS:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India,2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley,1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India,1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill,2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley,1985.

BTETPE603C **Nano Electronics** **4 Credits**

Course Objectives:

1. To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
2. Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to designthe recently developing VLSI applications.
3. This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
4. Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
5. The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in makingnano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in makingnano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT – 1 Overview Nano Technology and Basics of Quantum Mechanics: 07 Hours

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.**Basics of Quantum Mechanics:** Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones

UNIT – 2 MOS Scaling theory: 07 Hours

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT – 3 Nano electronics Semiconductor devices: 07 Hours

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

UNIT – 4 Properties of Nano devices: 07 Hours

Vertical transistors, Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

UNIT – 5 Characterization techniques for Nano materials: 07 Hours

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self-assembly.

TEXT/REFERENCE BOOKS:
1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced ElectronicMaterial and Novel Devices), Wiley-VCH,2003.
3. K.E. Drexler, Nanosystems, Wiley,1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press,1998.

BTETPE603D Advanced Digital Signal Processing 4 Credits

Course Objectives:
1. This Multirate Signal Processing course covers advanced techniques for the design of digital filters, which are essential components in almost every digital signal processing system, as well as cyclostationary signals, so important to the understanding of modulation systems.
2. The course then moves on to treat multi-rate systems and presents multi-rate processingof both deterministic and random signals, culminating in a full case study exercise.
3. To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
4. To analyze the effects of interpolation and decimation on random signals.
5. To design interpolation and decimation filters to agiven specification.

Course Outcomes:
After successfully completing the course students will have:
1. Ability to understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.
2. Able to explain how the multirate implementation of ADC and DAC converters works.
3. Able to describe basic sampling rate conversion algorithms.
4. Able to draw and describe different kinds of interpolator and decimator.
5. Able to analyze how the interpolated FIR filter works.
6. Able to do sampling rate conversion.

UNIT – 1 Fundamental of Multirate Systems: 07 Hours
Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Multiage implementation, Some application of multirate systems, Special filter and filter banks.
UNIT – 2 Maximally Decimaled Filter Banks: 07Hours
Introduction, Errors created in the QMF bank, A simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Tranmultiplexer.
UNIT – 3 Paranitary Perfect Reconstruction Filter Banks: 07 Hours
Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel para unitary QMF lattice, M - channel FIR paraunitary filter banks, Transform coding and LOT.
UNIT – 4 Linear Phase and Cosine Modulated Filter Banks: 07 Hours

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formalsynthesisoflinearphaseFIRPRQMFLattice.PseudoQMFbanks,Designofthe Pseudo QMF bank, Efficient poly phase structure, Cosine modulated perfect reconstruction system.

UNIT – 5 The Wavelet Transform and its Relation to Multirate Filter Banks: 07 Hours

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis. Multidimensional, Multivariable and Lossless Systems: Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals. Review of discrete time multi-input multi-output LTI System, Para UNITary and lossless system.

TEXT/REFERENCE BOOKS:

1. P. P. Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, MultirateSystem and FilterBanks.
2. N. J. Fliege , John Wiley & Sons, Multirate Digital SignalProcessing.
3. RaghuveerRao, AjitBopardikar, Pearson Education Asia, Wavelet TransformsIntroduction to Theory andApplication.
4. C. Sidney Burrus ,R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

BTETPE603E Information Theory and Coding 4Credits

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.
2. To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
3. To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy.
2. Understand Shannon‟s theorem for coding.
3. Calculation of channel capacity.
4. Apply coding techniques.

UNIT – 1 Theory of Probability and Random Processes: 07Hours

Concept of probability, random variables, random process, power spectral density of a random process, probability models, statistical averages, central limit theorem, correlation, linear mean square estimation.

UNIT – 2 Noise in Communication Systems: 07 Hours

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT – 3InformationTheory: 07 Hours

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT – 4 Error Correcting Codes and Markov sources: 07 Hours

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolution codes, ARQ
Markov sources: Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels

UNIT – 5 Speech Coding: 07 Hours

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

TEXT/REFERENCE BOOKS:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; OxfordPublication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New AgeInternational.
3. nd
4. Taub, Schilling, Principles of CommunicationEngineering(2 Edition), TMH.
5. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Interscience.
6. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital;TMH.
7. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2^{nd}Edition), Pearson India.
8. N. Abramson, Information and Coding, McGraw Hill,1963.
9. M. Mansurpur, Introduction to Information Theory, McGraw Hill,1987.

BTETPE603F VLSI Signal Processing 4 Credits

Course Objectives:

1. Introduce students to the fundamentals of VLSI signal processing and expose them to examples of applications.
2. Design and optimize VLSI architectures for basic DSP algorithms.
3. Design and optimize VLSI architectures for basic DSP algorithms.

Course Outcomes:

1. Understand VLSI design methodology for signal processing systems.
2. Be familiar with VLSI algorithms and architectures for DSP.

UNIT– 1 07 Hours

Pipelining and Parallel Processing: Introduction, Pipelining of FIR Digital Filters, Parallel Processing. Pipelining and Parallel Processing for Low Power. Retiming: Introduction, Definition and Properties, Solving System of Inequalities, Retiming Techniques.

UNIT– 2 07 Hours

Unfolding: Introduction an Algorithms for Unfolding, Properties of Unfolding, Critical Path, Unfolding and Retiming Application of Unfolding.

UNIT– 3 07 Hours

Folding: Introduction to Folding Transformation, Register Minimization Techniques, Register Minimization in Folded Architectures, Folding in Multirate Systems.

UNIT– 4 07 Hours

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations Containing Delays.

UNIT– 5 **07 Hours**

Fast Convolution: Introduction, Cook, Toom Algorithm, Winogard Algorithm, Iterated Convolution, Cyclic Convolution Design of Fast Convolution Algorithm by Inspection

TEXT/REFERENCE BOOKS:

1. Keshab K. Parhi. VLSI Digital Signal ProcessingSystems, Wiley-Inter Sciences,1999.
2. Mohammed Ismail, Terri, Fiez, Analog VLSI Signal and Information Processing,McGraw Hill, 1994.
3. Kung. S.Y., H.J. While house T.Kailath, VLSI and Modern singal processing, Prentice Hall,1985.
4. Jose E. France, YannisTsividls, Design of Analog Digital VLSI Circuits for Telecommunications andSignal ProcessingPrentice Hall, 1994.

BTETPE603G VLSI Design & Technology 4 Credits

Course Objectives:

1. To study HDL based design approach.
2. To learn digital CMOS logic design.
3. To nurture students with CMOS analog circuit designs.
4. To realize importance of testability in logic circuit design.
5. To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications

UNIT – 1 VHDL Modeling: **07 Hours**

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benchesusing text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

UNIT – 2PLDArchitectures: **07 Hours**

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLDArchitecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

UNIT – 3 SoC & Interconnect: **07 Hours**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

UNIT – 4 Digital CMOS Circuits: **07 Hours**

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logicalefforts.

UNIT – 5 Analog CMOS Design and Testability: 07 Hours

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier and Operational amplifier.Testability: Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS:

1. Charles H. Roth, "Digital systems design using VHDL",PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.
3. Allen Holberg, "Analog CMOS Design", Oxford University Press.
4. NeilH. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication.

BTETOE604A IoT and Industry4.0 4 Credits

Course Objectives:

1. Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors,communication,and Computational processing. Technologies such as Cyber Physical Systems (CPS)
2. Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.
3. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Outcomes:

1. Understand the drivers and enablers of Industry4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0world
4. Appreciate the power of Cloud Computing in a networked economy.
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

UNIT – 1 Introduction and Industry4.0: 07 Hours

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Cyber security in Industry4.0

UNIT – 2 Basics of Industrial IoT and Introduction: 07 Hours

Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and RefereceArchiterture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

UNIT – 3 Industrial IoT-Layers: 07 Hours

Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III., Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

UNIT – 4 Industrial IoT: Big Data Analytics and Software Defined Networks: 07 Hours

Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT – 5 Industrial IoT-Application Domains: 07 Hours

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Case study - I : Milk Processing and Packaging Industries Case study - II: Manufacturing Industries - Part ICase study - III : Manufacturing Industries - Part II Case study - IV : Student Projects - Part I Case study - V : Student Projects - Part IICase study - VI : Virtual Reality Lab Case study - VII : Steel Technology Lab

TEXT/REFERENCE BOOKS:

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist(Apress)
2. “Industrial Internet of Things: Cyber manufacturing Systems”by Sabina Jeschke,Christian Brecher, Houbing Song, Danda B. Rawat(Springer)
3. Research papers.

BTETOE604B Deep Learning 4Credits

Pre-Requisites: Machine Learning

Course Objectives:

1. The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolution neural networks.

Course Outcomes:

2. After successfully completing the course, students will be able to
3. Understand the fundamentals of neural networks as well as some advanced topics such as recurrent neural network.
4. Understand convolution neural networks.

UNIT –1 Basics: 07 Hours

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perception, Perceptron Learning Algorithm, Linear reparability. Convergence theorem for Perception Learning Algorithm.

UNIT – 2 Feed forward Networks: 07 Hours
Multilayer Perception, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, auto encoders.

UNIT – 3 Deep Neural Networks and Better Training of Neural Networks: 07 Hours
Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training. Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT – 4 Recurrent Neural Networks and Convolution Neural Networks: 07 Hours
Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs Convolution Neural Networks: LeNet, AlexNet.

UNIT – 5 Generative models, recent trends and Applications: 07 Hours
Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.
Recent trends: Variation Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

TEXT/REFERENCE BOOKS:

1. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press,2016.
2. Neural Networks: A Systematic Introduction, Raúl Rojas,1996
3. Pattern Recognition and Machine Learning, Christopher Bishop,2007

BTETOE604C Computer Network 4

Credits Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming
4. To provide a WLAN measurement idea.

Course Outcomes:

1. To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.
5. To be familiar with network tools and network programming.
6. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
7. For a given problem related TCP/IP protocol developed the network programming.

8. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

UNIT – 1 Physical Layer: **07 Hours**

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT – 2 Data Link Layer: **07 Hours**

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT– 3 Wireless LANS & Virtual Circuit Networks and Network Layer: **07 Hours**

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, connecting devicesand Virtual LANS: Connecting devices, Virtual LANS.Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – 4Transport Layer: **07Hours**

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT – 5ApplicationLayer: **07Hours**

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TEXT/REFERENCE BOOKS:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan,McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, TataMcGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice HallIndia.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New InternationalEdition.
5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall ofIndia.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

BTETOE604D Industrial Drives and Control 4

Credits**Course Objectives:**

1. To expose the students to the Engineering fundamentals of various Drives and its control, Dynamic operation and their Applications.

Course Outcomes:

2. At the end of the course, students will demonstrate the ability to gain an ability to design and conduct performance experiments, as well as to identify, formulate and solve drives related problems.

UNIT – 1 Electrical Drives: 07 Hours

Introduction &Dynamics Introduction, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives, Fundamental Torque equations, Speed Torque conventions and Multi-quadrant Operation, Equivalent values of Drive Parameter, Measurement of Moment of Inertia, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy-Loss in Transient Operations, Steady State Stability, Load Equalization.

UNIT – 2 Selection of Motor Power Rating and Control of Electrical Drives: 07 Hours

Thermal Model of Motor for Heating and Cooling, Classes of Motor Rating, Determinationof Motor Rating. Control of Electrical Drives: Modes of Operation, Speed Control, Drive Classification, and Closed loop Control of Drives

UNIT – 3 DC Drives: 07 Hours

Review of Speed Torque relations for Shunt, Series and Separately excited Motors, Review of Starting, Braking (Regenerative, Dynamic, Plugging), Review of Speed control, Controlled rectifier fed DC drives (separately excited only): Single phase fully-controlled Rectifier, Single phase Half controlled Rectifier, Three phase fully-controlled Rectifier, Three phase Half- controlled Rectifier, Dual Converter Control, Chopper Control – Motoring and Braking of separately excited and Series Motor. (No numerical from this module).

UNIT – 4 AC Drives: 07 Hours

Induction Motor drives, Review of Speed-Torque relations, Review of Starting methods, Braking (Regenerative, Plugging and AC dynamic braking), Transient Analysis, Speed Control: Stator voltage control, Variable frequency control from voltage source, Static Rotor Resistance control, Slip Power Recovery - Static Scherbius Drive, Review of d-q model of Induction Motor, Principle of Vector Control, Block diagram of Direct Vector Control Scheme, Comparison of Scalar control and Vector control, Basic Principle of Direct Torque Control (block diagram) of induction motor. Introduction to Synchronous Motor Variable Speed drives.

UNIT – 5 Special Motor Drives: 07Hours

Stepper Motor drives- Types, Torque vs. Stepping rate characteristics, Drive circuits, Introduction to Switched reluctance motor drives and Brushless DC motor drives.

TEXT/REFERENCE BOOKS:

3. Fundamentals of Electrical Drives by G. K. Dubey, NarosaPublication
4. A First Course on Electrical Drives by S. K. Pillai, New AgeInternational.
5. Electrical Drives: Concepts and Applications by VedamSubramanyam,T.M.H
6. Modern Power Electronics and AC Drives by B. K. Bose, Prentice HallPTR
7. Special Electrical Machines by E.G. Janardanan,PHI
8. Electric Motor Drives: Modeling, Analysis and Control by Krishnan. R,PHI
9. Power Electronics by Joseph Vithayathil, Tata McGrawHill
10. Power Semiconductor Controlled Drives by G. K. Dubey, Prentice HallInternational.

BTETOE604E Robotics Design 4Credits

Course Objectives:

1. To prepare students with basics of robotics
2. To familiarize students with kinematics & dynamics of robots

3. To familiarize students with path & Trajectory planning of robots
4. To familiarize students with robot vision

Course Outcomes:

1. At the end of the course, students will demonstrate the ability to:
2. Describe kinematics and dynamics of stationary and mobile robots
3. Describe trajectory planning for robots.
4. Implement trajectory generation and path planning various algorithms
5. Work in interdisciplinary projects.

UNIT – 1 Fundamentals of Robotics: 07 Hours

Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications.

UNIT – 2 Forward & Inverse Kinematics of Robots: 07 Hours

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation**,** Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Casestudies

UNIT – 3 Velocity Kinematics & Dynamics and Robot Motion Planning: 07 Hours

Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. Dynamic Analysis of Forces: Lagrangian mechanics, Newton Euler formulation, Dynamic equations of robots, Transformation offorces and moment between coordinate frames.**Robot Motion Planning:** Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug

UNIT – 4 Potential Functions andVisibilityGraphs: 07 Hour

Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods

UNIT – 5 Trajectory planning and Robot Vision: 07 Hours

Trajectory planning: Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories. Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.

TEXT/REFERENCE BOOKS:

1. Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of India
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition,2011
3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion – Theory, Algorithms and Implementations”, Prentice-Hall of India, 2005.
4. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd.,2006
5. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India,2009
6. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition,2013.
7. Mikell P. Groover et.al,” Industrial Robots-Technology, Programming & applications”, McGraw Hill, New York, 2008

BTETOE604F **Patents and IPR** **4Credits**

Course Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative proceduresrelating to IPR in India as well as abroad.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
2. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT –1 Patents: **07 Hours**

Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models

UNIT – 2 Patent Rights: **07 Hours**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – 3 Overview of Intellectual Property: **07 Hours**

Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad,

UNIT – 4 New Developments in IPR: **07 Hours**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

UNIT – 5 Case studies: **07 Hours**

Case studies related to patents and IPR

TEXT/REFERENCE BOOKS:

1. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition,2011
2. Mayall, “Industrial Design”, McGraw Hill,1992
3. Niebel , “Product Design”, McGraw Hill,1974.
4. Asimov, “Introduction to Design”, Prentice Hall,1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”,2016.
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand,2008

BTETOE604G Acoustic Engineering 4 Credits

Course Objectives:

1. The learner develops a basic understanding of audio production equipment andsoftware.
2. The Learner develops a basic understanding sound and acoustics
3. Learners will become proficient with an industry standard DAW user interface andrelated peripheral technology
4. Learners will demonstrate project management skills.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. understanding of audio production
2. basic understanding sound and acoustics
3. learners will come to know about Radiation and diffraction of acoustic, Cavities and waveguides, Resonators and filters

UNIT – 1 Fundamentals of Acoustics: 07 Hours

Equation of state, Equation of continuity , Euler"s equation , Linearized wave equation , Speed of sound in fluids , Harmonic plane waves , Energy density , Acoustic intensity , Specific acoustic impedance, Spherical waves , Decibel scales

UNIT – 2 Transmission and reflection: 07 Hours

Transmission from one fluid to another - normal incidence , Transmission through a fluid layer - normal incidence , Transmission from one fluid to another - oblique incidence , Transmission through a fluid layer - oblique incidence , Reflection at a solid surface – normal incidence , Reflection at a solid surface – oblique incidence

UNIT – 3 Radiation and diffraction: 07 Hours

Pulsating sphere , Acoustic reciprocity , Simple sources , Acoustic dipoles , Acoustic line source , Directivity and beam patterns , Plane circular piston , Near field and far field , Acoustic radiation impedance , Phased arrays

UNIT – 4 Cavities and waveguides: 07 Hours

Resonance in pipes , Open-ended pipes , Standing waves , Absorption in pipes , Pipes with drivers

UNIT – 5 Resonators and filters: 07 Hours

Helmoltz resonator, Acoustic impedance (radiation impedance and mechanical impedance), Waves in a pipe , Acoustic filters

TEXT/REFERENCEBOOKS:

1. Kinsler and Frey, „Fundamentals of Acoustics", 4thedition

BTHM605 Employability & Skill Development 3 Credits

Course Objectives:

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successfulin a profession.

4. To expose the students to leadership and team-building skills.

Course Outcomes:

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT – 1 Soft Skills & Communication basics: 07 Hours

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT – 2 07 Hours

Interpersonal Skills: Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, negotiation, avoiding Stress. **Commercial Awareness:** Professional etiquettes and manners, Global negotiating and Persuading, Integrity. Global trends and statistics about civil engineering businesses.

UNIT – 3 Grammar and Comprehension: 07 Hours

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT – 4 Skills for interviews: 07 Hours

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluatedin group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT – 5 Problem Solving Techniques: 07 Hours

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chandpublications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chandpublications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & SonsLtd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", KoganPage.
5. Eugene Ehrlich, Daniel Murphy, "Schaum‟s Outline of English Grammar", McGrawHills.
6. David F. Beer, David A. McMurrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

Semester VII

BTETC701 Microwave Engineering 4 Credits

Course Objectives:

1. To lay the foundation for microwave engineering.
2. To understand the applications of microwave engineering.
3. Carryout the microwave network analysis.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes.
4. Understand the working principles of all the solid-state devices.
5. Choose a suitable microwave tube and solid-state device for a particular application.
6. Carry out the microwave network analysis.
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

UNIT – 1 Transmission Lines and Waveguides: 10 Hours

RF and Microwave transmission Lines, Standing Waves, General Analysis of Time Harmonic waves, Introduction to coaxial line, Equivalent circuit parameters of Transmission Lines, Smith Chart, Single stub and Double stub matching, Microwave Frequency bands. General solution for TEM, TE and TM waves, Rectangular waveguide, Circular waveguide, Wave guide parameters, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT – 2 Microwave Network Theory and Passive Devices: 07 Hours

Introduction Properties of Z and Y matrices for reciprocal Networks, Scattering or S Metric representation of Multiport Network, Microwave Passive Components. Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix Scattering Matrix: -Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Related problems.

UNIT – 3 Microwave Tubes: 10 Hours

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation. O type tubes Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications. Slow wave devices Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

UNIT – 4 Measurement devices and Microwave Measurements: 07 Hours

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S- parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

UNIT – 5 Microwave Strip Lines Network Analysis and Microwave Hazards: 07 Hours

Strip lines: Structural details and applications of Strip lines, Micro strip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line. Hazards: Hazards of Electromagnetic Radiation, Radiation Hazard Levels for Personnel, Radiation Hazard Limits and Radiation Protection.

TEXT/REFERENCE BOOKS:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd,2010
2. Microwave Devices and circuits- Liao / PearsonEducation
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition, McGraw- Hill Education Pvt. Ltd.,2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn,2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn,2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTETPE702A Digital Image Processing 4Credits

Course Objectives:

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. Review the fundamental concepts of digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Categories various compression techniques.
4. Interpret image segmentation and representation techniques.

UNIT –1 Introduction: 07 Hours

Introduction to Digital Image Processing & Applications, Image Digitalization, Sampling, Quantization, Signal Reconstruction from Samples: Convolution Concept, Signal Reconstruction from Image using convolution, Basic Relationship Between Pixels: Relationship of Adjacency and Connected Components Labeling, Basic Transform: Translation, Rotation, Scaling, Image Formation

UNIT – 2 Image Transformation: 07 Hours

Image Geometry, Stereo Imaging Model, Interpolation and Re-sampling, Interpolation Techniques, Separable Transformation, Basis Images, Fourier transformation, Properties of FT, Rotation Invariance Property, DCT and Walsh Transform, Hadamard Transformation, KL- transform

UNIT – 3 Image Enhancement and morphological image processing: 07 Hours

Dilation, Erosion, Opening, Closing, Hit-miss transformation, Thinning, Thickening, Point Processing Techniques, Contrast Stretching Operation, Histogram Equalization, Histogram Implementation, Mask Processing Techniques: Linear smoothing filter, median filter, sharpening filter, Unsharp masking, High boost filter, first order derivative operator, Frequency Domain Processing Techniques: Smoothening (Ideal low pass filter, Butterworth LPF), Sharpening filters: (Ideal high pass filter, Butterworth HPF), Laplacianmask

UNIT – 4 Image Restoration and colour image processing: 07 Hours

Image restoration techniques: Inverse filtering, minimum mean square error (wiener) filtering, constrained least square filter, difference between image enhancement and image restoration, Image formation process, Estimation of degradation Model: by observation, by experimentation, Mathematical modelling, Primary and Secondary colours, colour characteristics, chromaticity diagram, RGB colour model, HIS colour model, conversion from one model to another, Pseudo color image processing

UNIT – 5 Image Segmentation and Object Recognition 07 Hours

Different approaches for image segmentation: discontinuity based (point, line and edge detection) and region based, global thresholding, local thresholding, Adaptive thresholding, Edge detection: Roberts operator, prewitt operator, sobel operator, Laplacian operator, linking of edge points: local processing and global processing (Hough transform), region based segmentation: region growing technique, region merging and splitting technique, object recognition.

TEXT/REFERENCE BOOKS:

1. Rafael C. Gonzalez and Woods, "Digital Image Processing", Addison Wesley,1998
2. K. Jain, "Digital Image Processing", PHI, New Delhi, 1997
3. Pratt W.K., "Digital Image Processing", 2nd Edition, John Wiley, New York,2001
4. Edward R. Dougherty, "Random Processes for Image and Signal Processing",PHI-2001

BTETPE702B RF Circuit Design 4 Credits

Course Objectives:

1. To study RF issues related to active and passive components.
2. To study circuit design aspects at RF
3. To learn design and modeling of circuits at RF.

Course Outcomes:

UNIT – 2 Bandwidth Estimation: 07 Hours

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC τs, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

UNIT –3 High Frequency Amplifier Design: 07 Hours

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni lateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations, Stabilization methods.

UNIT –4 Low Noise Amplifier Design: 07 Hours

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

UNIT –5 Oscillators and Mixers: 07 Hours

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS.

Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.
Mixers: Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non-Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

TEXT/REFERENCE BOOKS:

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design Theory and Applications”, Pearson Education.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, “Devices modeling for analog and RF COMS circuits design”, John Wiley publication.
4. Calvin Plett, “Radio frequency Integrated Circuits Design”, Artech house.

BTETPE702C Satellite Communication 4 Credits

Course Objectives:

1. To provide students with good depth of knowledge in radar and Satellite communication.
2. Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA,FDMA.
3. This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo- stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT – 1 Basic Principles and Earth Station: 07 Hours

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems. **Earth Station:** Introduction, earth station subsystem, different types of earth stations.

UNIT – 2Satellite Orbits: 07 Hours

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

UNIT – 3 Satellite Construction (Space Segment): 07 Hours

Introduction; attitude and orbit control system; Telemetry Tracking and command; Power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

UNIT – 4 Satellite Links: 07 Hours

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

UNIT – 5 The Space Segment Access and Utilization: 07 Hours

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods. **The Role and Application of Satellite Communication** Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS:

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley &Sons.
2. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed.2001.
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice- Hall, Inc.,NJ.
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc.NY.
5. Robert Gagliardi, "Satellite Communication" , CBSPublication.
6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley and Sons.

BTETPE702D Fiber Optic Communication 4 Credits

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
5. Understand the properties of optical fiber that affect the performance of a communication link.
6. Understand basic optical amplifier operation and its effect on signal power and noise in the system.
7. Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

1. At the end of the course, students will demonstrate the ability to:
2. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
3. Understand the properties of the optical fibers and optical components.
4. Understand operation of lasers, LEDs, and detectors.
5. Analyze system performance of optical communication systems.
6. Design optical networks and understand non-linear effects in optical fibers.

UNIT –1 Introduction: 07 Hours

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

UNIT –2 Types of optical fibers: 07 Hours
Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.
UNIT – 3 Optical sources: 07 Hours
LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsively, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties
UNIT – 4 Optical switches and Optical amplifiers: 07 Hours
Coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers: EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.
UNIT – 5 Non linear effects in fiber optic links: 07 Hours
Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solution based communication.
TEXT/REFERENCE BOOKS:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag,1975.
3. J. Gowar, Optical communication systems, Prentice Hall India,1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press,1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed.1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York,1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

BTETPE702E Bio-medical Signal Processing 4 Credits

Course Objectives:
1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in bio signals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signal problems.

Course Outcomes:
After successfully completing the course students will be able to:
1. The student will be able to model a biomedical system
2. The student will be able to understand various methods of acquiring bio signals.
3. The student will be able to understand various sources of bio signal distortions and its Remedial techniques
4. The students will be able to analyze ECG and EEG signal with characteristic feature points.
5. The student will have a basic understanding of diagnosing bio-signals and classifying them.

UNIT – 1 Introduction to Biomedical Signals: 07 Hours
ECG, EEG, EMG, ENG etc. Event related potentials Biomedical Signal Analysis- Computer Aided Diagnosis. Concurrent, coupled and correlated processes - illustration with case studies. Noise Filtering: Random noise structured noise and physiological interference- noise and artifacts in ECG.

UNIT – 2 Time domain filters and Frequency domain Filters: 07 Hours
Principles of adaptive filters- Winer Filtering- Steepest Descent algorithms- Widrow Hopf Least mean square adaptive algorithms- Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electro surgery.

UNIT – 3 Events Detection: 07 Hours
Detection of P, QRS and T waves in ECG- EEG rhythms- Correlation and coherence analysis of EEG channels- Detection of EEG spike and wave complexes- Homomorphism filtering. Analysis of event related potential – Morphological analysis of ECG waves- Envelope extraction and analysis- Analysis of activity: zero crossing rates.

UNIT – 4 Fourier Spectrum, Estimation of power spectral density and Modeling of Biomedical systems: 07Hours
Moments and spectral power ratio. Power Cestrum- Complex Cestrum Biomedical applications of Cepstrum analysis. Modeling of Biomedical systems: Point processes- Parametric system modeling- All-pole, pole zero modeling, electromechanical models of signal generation. Analysis of non-stationary signals: Characterization- Fixed segmentation- Short Time Fourier Transform- Adaptive segmentation Adaptive filters for segmentation- RLS and Lattice Filter.

UNIT – 5 Pattern classification and diagnostic decision: 07 Hours
Supervised and unsupervised pattern classification Probabilistic models and statistical decisions- Logistic regression analysis- training and test steps neural networks- Measures of diagnostic accuracy and cost- Reliability of classifiers and decisions. Application: Normal versus Ectopic ECG beats- Detection of Knee Joint cartilage pathology.

TEXT/REFERENCE BOOKS:

1. Rangaraj M. Rangayyan, “Biomedical Signal Analysis: A case study Approach”, Wiley Interscience2002.24.
2. D. C. Reddy, “Biomedical Signal Processing: Principles and techniques”, Tata McGrawHill, NewDelhi,2005.
3. MetinAkay, “Biomedical Signal Processing”, Academic press,Inc.
4. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley,2001.
5. Sornmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier.
6. Semmlow, Marcel Dekker “Biosignal and Biomedical Image Processing”,2004.
7. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier,2005.

BTETPE702F Principles of Modern Radar Engineering 4 Credits

Course Objectives:

1. To list basic terminology, principles and concepts related to the modern RADAR systems and operation
2. To describe theory of operation of a simple RADAR including RADAR range equation, waveform design, Doppler effect, resolution, coverage and multipath
3. To explain how RADAR works and compare different type of RADAR system functionality, and configurations along with associated applications
4. To discuss principles, procedures, techniques and evolution of RADAR technology

5. To sketch a high-level architecture of a simple RADAR system covering components and subsystems including transmitters, receivers, antennas, clutter and noise, detection, signal processing modules
6. To provide detection, identification, and classification of objects/targets using different RADAR systems
7. To understanding environmental and terrain effects on RADAR operations RADAR countermeasures target probability of detection and probability of false alarm.

Course Outcomes:

1. Demonstrate an understanding of the factors affecting the radar performance using Radar Range Equation.
2. Analyze the principle of FM-CW radar and apply it in FM- CW Altimeter.
3. Differentiate between a MTI Radar and a Pulse Doppler Radar based on their working principle.
4. Demonstrate an understanding of the importance of Matched Filter Receivers in Radars.
5. Familiarize with the different types of Radar Displays and their application in real time scenario
6. Know the suitable measurement methodologies to characterize and verify the performance of radar systems
7. Design radar systems and to undertake measurements to characterize and verify the performance of radar systems

UNIT– 1 **07 Hours**

Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, Pulsed Radar Principles.

UNIT– 2 **07 Hours**

Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, Tracking Radar, Angular resolution, Mono pulse Technique.

UNIT– 3 **07 Hours**

Detection Theory: Match Filtering, Radar Ambiguity Function, Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging

UNIT– 4 **07 Hours**

Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models, Ground Penetrating Radar for close sensing

UNIT– 5 **07 Hours**

Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles

TEXT/REFERENCE BOOKS:

1. Introduction to Radar Systems, M.I. Skolnik, 3rdEdition, Tata Mcgraw hill edition,2001
2. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press,2013
3. Monopulse Principles and Techniques, S.M.sherman and D.K.Barton, 2ndEdition,Artech house, 2011
4. Fundamentals of Radar Signal Processing, M.A.Richards, TMH,2005
5. Ground Penetrating Radar: Theory and Applications, Ed: H.M. Jolt, Elsevier,2009
6. Microwave Imaging, M.Pastorino, John Wiley,2010

BTETOE703A Wireless Sensor Networks — 4 Credits

Course Objectives:
1. To introduce the emerging research areas in the field of wireless sensor networks
2. To understand different protocols and there uses in WSN.

Course Outcomes:
At the end of the course the students will be able to
1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

UNIT –1 Introduction: 07 Hours
Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT –2 Networks: 07 Hours
Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT –3 Protocols: 07 Hours
Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B- MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT – 4 Dissemination protocol: 07 Hours
Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT –5 Design Principles for WSNs: 07 Hours
Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.
Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS:

1. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", By John Wiley & Sons Publications,2011.
2. SabrieSoloman, "Sensors Handbook" by McGraw Hill publication.2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", ElsevierPublications,2004
4. KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Interscience
5. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009.

BTETOE703B Block Chain Technology 4 Credits

UNIT –1 Introduction to Block chain: 07 Hours
History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, and Privacy.

UNIT – 2 Block chain Architecture and Design and Consensus: 07 Hours
Basic crypto primitives: Hash, Signature, Hash chain to Block chain, Basic consensus mechanisms. Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects

of Block chain consensus protocols, Permission Block chains: Design goals, Consensus protocols for Permission Block chains

UNIT – 3 Hyper ledger Fabric: 07 Hours

Hyper ledger Fabric I: Decomposing the consensus process, Hyper ledger fabric components, Chain code Design and Implementation

Hyper ledger Fabric II: Beyond Chain code: fabric SDK and Front End, Hyper ledger composer tool

UNIT – 4 Use Cases: 07 Hours

Use case I: Block chain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance.

Use case II: Block chain in tradesupply chain: Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc

Use case III: Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system social welfare systems.

UNIT – 5 Block chain Cryptography Privacy and Security on Block chain: 07 Hours

Research aspects I: Scalability of Block chain consensus protocols, Case Study "Various recent works on scalability,

Research aspects II: Secure cryptographic protocols on Block chain, Case Study "Secured Multi-party Computation, Block chain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bit coin, Hyper ledger, Ethereal and more.

TEXT/REFERENCE BOOKS:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa,O'Reilly
3. Hyperledger Fabric -https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

BTETOE703C Cyber Security 4 Credits

Course Objectives:

1. For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
2. The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still more complicated
3. To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

Course Outcomes:

Students should be able to understand:

1. The difference between threat, risk, attack and vulnerability.
2. How threats materialize into attacks.
3. Where to find information about threats, vulnerabilities and attacks.
4. Typical threats, attacks and exploits and the motivations behind them.

UNIT – 1 Introduction to Cyber Security: 07 Hours

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT – 2 Cyber Security Vulnerabilities and Cyber Security Safeguards: 07 Hours

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT – 3 Securing Web Application, Services and Servers: 07 Hours

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. **Intrusion Detection and Prevention:** Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT –4 Cryptography and Network Security: 07 Hours

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls-Types of Firewalls, User Management, VPN Security Protocols: - security at the Application Layer-PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer- IPSec.

UNIT – 5 Cyberspace and the Law, Cyber Forensics: 07 Hours

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

TEXT/REFERENCE BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education,2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press,2013.
3. MarttiLehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland2015.
4. NelsonPhillipsandEnfingerSteuart,―ComputerForensicsandInvestigations‖,Cengage Learning, New Delhi,2009.

BTETOE703D Mobile Computing 4 Credits

Course Objectives:

1. To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services.
2. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
3. To appreciate the social and ethical issues of mobile computing, including privacy.

Course Outcomes:

1. At the end of the course, the student will be able to demonstrate:
2. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
3. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
4. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
5. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

UNIT– 1 **07 Hours**

Mobile Computing, Mobile Computing vs. wireless Networking, Mobile Computing Applications, Characteristics of Mobile computing, Structure of Mobile Computing Application.

UNIT– 2 **07 Hours**

MAC Protocols, Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes.

UNIT– 3 **07 Hours**

Overview of Mobile IP, Features of Mobile IP, Key Mechanism in Mobile IP, route Optimization. Overview of TCP/IP, Architecture of TCP/IP- Adaptation of TCP Window, Improvement in TCP Performance, Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS).

UNIT– 4 **07 Hours**

Ad-Hoc Basic Concepts, Characteristics, Applications, Design Issues, Routing, Essential of Traditional Routing Protocols, Popular Routing Protocols, Vehicular Ad Hoc networks (VANET), MANET vs. VANET, Security.

UNIT– 5 **07 Hours**

Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems, Software Development Kit: iOS, Android, BlackBerry, Windows Phone, M Commerce, Structure, Pros & Cons, Mobile Payment System, Security Issues.

TEXT/REFERENCE BOOKS:

1. Principles of Mobile Computing, 2nd Edition, UweHansmann, LotharMerk, Martin Nicklous, Thomas Stober, Springer
2. Mobile Computing, Tomasz Imielinski, Springer.

BTETOE703E Mobile Communication and Networks 4 Credits

Course Objectives:

1. To provide an overview of Mobile Communication Networks area and its applications in communication engineering.

2. To appreciate the contribution of mobile communication networks to overall technological growth.

3. To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Mobile Communication Networks.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance.

UNIT – 1Cellularconcept: 07 Hours

Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

UNIT – 2 Signal propagation: 07 Hours

Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate, Capacity of flat and frequency selective channels.

UNIT – 3 Antennas and Multiple access schemes: 07 Hours

Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays. FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM

UNIT – 4 Receiver structure: 07 Hours

Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff

UNIT – 5 Performance measures: 07 Hours

Outage, average SNR, average symbol/bit error rate, System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

TEXT/REFERENCE BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill,1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall,1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York,1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

BTETOE703F EMI and EMC 4 Credits

Course Objectives:

1. To provide an overview of EMI and EMC
2. To provide the knowledge to compare and contrast the strengths and weaknesses of various errors correcting code

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Be familiar with importance of error correction methods in data communication and storage.
2. Have gained experience of use of mathematical tools from from groups and finite fields, in the design of codes and sequences.
3. Develop an ability to compare and contrast the strengths and weaknesses of various errors correcting code for a given application.
4. Develop and model different error correcting codes for appraise of reaching data rate to

Shannon limit.

5. Demonstrate competence in analyzing and evaluating the practice of different error correcting coded in digital communication system

UNIT –1 Introduction: 07 Hours

History of EMI/EMC, Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Benefits of Good EMC Design, EMC Regulations (Government, Commercial And Military), Examples of EMC Related Problems.

UNIT–2 EMC requirements for electronic systems: 07 Hours

Radiated Emission Limits For Class A, Class B, FCC And CICPR, Measurement of Emissions For Verification of Compliance, Radiated Emission And Susceptibility, Conducted Emissions And Susceptibility, Typical Product Emissions, Additional Product Requirements, Design Constraints For Products, Advantages of EMC Design.

UNIT–3 Conducted emission and susceptibility: 07 Hours

Measurement of Conducted Emission: LISN, Common And Differential Mode Currents, Power Supply Filters, Basic Properties of Filters, A Generic Topology, Effect of Filter Elements on Common And Differential Mode Currents, Separation of Conducted Emissions In to Common And Differential Mode Components For Diagnostic Purpose, Power Supplies: Linear And SMPS, Effect of Power Supply Components on Conducted Emissions, Power Supply And Filter Placement, Conducted Susceptibility.

UNIT–4 Radiated emission and susceptibility: 07 Hours

Simple Emission Models For Wires and PCB Lands: Differential Mode versus Common Mode Currents, Differential Mode Current Emission Model, Common Mode Current Emission Model, Current Probes, Simple Susceptibility Models for Wires and PCB Lands: Shielded Cables and Surface Transfer Impedance.

UNIT–5 Shielding and system design for EMC: 07 Hours

Shielding Effectiveness, Far Field Sources, Exact Solution, and Approximate Solution, Near Field Sources: Near Field Versus Far Field, Electric Sources, Magnetic Sources, Low Frequency, Magnetic Fielding Shielding, And Effect of Apertures Shielding and Grounding, PCB Design, System Configuration and Design, Electrostatic Discharge, Diagnostic Tools.

TEXT/REFERENCE BOOKS:

1. Paul Clayton,"Introduction to Electromagnetic Compatibility", Wiley Interscience, 2nd Ed., 2006.
2. Ott H. W.,"Noise Reduction Techniques in Electronic Systems", Wiley Interscience, 2nd Ed., 1988.
3. Goedbloed,"Electromagnetic Compatibility", Prentice Hall, 1st English Language Ed., 1993
4. Kaiser K. L.,"Electromagnetic Shielding", CRC Press, 1st Ed.,2006.
5. Stallings W.,"Cryptography and Network Security Principles and Practices", Pearson Education, 3rd Ed.,2007.
6. Michel Mardiguian,"EMI Troubleshooting Techniques", McGraw-Hill Professional, 1st Ed., 1999.

BTETOE704A Soft Computing 4Credits

Course Objectives:

1. Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real-world problems.
2. Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural

networks and hybrid systems Techniques.

3. To create awareness of the application areas of soft computing technique.
4. Provide alternative solutions to the conventional problem-solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real-world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT – 1 Artificial Neural Network–I: 07 Hours

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch‐ Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule o Perception and its limitations Draft.

UNIT –2 Artificial Neural Network-II: 07 Hours

Multilayer perception (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self‐ organizing Feature Maps, k‐ means clustering o Learning vector quantization Radial Basis Function networks: Cover‟s theorem, mapping functions (Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associative memories.

UNIT – 3 Fuzzy Logic –I: 07 Hours

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T‐conorm) o Fuzzy if‐then rules.

UNIT – 4 Fuzzy Logic –II: 07 Hours

Fuzzification, Membership Value Assignment techniques, De‐fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes‐Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems ‐Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two‐input single output FIS employing Mamdani model Computing.

UNIT – 5 Fuzzy Control Systems and Adaptive Neuro-Fuzzy Inference Systems (ANFIS): 07Hours

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing controlproblem. ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, LaureneFausett, Pearson Education, Inc,2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons,2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.

4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons,2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company,1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall InternationalInc-1999.
7. NeuralandAdaptiveSystems:FundamentalsthroughSimulations,JoséC.PrincipeNeil
8. R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
9. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
10. Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press,2008.
11. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC,2008.
12. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag,2007.

BTETOE704B Big Data Analytics 4 Credits

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
5. To introduce to the students several types of big data like social media, web graphs and data streams
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in BigData.

UNIT – 1 Big Data Platforms: 07 Hours

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

UNIT – 2YATRAP: 07 Hours

YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

UNIT – 3 Fog computing: 07 Hours

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

UNIT – 4 Web Enhanced Building and Technologies for Healthcare: 07 Hours

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements. Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

UNIT –5 Sustainability Data and Analytics: 07 Hours

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

TEXT/REFERENCE BOOKS:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and the Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015. 2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.
2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.

BTETOE704C Data Structure & Algorithms Using Java Programming
4 Credits

Prerequisites: Basic knowledge of Java Programming fundamentals required.

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. To choose the appropriate data structure and algorithm design method for a specified application.
3. To study the systematic way of solving problems, various methods of organizing large amounts of data.
4. To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
5. To employ the different data structures to find the solutions for specific problems

Course Outcomes:

On completion of the course, student will be able to:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data

structures.

UNIT –1 Introduction: **07 Hours**

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT –2 Stacks and Queues: **07 Hours**

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT – 3 Linked Lists: **07 Hours**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT –4Trees: **07 Hours**

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT – 5 Sortingand Hashing: **07 Hours**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT/REFERENCE BOOKS:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley PublishingCompany
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, PearsonEducation.
3. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10:0716782928.
4. Richard F. Gilberg&Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10:0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum‟s Outlines, Tata Mc Graw Hill. ISBN-10:1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. YedidyahLangsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10:8120311779.

BTETOE704D Entrepreneurship Development 4Credits

Course Objectives:

1. To Develop and Strengthen Entrepreneurial Quality and Motivation in Students and To Impart Basic Entrepreneurial Skills and Understanding to Run a Business Efficiently and Effectively.

2. The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Have the ability to discern distinct entrepreneurial traits.
2. Know the parameters to assess opportunities and constraints for new business ideas.
3. Understand the systematic process to select and screen a business idea.
4. Design strategies for successful implementation of ideas.
5. Write a business plan.

UNIT –1Entrepreneurship: 07 Hours

Entrepreneur – Types of Entrepreneurs – Difference Between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT –2 Motivation: 07 Hours

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self- Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT –3 Business: 07 Hours

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps Involved in Setting Up A Business – Identifying, Selecting A Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT –4 Financing and Accounting: 07 Hours

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT – 5 Supportto Entrepreneurs: 07 Hours

Sickness in Small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in Small Industry – Expansion, Diversification, Joint Venture, Merger And Sub Contracting.

TEXT/REFERENCE BOOKS:

1. Khanka. S.S., “Entrepreneurial Development” S. Chand & Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning2014.
3. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill,2013.
4. Mathew J Manimala, “Entrepreneurship Theory At Cross Roads: Paradigms and Praxis” 2nd Edition Dream Tech,2005.
5. Rajeev Roy, „Entrepreneurship‟ 2nd Edition, Oxford University Press,2011.
6. EDII “Faulty and External Experts – A Hand Book For New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad,1986.
8. , Design of analog filters by, Prentice-Hall 1990 (or newer additions).
9. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETOE704E Software Defined Radio 4 Credits

Course Objectives:

1. The objective of this course is to provide knowledge of fundamental and state-of the art concepts in software defined radio.
2. To understand the various components of software-defined-radios with the understanding of their limitation and application of „software-defined-solutions‟ to overcome such limitations.
3. To Understanding the interplay of analog and digital signal processing for power as well as spectrum efficient transmission and reception of signal leads to an optimized, yet, practical radio solution.

Course Outcomes:

1. The student will study Needs, Characteristics, Benefits and Design Principles of a Software Radio.
2. The student will be study design aspects of software radios.
3. The student will understand concept of Smart Antennas.
4. The student will study key hardware elements and related Trade-Offs.

UNIT – 1 Fundamentals of SDR: **07 Hours**

Software Radios, Needs, Characteristics, Benefits, Design Principles of a Software Radio, Radio frequency implementation issues, Principal Challenge of Receiver Design

UNIT – 2 RF and SDR: **07 Hours**

RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Transmitter Architectures and their issues, Noise and Distortion in the RF Chain, Timing Recovery in Digital Receivers Using MultiMate Digital Filters

UNIT – 3 Signals in SDR: **07 Hours**

Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Band-pass Signal Generation, Hybrid DDS-PLL Systems, Generation of Random Sequences, Parameters of data converters

UNIT – 4 Smart Antennas: **07 Hours**

Concept of Smart Antennas, Structures for Beam-forming Systems, Smart Antenna Algorithms, Digital hardware choices, Key Hardware Elements, DSP Processors, Field Programmable Gate Arrays, Trade-Offs in Using DSPs, FPGAs and ASICs.

UNIT – 5 Case studies in Radio System: **07 Hours**

Power Management Issues, Object-oriented representation of radios and network resources, Mobile Application Environments, Joint Tactical Radio System, Case studies in software radio design.

TEXT/REFERENCE BOOKS:

1. Jeffrey H. Reed, “Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall PTR; May 2002 ISBN:0130811580
2. Dillinger, Madani, Alonistioti (Eds.), “Software Defined Radio, Architectures, Systems and Functions”, Wiley2003
3. Bard, Kovarik, “Software Defined Radio, The Software Communications Architecture”, Wiley2007
4. Johnson, C.R. and W.A. Sethares, “Telecommunication Breakdown: Concepts of Communication Transmitted via Software-Defined Radio, Pearson Prentice Hall,2004
5. Bard, John and Kovarik, Vincent, “Software Defined Radio:The Software Communications Architecture”, Wiley Series in Software Radio,2007.

BTETOE704F E Waste Management 4 Credits

Course Objectives:

1. To understand the problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc
2. To understand health and environmental issues related to E waste and management.

UNIT– 1 **07 Hours**
E-Waste Overview, E-waste Management Overview

UNIT– 2 **07 Hours**
Environmental and Public Health Issues, E-waste Health Risk Assessment

UNIT– 3 **07 Hours**
Environmental and Public Health Issues, Recovery of Materials from E-Waste

UNIT– 4 **07 Hours**
Metal Recovery Process, Recovery of Metals from Electronic Waste

UNIT– 5 **07 Hours**
E-waste Management, Electronics and LCA, LCA applications for Electronics

TEXT BOOKS/REFERENCES:

1. G H Eduljee, R M Harrison, "Electronic Waste Management" 2nd edition.
2. HugoMarcelo Veit, AndréaMouraBernardes, "Electronic Waste: Recycling Techniques" Springer.
3. Anish Khan, Inamuddin, Abdullah M. Asiri, "E-waste Recycling and Management: Present Scenarios and Environmental Issues"Springer.

BTHM705 Engineering Economics and Financial Mathematics 3 Credits

Course Objective:

1. After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

UNIT – 1 Introduction Engineering Economy: **07 Hours**
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering − Economics − Engineering efficiency, Economic efficiency, Scope of engineering economics − Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, P − V ratio, Elementary economic Analysis− Material selection for product, Design selection for a product, Process planning.

UNIT – 2 Value Engineering: **07 Hours**
Make or buy decision, Value engineering − Function, aims, Value engineering procedure. Interest formulae and their applications− Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor,Equalpaymentseriespayment Presentworthfactor–equalpaymentseriescapital recovery factor − Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT – 3 Cash Flow: 07 Hours

Methods of comparison of alternatives − Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT −4 Replacement And Maintenance Analysis: 07 Hours

Replacement and Maintenance analysis − Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with an ewasset − capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT −5 Depreciation: 07 Hours

Depreciation − Introduction, Straight line method of depreciation, − Declining balance method of depreciation − Sum of the years digits method of depreciation, − Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation − Evaluation of public alternatives − Introduction − Examples – Inflation adjusted decisions − Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TEXT BOOKS/REFERENCES:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, “ Managerial economics”, Oxford university press2006
3. A Text book of Economic Theory: by stonier and hauge,pearsonPublication.
4. Modern Economic Theory: by Sampat Mukherjee, New Age InternationalPublisher
5. Engineering Economics: by Degramo, prenticeHall.
6. International Economics: by Bo Sodersten,Macmillan.
7. Principle of Macroeconomics : by Rangarajan and Dholokia, Tata McGrawHill.
8. Monetary Economics: by SurajB.Gupta, Schand.
9. Project planning analysis, Selection, Implementation and review: by Prasanna Chandra, Tata McGraw Hill Education.8.Cost Accounting: by Jawahar Lal , McGrawHill.

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University
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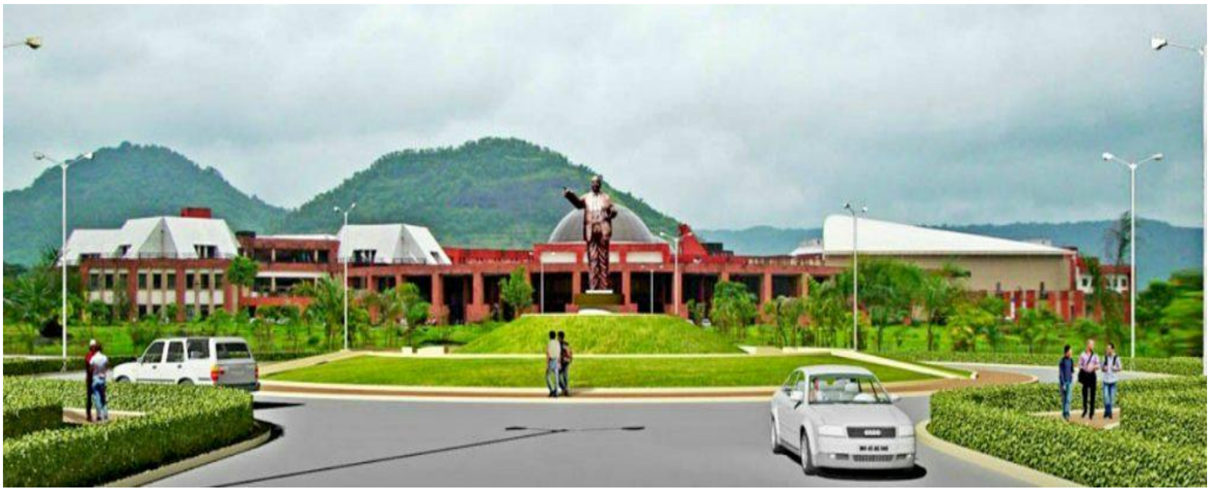
CURRICULUM FOR SECOND YEAR
B. TECH IN

Electronics Engineering

With effect from the Academic Year 2021-2022.



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Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:
   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted

LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.

3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

   (a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination

   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;

   (c) Paid all required advance payments of the Institute and hostel for the current semester;

   (d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below has been implemented from academic year 2019-20, starting from Ist year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA $\geq$ 5.50 &<6.00	SecondClass
CGPA $\geq$ 6.00 &<7.50	First Class
CGPA $\geq$ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

1.	MidSemester Exam (MSE) Marks	20
2.	ContinuousAssesment Marks	20
3.	End SemesterExamination(ESE)Marks	60

4.A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assesment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, <u>with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.</u>

This has been implemented for the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where
'm' is the total number of subjects from the first semester onwards up to and including the semester S,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. <u>Eligibility Criteria for Majors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester

3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)
Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. <u>Eligibility Criteria for Minors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)
Student complying with these criteria will be awarded with B.Tech Degree in ------- Engineering with Minor in ------ --Engineering.
(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b)Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

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Bachelor of Technology in Electronics Engineering

Basic Science Course (BSC)

BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics - III	(3-1-0)4
BTBS404	Probability Theory and Random Processes	(3-0-0)3

Engineering Science Courses (ESC)

BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES401	Electrical Machines and	(3-1-0)4

Humanities and Social Science including Management Courses(HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(3-0-0)3
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM706	Foreign Language Studies	Audit

Professional Core Courses (PCC)

BTEXC302	Electronic Devices & Circuits	(3-1-0)4
BTEXC303	Digital Electronics	(3-1-0)4
BTEXC304	Network Theory	(3-1-0)4
BTEXL305	Electronic Devices & Circuits Lab	(0-0-2)1
BTEXL306	Digital Electronics Lab & Network Theory Lab	(0-0-4)2
BTEXL406	Signals and Systems Lab	(0-0-2)1
BTEXC501	Analog Circuits	(2-2-0)4
BTEXC502	Digital Signal Processing	(3-1-0)4
BTEXC503	Microelectronics	(3-1-0)4
BTEXL507	Analog Circuits Lab & Digital Signal Processing Lab	(0-0-4)2
BTEXC601	Power Electronics	(3-1-0)4
BTEXC602	Microprocessors and	(3-1-0)4

	Instruments	

Professional Elective Course (PEC)

BTEXPE405	(A) Numerical Methods and Computer Programming	(3-1-0)4
	(B) Data Compression & Encryption	
	(C) Computer Organization and Architecture	
	(D) Introduction to MEMS	
BTEXPE504	(A) Electromagnetic field theory	(3-1-0)4
	(B) VLSI design and Technology	
	(C) Electronics in smart city	
	(D) Electronics measurement and Instruments	
	(E) Mixed Signal Design	
	(F) Automotive Electronics	
BTEXPE603	(A) Information Theory and Coding	(3-1-0)4
	(B) Control System Engineering	
	(C) Electronics Circuit Design	
	(D) Nanoelectronics	

	Microcontrollers	
BTEXL606	Power Electronics Lab and Microprocessors and Microcontrollers Lab	(0-0-4)2
BTEXC701	Embedded System Design	(3-1-0)4
BTEXL707	Embedded System Design Lab	(0-0-2)1

Open Elective Course (OEC)

BTEXOE505	(A) Digital System Design	(3-1-0)4
	(B) Artificial Intelligence and Machine learning	
	(C) Optimization Techniques	
	(D) Project Management and Operation Research	
	(E) Augmented, Virtual and Mixed Reality	
BTEXOE604	(A) IoT and Industry 4.0	(3-1-0)4
	(B) Communication Engineering	
	(C) Computer Network & Cloud Computing	
	(D) Industrial Drives and Control	
	(E) Robotics Design	
BTEXOE703	(A) Wireless Sensor	(3-1-0)4

	(E) Advanced Digital Signal Processing	
BTEXPE702	(A) Microwave Engineering	(3-1-0)4
	(B) Advanced Industrial Automation	
	(C) Satellite Communication	
	(D) Fiber Optic Communication	
	(E) CMOS Design	

Seminar/Mini Project/ Internship

BTES209S	Seminar	(0-0-2)1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time). (Internship – 1)	Audit
BTEXS307	Seminar I	(0-0-4)2
BTEXS407	Seminar II	(0-0-4)2
BTEXP408	(Internship – 2)	Audit
BTEXM508	Mini Project – 1	(0-0-4)2
BTEXM606	Mini Project – 2	(0-0-4)2
BTEXP607	(Internship – 3)	Audit
BTEXM708	Mini Project – 3	(0-0-4)2

	Networks	
	(B) Block Chain Technology	
	(C) Cyber Security	
	(D) Bio-medical signal processing	
	(E) Mobile Communication and Networks	
BTEXOE704	(A) Soft Computing	(3-1-0)4
	(B) Big Data Analytics	
	(C) Data Structure & Algorithms Using Java Programming	
	(D) Entrepreneurship Development	
	(E) Software Defined Radio	

Project (MP)

BTEXP801	Project work/ Internship	(0-0-24)12

Minor Courses (MC)

BTEXC302	Electronic Devices & Circuits	(3-1-0)4
BTEXC303	Digital Electronics	(3-1-0)4
BTEXC501	Analog Circuits	(3-1-0)4
BTEXC503	Microelectronics	(3-1-0)4
BTEXC602	Microprocessors and Microcontrollers	(3-1-0)4

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Suggested Plan of Study:

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTBS301	BTES401	BTEXC501	BTEXC601	BTEXC701	BTEXP801 (Project/Internship)
2	BTBS102	BTBS202	BTEXC302	BTEXC402	BTEXC502	BTEXC602	BTEXPE702 **(Elective)**	--
3	BTES103	BTES203	BTEXC303	BTHM403	BTEXC503	BTEXPE603 **(Elective)**	BTEXOE703 **(Elective)**	--
4	BTHM104	BTES204	BTEXC304	BTBS404	BTEXPE504 **(Elective)**	BTEXOE604 **(Elective)**	BTEXOE704 **(Elective)**	--
5	BTES105	BTES205	BTEXL305	BTEXPE405 **(Elective)**	BTEXOE505 **(Elective)**	BTHM605	BTHM705	--
6	BTES106	BTES206	BTEXL306	BTEXL406	BTEXL507	BTEXL606	BTHM706	--
7	BTBS107L	BTBS207L	BTEXS307	BTEXS407	BTEXM508	BTEXM607	BTEXL707	--
8	BTES108L	BTES208L	BTES211P (Internship - 1 Evaluation)	BTEXP408 (Internship – 2)	BTEXP408 (Internship – 2 Evaluation)	BTEXP608 (Internship – 3)	BTEXM708	--
9	BTHM109L	BTES209S	--	--	--	--	BTETP608 (Internship – 3 Evaluation)	--
10	--	BTES211P (Internship - 1)	--	--	--	--	--	--

Degree Requirements:

Category of courses	**Minimum credits to be earned**
Basic Science Course (BSC)	**25**
Engineering Science Course (ESC)	**19**
Humanities and Social Science including Management Courses (HSSMC)	**12**
Professional Core Course (PCC)	**49**
Professional Elective Course (PEC)	**16**
Open Elective Course (OEC)	**16**
Seminar/Mini Project/ Internship/Major Project	**23**
Total	**160**

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B. Tech in Electronics Engineering
Program Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

Graduates will able to–

1. To equip graduates with a strong foundation in engineering sciences and Electronics Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
2. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to Electronic Circuits, Embedded & wireless communication Systems and Signal Processing to solve engineering/ societal problems in the field of Electronics Engineering.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirements.

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B. Tech in (Electronics Engineering)

Curriculum for Second Year

Semester III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTEXC302	Electronic Devices & Circuits	3	1	-	20	20	60	100	4
PCC 2	BTEXC303	Digital Electronics	3	1	-	20	20	60	100	4
PCC 3	BTEXC304	Network Theory	3	1	-	20	20	60	100	4
LC	BTEXL305	Electronic Devices & Circuits Lab	-	-	2	60	-	40	100	1
LC	BTEXL306	Digital Electronics Lab & Network Theory Lab	-	-	4	60	-	40	100	2
Seminar	BTEXS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship – 1 Evaluation	-	-	-	-	-	50	50	Audit
		Total	**12**	**4**	**10**	**260**	**80**	**410**	**750**	**21**

Semester IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
ESC	BTES401	Electrical Machines and Instruments	3	1	-	20	20	60	100	4
PCC 4	BTEXC402	Signals and Systems	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC 1	BTEXPE405	Numerical Methods and Computer Programming Data Compression & Encryption Computer Organization and Architecture Introduction to MEMS	3	1	-	20	20	60	100	4
LC	BTEXL406	Signals and Systems Lab	-	-	2	60	-	40	100	1
Seminar	BTEXS407	Seminar II	-	-	4	60	-	40	100	2
Internship	BTEXP408 (Internship – 2)	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in V Sem.
		Total	**16**	**3**	**6**	**220**	**100**	**380**	**700**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

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Semester III

BTBS301 Engineering Mathematics-III 4 Credits

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electromagnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: Laplace Transform 09 Hours

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform 09 Hours

Introductory remarks; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform 09 Hours

Definitions – integral transforms; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications 09 Hours

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and one dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables 09 Hours

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
   The minimum number of assignments should be eight covering all topics.

BTEXC302 Electronic Devices and Circuits — 4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce Static characteristics of ideal two terminal and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results.

Course Outcomes:

On completion of the course, students will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.
3. Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feedback amplifiers and oscillators..

UNIT – 1 Bipolar Junction Transistor: 07 Hours

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier , Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier, Emitter follower, Cascaded Amplifier, Need for multistage amplifiers and suitability of CE, CC and CB configurations in multistage amplifiers.

UNIT – 2 Junction Field Effect Transistor and MOSFET **07 Hours**

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET, The FET as VVR. **MOSFET:** Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p -MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT – 3 Power amplifiers: **07 Hours**

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, efficiency, calculation of power output, power dissipation, cross over distortion and its elimination methods, need of heat sink and its design.

UNIT – 4 Feedback amplifiers: **07 Hours**

Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt, Current series, Current shunt types of Negative feedback, Typical transistor circuits effects of Negative feedback on Input and Output impedance, Voltage and Current gains, Bandwidth, Noise and Distortion

UNIT – 5 Oscillators & Voltage Regulator Circuits **07 Hours**

Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, RC, Clapp, Wien Bridge, Colpitt, Hartley, Tuned LC, UJT, Relaxation Oscillators.

T**ransistor application:** Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator

TEXT/REFERENCE BOOKS:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, “Electronics Devices & Circuits”, Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.

BTEXC303 Digital Electronics 4 Credits

Course Objectives:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

On completion of the course, students will be able to:

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.
3. Design and implement hardware circuit to test performance and application.
4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT – 1 Combinational Logic Design: **07 Hours**

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don‘t care conditions, Design Examples: Arithmetic Circuits, BCD - to - 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and De-multiplexers, Decoders.

UNIT – 2 Sequential Logic Design: 07 Hours

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops, Conversion of flip flops. Application of Flip-flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT – 3 State Machines: 07 Hours

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT – 4 Digital Logic Families: 07 Hours

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L and DCTL

UNIT – 5 Programmable Logic Devices, Semiconductor Memories and Introduction to VHDL: 07 Hours

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India, 2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., “Digital Circuit Design with VHDL”, Prentice Hall India, 2nd 2001 Edition.

BTEXC304 Network Theory 4 Credits

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

On completion of the course, students will be able to:

1. Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze the same.
2. Design passive filters and attenuators theoretically and practically. To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
3. Identify issues related to transmission of signals, analyze different RLC networks.
4. Find technology recognition for the benefit of the society.

UNIT – 1 Network Theorems: 07 Hours

Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin's, Norton's and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

UNIT – 2 Transient Analysis and Frequency Domain Analysis: 07 Hours

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

UNIT – 3 Laplace transform and its circuit applications: 07 Hours

Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response.

UNIT – 4 Two Port Networks: 07 Hours

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

UNIT – 5 State Variable Analysis and RL & RC Network Synthesis: 07 Hours

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press. 2003.
3. M.E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson 2006.
4. M.E. Van Valkenburg, "Network Synthesis," PHI 2007.
5. Kuo, F.F., "Network Analysis and Synthesis", 2nd Ed., Wiley India. 2008.
6. D Roy Choudary, "Network and Systems" 1st edition, New Age International, 1988
7. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill, 1982.
8. Royal Signal Handbook on Line Communication.

Semester IV

BTES401 Electrical Machines and Instruments 4 Credits

Course Objectives:

1. Model and Analyze the performance of different types of DC machines
2. Learn the applications of DC generators
3. Analyze the performance of different types of DC motors
4. Analyze the performance of different types of Sensors and Transducers
5. Familiarize with the applications of DC machines
6. To prepare students to perform the analysis of any electromechanical system.
7. To empower students to understand the working of electrical equipment used in everyday life.

Course Outcomes:

On completion of the course, students will be able to:

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The skill to analyze the response of any electrical machine.
3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

UNIT – 1 DC Machines: **07 Hours**

DC machines construction, working principle (motor & generator), EMF equation of DC Machine (motor and generator), Types and its characteristics of DC machines (motor and generator), back emf, starters of dc machine, Speed control of DC motor Breaking of DC motor, applications of DC machines (motor and generator).

UNIT – 2 Induction Motor and Synchronous Motor: **07 Hours**

Induction Motor: Construction, working principle, types, torque equation, torque slip characteristics, power stages, losses and efficiency, starters speed control, breaking, applications.

Synchronous motor: Construction, working principle, starting methods, effect of load, hunting, V-curve, synchronous condenser, applications.

UNIT – 3 Special Purpose Machines: **07 Hours**

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

UNIT – 4 Sensors and Transducers: **07 Hours**

Classification selection of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types, interfacing techniques of transducers with microprocessor and controller.

UNIT – 5 Industrial Measurement and Industrial Applications: **07 Hours**

Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm, object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.

TEXT/REFERENCE BOOKS:

1. A course in Electrical and Electronic Measurement and Instrumentation" by A. K. Sawhney (Publisher name: Dhanpat Rai & Co.)
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGraw Hill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai and publication
4. Instrumentation Devices System edition C. S. Rajan, G. R. sharma

5. Abhijit Chakrabarti & Sudipta Debnath, “Electrical Machines”, Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, “Electrical Machinery”, Tata McGraw-hill Publication 6th Edition.
8. I.J Nagarath & D.P Kothari, “Electrical Machines”, Tata McGraw-hill Publication 4th Edition.
9. T. J. E. Miller, “Brushless permanent-magnet and reluctance motor drives”, Oxford University Press (1989).
10. Ned Mohan, “Electric Machines and Drives”: A first course, Wiley.
11. B. L. Theraja, “Electrical technology” volume 2, S. Chand.

BTEXC402 Signals and Systems 4 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.

UNIT – 1 Introduction to Signals and Systems: 07 Hours

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding, Sampling Theorem and reconstruction of sampled signal, Concept of aliasing, examples on under sampled and over sampled signals.**Systems:** Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT – 2 Time domain representation of LTI System: 07 Hours

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulse response.

UNIT – 3 Fourier Series: 07 Hours

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties.

UNIT – 4 Fourier Transform: 07 Hours

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of bandpass signals.

UNIT – 5 Laplace and Z-Transform: 07 Hours

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI system analysis. Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z-transform, Z-transform for discrete time system LTI analysis.

TEXT/REFERENCE BOOKS:

1. Alan V. *Oppenheim*. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware, 2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley India.
4. Shaila Apte, “Signals and Systems-principles and applications”, Cambridge University press, 2016.
5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.
6. Peyton Peebles, “Probability, Random Variable, Random Processes”, 4th Edition, Tata McGraw Hill.
7. A. Nagoor Kanni “Signals and Systems”, 2nd edition, McGraw Hill.
8. NPTEL video lectures on Signals and Systems.
9. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw Hill. 2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th 2001 Ed., Pearson Education.

BTHM403 Basic Human Rights 3 Credits

Course Objectives:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

1. Students will be able to understand the history of human rights.
2. Students will learn to respect others caste, religion, region and culture.
3. Students will be aware of their rights as Indian citizen.
4. Students will be able to understand the importance of groups and communities in the society.
5. Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

UNIT – 1 07 Hours

The Basic Concepts: - Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

UNIT – 2 **07 Hours**

Fundamental rights and economic programme. Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT – 3 **07 Hours**

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT – 4 **07 Hours**

Human rights in Indian constitution and law:-

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT – 5 **07 Hours**

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Reference books:

Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005

Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India

BTBS404 Probability Theory and Random Processes 3 Credits

Course Objectives:

1. To develop basic of probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT – 1 Introduction to Probability: **07 Hours**

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications

UNIT – 2 Random variables: **07 Hours**

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation; independent,

UNIT – 3 Random vector and distributions: **07 Hours**

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT – 4 Sequence of random variables **07 Hours**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT – 5 Random process: **07 Hours**

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross-correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS:

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

BTEXPE405A Numerical Methods and Computer Programming 4 Credits

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

On completion of the course, students will be able to:

1. Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.

2. Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. Prepare them to write computer programs for the numerical computational techniques.
5. Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Understand procedure-oriented and object-oriented programming concepts.
7. Capable of writing C and C++ programs efficiently.

UNIT – 1 Introduction to Computational Methods and Errors: 07 Hours

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques. Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT – 2 Solution of Transcendental / Polynomial Equations and System of Linear Equation: 07 Hours

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT – 3 Interpolation and Polynomial Approximation: 07 Hours

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange’s interpolation polynomials, Spline interpolation, Least square approximation.

UNIT – 4 Numerical Integration and Differentiation: 07 Hours

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, Runge Kutta 2ndand 4th order, Stability analysis of above methods.

UNIT – 5 Object Oriented Programming: 07 Hours

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors.

TEXT/REFERENCE BOOKS:

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rd edition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rd Edition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi, 1996.
4. D. Ravichandran, "Programming with C++", TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2ndEdition
6. Yeshwant Kanetkar, "Let us C++, BPB Pub.", Delhi, 2002, 4thEdition.
7. Stroupstrup Bjarne, "C++ Programming Language", Addison Wesley, 1997, 3rd Edition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai, 1998.

BTEXPE405B Data Compression & Encryption 4 Credits

Course Objectives:

1. The concept of security, types of attack experienced.
2. Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT – 1 Data Compression and Encryption: 07 Hours

Need for data compression, Lossy/lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT – 2 Statistical Methods and Dictionary Methods: 07 Hours

Statistical Methods: Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPM method.

Dictionary Methods: String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT – 3 Image Compression: 07 Hours

Lossless techniques of image compression, gray codes, two-dimensional image transform, Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT – 4 Audio Compression: 07 Hours

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT – 5 Conventional Encryption: 07 Hours

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS:

1. Data compression- David Solomon Springer Verlag publication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmann publication.
4. The data compression book- Mark Nelson BPB publication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc., publications.

BTEXPE405C Computer Organization and Architecture 4 Credits

Prerequisites: Digital Electronic Circuits.

Course Objectives:

1. To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.

2. To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
3. Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
4. Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer's working
3. analyze the performance of computers
4. know how computers are designed and built.

UNIT – 1 Overview of computer organization: **07 Hours**

Overview of computer organization – components and system buses; Concepts of assembly and machine language programs. Machine language program execution – instruction cycles, machine cycles and bus cycles. Overview of memory and I/O addressing; CPU organization – components and subsystems, register banks, internal bus structure, information flow;

UNIT – 2 Instruction set: **07 Hours**

Instruction set – characteristics and functions, types of operation and operands. Addressing modes – various ways of addressing memory and input-output devices and their timing characteristics.

UNIT – 3 CISC and RISC architectures: **07 Hours**

CISC and RISC architectures – examples; ALU – flags, logical operations, fixed point number representations and arithmetic, floating point number representations and arithmetic, exceptions. Control Unit – how it operates, hardwired control unit, concepts of micro programs and micro programmed control unit;

UNIT – 4 Memory: **07 Hours**

Memory hierarchy – main memory – types and interfacing; Cache memory – its organizations and operations, levels of caches; Memory management module – paging and segmentation, virtual memory; Disk memory, RAIDs. Back-up memory.

UNIT – 5 Interrupts and interrupt structures and DMA controller: **07 Hours**

Interrupts and interrupt structures – interrupt cycles, handling multiple simultaneous interrupts, programmable interrupt controllers; I/O interfacing and modes of I/O data transfer. Direct memory access – DMA controller; Instruction level parallelism – instruction pipelining, pipeline hazards; Concepts of multiprocessor systems; Examples will be drawn from real life RISC and CISC processors.

TEXT/REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization," McGraw Hill, 2011.
2. D A Patterson and J L Hennessy, "Computer Architecture – A Quantitative Approach," Morgan Kaufmann, 2011.
3. W Stallings, "Computer Organization and Architecture – Designing for Performance," Pearson, 2013.
4. J. P. Hayes, "Computer Architecture and Organization," McGraw-Hill, 1998.
5. D A Patterson and J L Hennessy, "Computer Organization and Design – The Hardware/Software Interface," ARM Edition, Morgan Kaufmann, 2012.
6. S. Tannenbaum, "Structured Computer Organization," EEE Ed., Prentice Hall, 2013.
7. Mano, M.M., "Computer System Architecture" 3rd Ed., Prentice-Hall of 2004 India.

BTEXPE405D Introduction to MEMS 4 Credits

Course Objectives:

1. The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
2. This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
3. This will enable student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modelling of Microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT – 1 Introduction to MEMS: 07 Hours

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT – 2 Control and Materials of MEMS: 07 Hours

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT – 3 Review of Basic MEMS fabrication modules: 07 Hours

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT – 4 Micromachining: 07 Hours

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT – 5 Mechanics of solids in MEMS/NEMS: 07 Hours

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods. Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TEXT/REFERENCE BOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University (Established as a University of Technology in the State of Maharashtra) (under Maharashtra Act No. XXIX of 2014)

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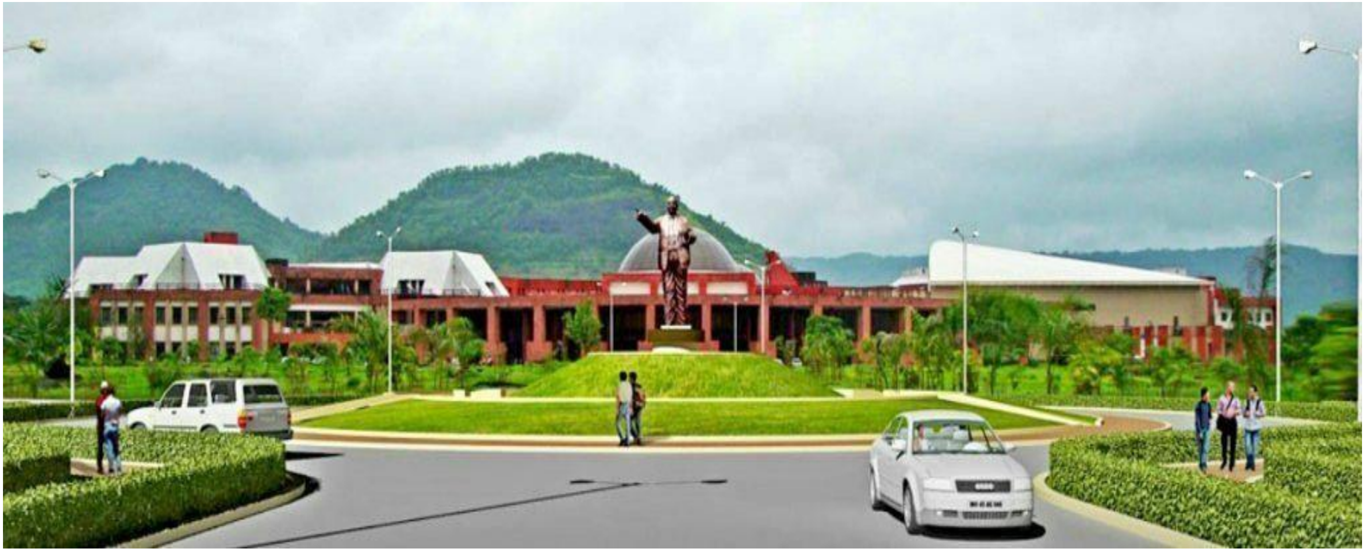
COURSE STRUCTURE AND SYLLABUS

For

Third and Final Year

B. Tech. Electronics Engineering Programme

for the Academic Year 2021-22



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B. Tech (Electronics Engineering)

Proposed Curriculum for Semester V [Third Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC501	Professional Core Course 1	Electromagnetic Field Theory	2	1	0	20	20	60	100	3
2	BTEXC502	Professional Core Course 2	Control System Engineering	2	1	0	20	20	60	100	3
3	BTEXC503	Professional Core Course 3	Microelectronics	3	0	0	20	20	60	100	3
4	BTEXC504	Professional Core Course 4	Digital Signal Processing	2	1	0	20	20	60	100	3
5	BTEXC505	Professional Core Course 5	Microcontroller and its Applications	3	0	0	20	20	60		3
6	BTEXPE506A	Program Elective Course 1	Probability Theory and Random Processes	3	0	0	20	20	60	100	3
	BTEXPE506 B		NSQF (Level 7 Course)								
	BTEXPE506C		Data Structures and Algorithms Using Java Programming								
	BTEXPE506D		Introduction to MEMS								
	BTEXPE506E		Audio and Video Processing								
7	BTEXL507	Control System Engineering Lab		0	0	2	--	30	20	50	1
8	BTEXL508	Digital Signal Processing Lab		0	0	2	--	30	20	50	1
9	BTEXL509	Microcontroller and its Applications Lab		0	0	2	--	30	20	50	1
10	BTEXP510	Mini Project		0	0	2	--	30	20	50	1
11	BTEXS511	Seminar		0	0	2	--	30	20	50	1
12	BTEXF412	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**15**	**3**	**10**	**120**	**270**	**510**	**900**	**24**

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B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VI [Third Year]

S.N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC601	Professional Core Course 1	Computer Architecture	3	0	0	20	20	60	100	3
2	BTEXC602	Professional Core Course 2	Power Electronics	3	0	0	20	20	60	100	3
3	BTEXPE603A	Program Elective Course 2	Digital Communication	3	0	0	20	20	60	100	3
	BTEXPE603B		Computer Network and Cloud Computing								
	BTEXPE603C		Nano Electronics								
	BTEXPE603D		Web Development and Design								
4	BTEXOE604A	Open Elective Course 1	Digital System Design	3	0	0	20	20	60	100	3
	BTEXOE604B		Neural Networks and Fuzzy Systems								
	BTEXOE604C		NSQF (Level 7 Course)								
	BTEXOE604D		Analog Integrated Circuit Design								
5	BTEXOE605A	Open Elective Course 2	Embedded System Design	2	0	0	20	20	60	100	2
	BTEXOE605B		Electronics System Design								
	BTEXOE605C		Project Management and Operation Research								
	BTEXOE605D		Android Programming								
6	BTHM606	Humanities & Social Science including Management Courses	Employability & Skill Development	2	0	0	--	50	0	50	2
7	BTEXL607	Power Electronics Lab		0	0	2	--	30	20	50	1
8	BTEXL608	Program Elective Course 2 Lab		0	0	2	--	30	20	50	1

9	BTEXL609	Open Elective Course 1 Lab	0	0	2	--	30	20	50	1
10	BTEXP610	Community Project	0	0	2	--	30	20	50	1
11	BTEXS611	Seminar	0	0	2	--	30	20	50	1
12	BTEXF612	Field Training/ Internship/Industrial Training (Minimum 4 weeks)	--	--	--	--	--	--	--	1*
		Total	**16**	**0**	**10**	**100**	**300**	**400**	**800**	**21**

Program Elective 2	**Open Elective 1**	**Open Elective 2**
(A) Digital Communication	(A) Digital System Design	(A) Embedded System Design
(B) Computer Network and Cloud Computing	(B) Neural Networks and Fuzzy Systems	(B) Electronics System Design
(C) Nano Electronics	(C) NSQF (Level 7 Course)	(C) Project Management and Operation Research
(D) Web Development and Design	(D) Analog Integrated Circuit Design	(D) Android Programming

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B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VII [Final Year]

S.N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC701	Professional Core Course 1	Antennas and Wave Propagation	3	0	0	20	20	60	100	3
2	BTEXPE702	Program Elective 3	Group A	3	0	0	20	20	60	100	3
3	BTEXPE703	Program Elective 4	Group B	3	0	0	20	20	60	100	3
4	BTEXPE704	Program Elective 5	Group C	3	0	0	20	20	60	100	3
5	BTHM705	Humanities & Social Science including Management Courses	Financial management	2	0	0	--	50	--	50	2
6	BTEXL706	Program Elective 3 Lab		0	0	2	--	30	20	50	1
7	BTEXL707	Program Elective 4 Lab		0	0	2	--	30	20	50	1
8	BTEXL708	Program Elective 5 Lab		0	0	2	--	30	20	50	1
9	BTEXP709	Project Part-I		0	0	8	--	50	50	100	4
10	BTEXS710	Seminar		0	0	2	--	30	20	50	1
11	BTEXF612	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**14**	**0**	**16**	**80**	**300**	**420**	**800**	**23**

Program Elective 3 (Group A)	Program Elective 4 (Group B)	Program Elective 5 (Group C)
(A) Digital Image Processing	(A) IOT 4.0	(A) Microwave Theory & Techniques
(B) Data Compression and Encryption /Cryptography	(B) Wireless Sensor Networks	(B) Satellite Communication
(C) NSQF (Level 7 Course)	(C) CMOS Design	(C) Fiber Optic Communication
(D) Parallel Processing	(D) Process Instrumentation	(D) Wireless Communication

B. Tech (Electronics Engineering)

Course Structure for Semester VIII [Fourth Year]

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	MSE	CA	ESE	Total	
		• Introduction to Internet of Things • Computer Vision and Image Processing • Biomedical Signal Processing • Industrial Automation and Control • Cryptography and Network Security • Digital IC Design # Student to opt any two subjects from above list	3	-	--	20*	20*	60*	100	3
			3	-	--	20*	20*	60*	100	3
BTMEP803	Project Part-II or Internship*		--	--	30	--	--	100	150	15
		Total	--	--				220	350	21

** Six months of Internship in the industry*

**Students doing project at institute will have to appear for CA/MSE/ESE*

** Student doing project at Industry will give NPTEL examination / Examination conducted by university i.e. CA/MSE/ESE*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

 # Project Load: 2hrs/week/project.

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

No	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	Introduction to internet of things	12	IIT Kharagpur	Prof. Sudip Misra
2	Computer Vision and Image Processing	12	IIT Gandhinagar	Prof. M. K. Bhuyan
3	Biomedical Signal Processing	12	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4	Industrial Automation and Control	12	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay
5	Cryptography & Network Security	12	IIT Kharagpur	Prof. Sourav Mukhopadhyay
6	Digital IC Design	12	IIT Madras	Prof. Janakiraman

BTEXC501	Electromagnetic Field Theory	3 Credits

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
3. To understand the boundary conditions for different materials /surfaces.
4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
5. To get the basics of microwave, transmission lines and antenna parameters.
6. Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna.

UNIT - 1

Maxwell’s Equations

Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

UNIT - 2

Uniform Plane Wave

Uniform plane wave, Propagation of wave, Wave polarization, Poincare‟s Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

UNIT - 3

Transmission Lines

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT - 4

Plane Waves at a Media Interface

Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

UNIT - 5

Wave propagation

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide

UNIT - 6

Radiation

Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna

TEXT/REFERENCE BOOKS

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005

2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, "Electromagnetics", Prentice Hall.
5. Sadiku, "Elements of Electromagnetics", Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi, 1999.
8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", Wiley Eastern.

BTEXC502	Control Systems Engineering	3 Credits

Course Objectives:

- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.
- To introduce concepts of PID controllers and digital and control systems.
- To introduce concepts programmable logic controller.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

UNIT - 1

Introduction to control problem

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.

UNIT - 2

Time Response Analysis

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response

UNIT - 3

Stability Analysis

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram,

UNIT - 4

Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT - 5

Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and Bode Plot.

UNIT - 6

State variable Analysis

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigenvalues and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT/REFERENCE BOOKS

1. N. J. Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2009.
2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.
3. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
4. Schaum"s Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
5. John J. D"Azzo& Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc., 1995.
6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

BTEXC503	Microelectronics	3 Credits

Course Objectives: As part of this course, students:

- Will understand the physical, electrical, and optical properties of semiconductor materials and their use in microelectronic.
- Relate the atomic and physical properties of semiconductor materials to device and circuit performance issues.
- Develop an understanding of the connection between device-level and circuit-level performance of microelectronic systems.

Course Outcomes: After successfully completing the course students will be able to upon successful completion of this course, students should be able to:

1. Compute carrier concentrations for semiconductor materials under a variety of doping conditions.
2. Compute conductivity and resistivity of semiconductor materials under a variety of condition.
3. Silicon wafer processing and formation of P N junction using diffusion and Ion Implantation technique
4. Wet and Dry oxidation process required for photolithography process.
5. Manufacturing process for P N junction, BJT, MOS, and IC fabrication.

UNIT - 1

MOSFETS:

Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, Biasing in MOS amplifier Circuits, Small Signal Operation and Models, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation modes, single stage MOS amplifiers. MOSFET internal capacitances and high frequency modes, Frequency response of CS amplifiers, CMOS digital logic inverter, and detection type MOSFET.

UNIT - 2

Single Stage IC Amplifier:

IC Design philosophy, Comparison of MOSFET and BJT, Current sources, Current mirrors and Current steering circuits, high frequency response.

UNIT - 3

Single Stage IC amplifiers:

CS and CF amplifiers with loads, high frequency response of CS and CF amplifiers, CG and CB amplifiers with active loads, high frequency response of CG and CB amplifiers, Cascade amplifiers. CS and CE amplifiers with source (emitter) degeneration source and emitter followers, some useful transfer parings, current mirrors with improved performance. SPICE examples.

UNIT - 4

Differences and Multistage Amplifiers:

The MOS differential pair, small signal operation of MOS differential pair, the BJT differences pair, other non-ideal characteristics and differential pair, Differential amplifier with active loads, frequency response and differential amplifiers. Multistage amplifier. SPICE examples.

UNIT - 5

Feedback

General Feedback structure, Properties of negative feedback. Four basic feedback topologies. Series-Shunt feedback. Determining the loop gain. Stability problem. Effect of feedback on amplifier poles. Stability study using Bode plots. Frequency compensation. SPICE examples.

UNIT - 6

Digital CMOS circuits

Overview, Design and performance analysis of CMOS inverter, Logic Gate Circuits, Pass-transistor logic, Dynamic Logic Circuits, SPICE examples

TEXT/REFERENCE BOOKS

1. "Microelectronic Circuits", Adel Sedra and K.C. Smith, 5th Edition, Oxford University Press, International Version, 2009.
2. "Fundamentals of Microelectronics", Behzad Razavi, John Wiley India Pvt. Ltd, 2008.
3. "Microelectronics – Analysis and Design", Sundaram Natarajan, Tata McGraw-Hill, 2007.

BTEXC504	Digital Signal Processing	3 Credits

Course Objectives:

- To introduce students with transforms for analysis of discrete time signals and systems.
- To understand the digital signal processing, sampling and aliasing.
- To use and understand implementation of digital filters.
- To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to:

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT - 1

DSP Preliminaries

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

UNIT - 2

Discrete Fourier Transform

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm

UNIT - 3

Z transform

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

UNIT - 4

IIR Filter Design

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Lowpass filter)

UNIT - 5

FIR Filter Design

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form.

UNIT - 6

Introduction to Multirate signal processing

Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
4. S. L. Nalbalwar, Digital Signal Processing, Synergy Knowledgeware Publication, Mumbai, 2018
5. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
6. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
7. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTEXC505	Microcontroller & its Applications	3 Credits

Course Objectives:

- Objective of this course is to introduce to the students the fundamentals of microcontroller.
- After learning Microcontroller course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
- The learner can design microcontroller based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
- The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.

- The students will get acquainted with recent trends in microcontroller like pipelining, cache memory etc.
- To understand the applications of Microcontrollers.
- To understand need of microcontrollers in embedded system.
- To understand architecture and features of typical Microcontroller.
- To learn interfacing of real world input and output devices.
- To study various hardware and software tools for developing applications.

Course Outcomes:

1. Learner gains ability to apply knowledge of engineering in designing different case studies.
2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Graduates will be able to design real time controllers using microcontroller based system.
4. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
5. Students can identify and formulate control and monitoring systems using microcontrollers.
6. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
7. This course understanding will enforce students to acquire knowledge of recent trends like superscalar and pipelining and thus finds recognition of continuous updation.
8. Learners get acquainted with modern tools like Programmers, Debuggers, cross compilers and current IDE i.e. integrated development environment tools.
9. Learn importance of microcontroller in designing embedded application.
10. Learn use of hardware and software tools.
11. Develop interfacing to real world devices.

UNIT - 1

Fundamentals of Microcontrollers

Introduction to the general structure of 8 and 16 bit Microcontrollers Harward & Von Neumann architecture, RISC & CISC processors. Role of microcontroller in embedded system. Selection criteria of microcontroller Block diagram and explanation of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Sample programs (assembly): Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port.

UNIT - 2

Interfacing with 8051 PART I

Software and Hardware tools for development of microcontroller-based systems such as assemblers, compliers, IDE, Emulators, debuggers, programmers, development board, DSO, Logic Analyzer. Interfacing LED with and without interrupt, Keypads, Seven Segment multiplexed Display, LCD, ADC Interfacing. All Programs in assembly language and C.

UNIT - 3

Interfacing with 8051 PART II

8051 timer programming, serial port and its programming, interrupt programming, LCD and keyboard interfacing, ADC and DAC interfacing, interfacing to external memory Interfacing of DAC, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Opto-isolators. All programs in assembly and C.

UNIT - 4

PIC Microcontroller Architecture

PIC 10, PIC12, PIC16, PIC18 series comparison, features and selection as per application. PIC18FXX architecture, registers, memory Organization and types, stack, oscillator options, BOD, power down modes and configuration bit settings, timer and its programming. Brief summary of Peripheral support, Overview of instruction set, MPLAB IDE & C18 Compiler.

UNIT - 5

Real World Interfacing Part I

Port structure with programming, Interrupt Structure (Legacy and priority mode) of PIC18F with SFRS. Interfacing of switch, LED, LCD (4&8 bits), and Key board. Use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP: All programs in embedded C.

UNIT - 6

Real World Interfacing Part I

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI &I2C), UART, Sensor interfacing using ADC, RTC (DS1306) with I2C and EEPROM with SPI. Design of PIC test Board, Home protection System: All programs in embedded C..

TEXT/REFERENCE BOOKS

1. Mazidi, 8051 microcontroller & embedded system 3rd Edition ,Pearson
2. Mazidi, PIC microcontroller & embedded system 3rd Edition ,Pearson
3. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
4. Calcut, 8051 microcontrollers: Applications based introduction, Elsevier.
5. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
6. Han-way Huang, using The MCS-51 microcontroller, Oxford university press
7. Ayala, 8051 microcontroller, cengage (Thomson)

BTEXPE506A	**Probability Theory and Random Processes**	**3 Credits**

Course Objectives:

- To develop basic of probability and random variables.
- The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals

4. To understand propagation of random signals in LTI systems.

UNIT - 1

Introduction to Probability

Definitions, scope and history; limitation of classical and relative- frequency- based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.

UNIT - 2

Random variables

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf);probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables, Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables, mean, variance and moments of a random variable, Joint moments, conditional expectation; covariance and correlation, independent, uncorrelated and orthogonal random variables.

UNIT - 3

Random vector and distributions

Mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector- space representation of random variables, linear indepe ndence, inner product, Schwarz Inequality, Elements of estimation theory: linear minimum mean - square error and orthogonality principle in estimation; Moment - generating and characteristic functions and their applications, Bounds and approximations: Chebysev inequality and Chernoff Bound.

UNIT - 4

Sequence of random variables and convergence

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT - 5

Random process

Random process: realizations, sample paths, discrete and continuous time processes, examples, Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance.

UNIT - 6

Spectral representation of a real WSS process

Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, Line ar time - invariant system with a WSS process as an input: sationarity of the output, auto -correlation and power - spectral density of the output; examples with white - noise as input; linear shift - invariant discrete- time system with a WSS sequence as input, Spe ctral factorization theorem, Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.

4. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

BTEXPE506C	Data Structure & Algorithms using Java Programming	3 Credits

Prerequisites: Basic knowledge of C language is required.

Course Objectives:

- To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.
- To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
- To employ the different data structures to find the solutions for specific problems

Course Outcomes:

On completion of the course, student will be able to:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT - 1

Introduction

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT - 2

Stacks and Queues

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT - 3

Linked Lists

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT - 4

Trees

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT - 5

Sorting and Hashing

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

UNIT - 6

Graph

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT/REFERENCE BOOKS

1. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
2. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928
3. Java: The Complete Reference, Seventh Edition, Herbert Schildt, McGraw Hill
4. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum"s Outlines, Tata Mc Graw Hill. ISBN-10: 1259029964.

BTEXPE506D	Introduction to MEMS	3 Credits

Course Objectives:

- The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
- This will enables student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT - 1

Introduction to MEMS

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT - 2

Control and Materials of MEMS

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT - 3

Review of Basic MEMS fabrication modules:

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT - 4

Micromachining

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT - 5

Mechanics of solids in MEMS/NEMS

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes‟s law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods.

UNIT - 6

Finite Element Method and Electromechanical Systems

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems

TEXT/REFERENCE BOOKS

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

BTEXPE506E	Audio & Video Processing	3 Credits

Course Objectives:

- The objective is to provide students with a strong understanding of the fundamental principles and practical applications of audio and video engineering with latest updates.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand the concept of basic television signal processing.
2. Identify globally accepted color TV standards.
3. Demonstrate the need of audio and video compression techniques in real life.
4. Acquire knowledge of latest digital TV systems and applications.
5. Describe the attributes of acoustics, sound engineering and storage media.

UNIT - 1

Fundamentals of Color Television

Aspect, scanning, perception of brightness and colour, colour mixing, composite video signal, synchronisation details, digital TV camera, modulation of audio and video, terrestrial signal transmission, video displays: LCD vs LED.

UNIT - 2

Colour Standards and digital video

Standards: NTSC, PAL, SECAM colour system, generalized colour TV receiver block diagram, study of functionality of each block, alignment issues, sampling of video signal, colour sub sampling, composite vs component video, interlace vs progressive scan.

UNIT - 3

Digital TV

Digital video, resolution, notation, digital video formats, digital video quality measure, video restoration, video streaming, DTH, Video compression: MPEG 2, MPEG 4, comparison of SDTV, EDTV and HDTV.

UNIT - 4

Advanced TV Systems and Techniques

Introduction to UHDTV: 4K and 8K, IPTV/web TV, smart TV, Wi-Fi TV, digital surveillance, 3D TV concept, over view of H.264 features, camcorders, webcams, perspective of TV White spaces.

UNIT - 5

Acoustics

Human Hearing and sound, frequency range, dynamic range, masking, digital representation of sound wave, intensity, decibel sound level, sound waves in rooms, reverberation, room/studio acoustics as a component in speech system, PA systems, special types of microphones and speakers.

UNIT - 6

Audio and Video Recording Systems

Digital sound, sound recording, CD/ DVD player, MP3 player, Blue Ray DVD Player,ITU-T(G) compression standards, multichannel/Dolby 5.1sound in DTV.

TEXT/REFERENCE BOOKS

1. A. M. Dhake, Television and video Engineering, TMH Publication, 2nd Edition, 2001.
2. Kelth jack, Video Demystified: A Handbook for the Digital Engineer, 5th Edition, Newnes, 2007.
3. R.G. Gupta, Audio and Video Systems, McGraw Hill l Education (India), 2nd Edition, 2010.
4. S. P. Bali, Color Television Theory and Practice, McGraw Hill Education (India), 1994.
5. A. M. Tekalp, Digital Video, Prentice Hall, 1995.
6. R. P. Gulathi, Modern Television Practice, 4th edition, New Age International Publisher, 2014.

BTEXC601	Computer Architecture	3 Credits

Course Objectives:

- To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
- To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
- Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
- Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Learn how computers work

2. Know basic principles of computer‟s working
3. Analyze the performance of computers
4. Know how computers are designed and built
5. Understand issues affecting modern processors (caches, pipelines etc.).

UNIT - 1

Basics of Computers

Basic Structure of Computers, Functional units, software, performance issues software, machine Instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly Language, Stacks, Queues, Subroutines.

UNIT - 2

Processor organization

Processor organization, Information representation, number formats.

UNIT - 3

ALU design

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit.

UNIT - 4

Memory organization

Memory organization, device characteristics, RAMS, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

UNIT - 5

System organization

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces.

UNIT - 6

Parallel processing

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

TEXT/REFERENCE BOOKS

1. V. Carl Hammacher, “Computer Organisation”, Fifth Edition.
2. A. S. Tanenbum, “Structured Computer Organisation”, PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M. M. Mano, “Computer System Architecture”, Edition
5. C. W. Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
6. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

BTEXC602	Power Electronics	3 Credits

Course Objectives:

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT - 1

Characteristics of Semiconductor Power Devices

Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

UNIT - 2

Controlled Rectifiers

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT - 3

Choppers

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

UNIT - 4

Single-phase inverters

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

UNIT - 5

Switching Power Supplies

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

UNIT - 6

Applications

Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

TEXT/REFERENCE BOOKS

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V. R. Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

BTEXPE603A	Digital Communication	3 Credits

Course Objectives:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

Course Outcomes:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

UNIT - 1

Digital Transmission of Analog Signal

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speech synthesis.

UNIT - 2

Baseband Digital Transmission

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

UNIT - 3

Random Processes

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT - 4

Baseband Receivers

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT - 5

Passband Digital Transmission

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

UNIT - 6

Spread Spectrum Techniques

Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS

1. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, “A First Course in Digital Communication”, Cambridge University Press.

4. B P Lathi, Zhi Ding "Modern Analog and Digital Communication System", Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications" Second Edition, Pearson Education.
6. Taub, Schilling, "Principles of Communication System", Fourth Edition, McGraw Hill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTEXPE603B	Computer Network and Cloud Computing	3 Credits

Course Objectives:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.
- Discuss, with confidence, what is cloud computing and what are key security and control
- Considerations within cloud computing environments.
- Identify various cloud services.

Course Outcomes:

1. To master the terminology and concepts of the OSI reference model and the TCP-IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks.
3. To be familiar with contemporary issues in networking technologies.
4. To be familiar with network tools and network programming.
5. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
6. For a given problem related TCP/IP protocol developed the network programming.
7. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

8. To impart fundamental concepts in the area of cloud computing.
9. To impart knowledge in applications of cloud computing.
10. Develop applications for cloud computing.

UNIT - 1

Physical Layer and Data Link Layer

Network types, OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet.

UNIT - 2

Network Layer and Transport Layer

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques.

UNIT - 3

Application Layer

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

UNIT - 4

Wireless LANS & Virtual Circuit Networks

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

UNIT - 5

.Introduction and Cloud Computing Technology

Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment.

Client systems, Networks, server systems and security from services perspectives; accessing the cloud with platforms and applications; cloud storage.

UNIT - 6

Working with Cloud and Cloud Services

Infrastructure and working platform as a Service – conceptual model model and functionalities. Software as a Service –conceptual model and working. Trends inService provisioning with clouds.Using Cloud Services-Cloud collaborative applications and services.

TEXT/REFERENCE BOOKS

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, Tata McGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.
7. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010.
8. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011.

BTEXPE603C	Nano Electronics	3 Credits

Course Objectives:

- To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
- Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.

- This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
- Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
- The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT - 1

Overview Nano Technology

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

UNIT - 2

Basics of Quantum Mechanics

Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

UNIT - 3

MOS Scaling theory

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT - 4

Nano electronics Semiconductor devices

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

UNIT - 5

Properties of Nano devices

Vertical transistors -Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

UNIT - 6

Characterization techniques for Nano materials

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self assembly.

TEXT/REFERENCE BOOKS

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

BTEXPE603D	**Web Development and Design**	**3 Credits**

Course Objectives:

- Define the principle of Web page design
- Define the basics in web design
- Visualize the basic concept of HTML.
- Recognize the elements of HTML.
- Introduce basics concept of CSS.
- Develop the concept of web publishing

Course Outcomes:

On completion of the course, student will be able to:

1. Develop the skill & knowledge of Web page design
2. Understand the knowhow and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors.

UNIT - 1

Web Design Principles , Basic principles involved in developing a web site , Planning process , Five Golden rules of web designing , Designing navigation bar , Page design, Layout of pages , Design Concept.

UNIT - 2

Basics in Web Design , Brief History of Internet , What is World Wide Web , Why create a web site , Web Standards , Audience requirement.

UNIT - 3

Introduction to HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags , Heading, Paragraphs , Line Breaks , HTML Tags.

UNIT - 4

Elements of HTML, Working with Text , Lists, Tables and Frames , Hyperlinks, Images and Multimedia Working with Forms and controls.

UNIT - 5

Introduction to Cascading Style Sheets , CSS Properties , CSS Styling (Background, Text Format, Controlling Fonts) , Working with block elements and objects , Working with Lists and Tables , CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) , CSS Color , Creating page Layout and Site Designs.

UNIT - 6

Introduction to Web Publishing or Hosting , Creating the Web Site ,Saving the site, Working on the web site, Creating web site structure, Creating Titles for web pages, Themes, Publishing web sites.

TEXT/REFERENCE BOOKS

1. J. N. Robbins, Learning Web Design, O'Reilly Media, 4th Edition, 2012
2. Steven M. Schafer, HTML, XHTML, and CSS Bible, Wiley India, 5th Edition, 2010
3. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India, 3rd Edition, 2009
4. Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication, 3rd Edition, 2015
5. E. Robson, E. Freeman, Head First HTML & CSS, O"Reilly Media, nd Edition, 2012.

BTEXOE604A	**Digital System Design**	**3 Credits**

Course Objectives:

- The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
- The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
- This course will explore the basic concepts of digital electronics.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

UNIT - 1

Logic Simplification and Combinational Logic Design

Review of Boolean algebra and De Morgan‟s Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

UNIT - 2

MSI devices

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT - 3

Sequential Logic Design

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

UNIT - 4

Logic Families and Semiconductor Memories

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing.

UNIT - 5

Memory Elements

Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices.

UNIT - 6

VLSI Design flow

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

TEXT/REFERENCE BOOKS

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition, 2006.
4. D.V. Hall, “ Digital Circuits and Systems” , Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

BTEXOE604B	Neural Network & Fuzzy System	3 Credits

Course Objectives:

- This course covers basic concepts of artificial neural networks, fuzzy logic systems and their applications.
- Its focus will be on the introduction of basic theory, algorithm formulation and ways to apply these techniques to solve real world problems.
- It deals with Introduction and different architectures of neural network
- It deals with the Application of Neural Networks.
- It deals with Fuzzy Logic Controller.
- It deals with applications of Fuzzy logic

Course Outcomes:

1. The student will be able to obtain the fundamentals and types of neural networks.
2. The student will have a broad knowledge in developing the different algorithms for neural networks.
3. Student will be able analyze neural controllers.
4. Student will have a broad knowledge in Fuzzy logic principles.
5. Student will be able to determine different methods of Deffuzification.

UNIT - 1

Introduction

Biological neurons, McCulloch and Pitts models of neuron, Types of activation function, Network architectures, Knowledge representation, Learning process: Error-correction learning, Supervised learning, Unsupervised learning, Learning Rules.

UNIT - 2

Single Layer Perception

Perception convergence theorem, Method steepest descent - least mean square algorithms.

UNIT - 3

Multilayer Perception

Derivation of the back-propagation algorithm, Learning Factors.

UNIT - 4

Radial Basis and Recurrent Neural Networks

RBF network structure theorem and the reparability of patterns, RBF learning strategies, K-means and LMS algorithms, comparison of RBF and MLP networks, Hopfield networks: energy function, spurious states, error performance.

UNIT - 5

Neuro-dynamics

Attractors, Neuro dynamical model, Adaptive Resonance theory, Towards the Self Organizing Feature Map. Brain-state-in- a-box model,

UNIT - 6

Fuzzy logic

Fuzzy sets, Properties, Operations on fuzzy sets, Fuzzy relation Operations on fuzzy relations, The extension principle, Fuzzy mean Membership functions, Fuzzification and defuzzification methods, Fuzzy controllers.

TEXT/REFERENCE BOOKS

1. Simon Haykin, "Neural Network a - Comprehensive Foundation", Pearson Education.
2. Dr. S. N. Sivanandam, Mrs S.N. Deepa Introduction to Soft computing tool Wiley Publication.
3. Satish Kumar Neural Networks: A classroom Approach Tata McGraw-Hill.
4. Zurada J.M., "Introduction to Artificial Neural Systems, Jaico publishers.
5. Thimothv J. Ross, "Fuzz V Logic with Engineering Applications", McGraw.
6. Ahmad Ibrahim, "Introduction to Applied Fuzzy Electronics', PHI.

7. Rajsekaran S, VijaylakshmiPai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI.

8. Hagan, Demuth, Beale, ëNeural Network Designí, Thomson Learning

9. Christopher M Bishop Neural Networks for Pattern Recognition, Oxford Publication.

10. William W Hsieh Machine Learning Methods in the Environmental Sciences Neural Network and Kernels Cambridge Publication.

11. Dr. S. N. Sivanandam, Dr. S. Sumathi Introduction to Neural Network Using Matlab Tata McGraw-Hill

BTEXOE604D	Analog Integrated Circuit Design	3 Credits

Course Objectives:

- Introduction to Circuit Simulation & EM Simulations
- Deep Understanding of MOS Device Physics & Modeling
- Understanding of few transistor circuits like common gate, common source & common drain amplifiers with their frequency response
- Understanding of Operational Amplifier Design & Trade-offs
- Advanced Op-Amps and OTAs
- Temperature Compensated Biasing Schemes.

Course Outcomes:

At the end of the course, the student must be able to:

1. Design MOSFET based analog integrated circuits.
2. Analyze analog circuits at least to the first order.
3. Appreciate the trade-offs involved in analog integrated circuit design.
4. Understand and appreciate the importance of noise and distortion in analog circuits.

UNIT - 1

Introduction to Simulations

Introduction to Advanced Design System and Cadence Virtuoso, DC Simulations, AC Simulations, Harmonic Balance, Envelope Simulation, Electromagnetic Simulations- FEM, MOM, FDTD, Circuit Net listing.

UNIT - 2

MOSFET Device Physics & Modeling

MOSFET Structure, Threshold Voltage, Drain Current Equation, Transfer & Output Characteristics, Weak/Moderate/Strong Inversion, Linear/Triode/Saturation Region of Operation, Device Leakages and Losses, Short Channel Effects, High Frequency Small Signal Model of MOSFET, Cubic, BSIM and Materka Models of MOSFET.

UNIT - 3

Few Transistor Circuits

Current Mirrors, Common Source/Common Gate/Common Drain Amplifiers, Design and Analysis of CS/CG/CD Amplifiers, Cascode Amplifiers, Differential Gain Stage, Frequency Response & Design Trade-offs, Telescopic Cascode and Wide Swing Cascode Current Mirrors, PTAT, CTAT & Bandgap Bias Circuits.

UNIT - 4

Operational Amplifiers & OTAs

Design of Classical Op-Amps, Op-Amp Characteristics, Analysis and Trade-offs, Wideband Op-Amps, High Speed Op-Amps, Very High Gain Op-Amps, Operational Transconductance Amplifiers, Ultra Low Power OTAs for Medical Implants, Folded Cascode Op-Amps.

UNIT - 5

Biasing Schemes

Voltage and Current References, Vt reference bias, PTAT Current Reference, CTAT and Bandgap Voltage References, High Precision Voltage References, Voltage Level Shifters.

UNIT - 6

Non-Linear Circuits

Single and Balanced Diode Mixers, Translinear Cell, Gilbert Cell Mixers, Power Amplifiers, Even & Odd Order Mixing, In-Modulation (AM, PM Conversions) Distortions, Intermodulation Distortions, Intermodulation Products, ACPR & EVM.

TEXT/REFERENCE BOOKS

1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, "Analog Integrated Circuit Design", John Wiley & Sons
2. Keliu Shu, Edgar Sanchez-Sinencio, "CMOS PLL Synthesizers", Springer
3. Jose´ Carlos Pedro, Nuno Borges Carvalho, "Intermodulation Distortion in Microwave and Wireless Circuits", Artech House
4. Stephen A. Maas, "Microwave Mixers", Artech House.

BTEXOE605A	Embedded System Design	3 Credits

Course Objectives:

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
4. Get to know the hardware – software co design issues and testing methodology for embedded system.

UNIT - 1

Introduction to Embedded Computing

The concept of embedded systems design, Characteristics of Embedding Computing Applications, Concept of Real time Systems.

UNIT - 2

Design Process

Requirements, Specifications, Architecture Design, Designing of Components, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT - 3

Technological aspects of embedded systems

Interfacing between analog and digital blocks, signal conditioning, digital signal processing, subsystem interfacing, interfacing with external systems, user interfacing.

UNIT - 4

Design tradeoffs

Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

UNIT - 5

Operating System

Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.

UNIT - 6

Scheduling and Inter-process Communication

Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling Signals, Shared Memory Communication, Message-Based Communication.

TEXT/REFERENCE BOOKS

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996

BTEXOE605B	Electronics System Design	3 Credits

Course Objectives:

- To understand the various processes and systems to address human needs by creating tangible Electronic Products.
- To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems.

Course Outcomes:

On completion of the course, student will be able to

1. Design electronic products using user centered design process
2. Develop sketches, virtual and physical appearance models to communicate proposed designs
3. Refine product design considering engineering design & manufacturing requirements and constraints.
4. Make mock-up model and working prototype along with design documentation.

UNIT - 1

Introduction to Industrial Design

General introduction in the course, role of ID in the domain of industry, product innovation, designer"s philosophy and role in product design. Product development tools and methods.

UNIT - 2

Product Design Methodology and Product Planning

Electronic product design and development, Methodology, creativity techniques, brain storming, documentation, Defining the task, scheduling the task, estimation of labor cost and amount of documentation.

UNIT - 3

Ergonomics

Ergonomics of electronics electronic use of ergonomics at work places and plan layouts, ergonomics of panel design, case study.

UNIT - 4

Aesthetics and Visual Communication Techniques

Elements of aesthetics, aesthetics of control design, Visual Communication Techniques: perspective, band sketching and rendering technique, elements of Engineering drawing, assembly drawing part drawing , exploded views.

UNIT - 5

Product Anatomy and Product Detailing

Layout design, structure design, standard and non-standard structures, Industrials standards, Product detailing in sheet metal and plastics for ease of assembly, maintenance and aesthetics.

UNIT - 6

Product Manufacturing and Value Engineering

Different manufacturing processes in sheet metal and plastics, product finishing, finishing methods like platting, anodization, spray painting, powder coating etc, Introduction to marketing, graphics & packing.

TEXT/REFERENCE BOOKS

1. Peter Z. , "German Design Standard Vol 2", Reddot(2006)
2. Jordan P. W., "Designing Pleasurable Products: An Introduction to the New Human Factors." Taylor and Francis(2002)
3. Otto K. and Wood K., "Product design: Techniques in Reverse Engineering and New Product development", Prentice Hall. (2001)

4. Cross N. “Engineering Design Methods: Strategies for Product Design”, Willey.(2000)
5. Cagan J. and Vogel C. M. (2007) Creating Breakthrough Products, “Innovation from Product Planning to Program Approval”. Pearson Education
6. Coats D. , “Watches Tell More than Time: Product Design, Information, Quest for elegance” McGraw Hill(2002)
7. Norman D. A., “The design of everyday things, Basic Books.”(2002)
8. Chakrabarty D., “Indian Anthropometric Dimensions for Ergonomic Design Practice”, NID, Ahmedabad (1999).
9. E.J. McCormic, Human factors in engineering design, McGraw Hill 1976

Journals

1. Behaviour & Information Technology, Taylor & Francis
2. The Journal of Sustainable Product Design, Publisher: Springer
3. International Journal of Design; College of Design, National Taiwan University of Science and Technology, Taiwan.
4. Virtual & Physical Prototyping, Taylor & Francis

Internet Sites

1. http://www.ulrich-eppinger.net/
2. http://www.npd-solutions.com
3. http://www.qfdi.org
4. http://www.cheshirehenbury.com/rapid/

BTEXOE605C	**Project Management and Operation Research**	**3 Credits**

Course Objectives:

- To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
- To introduce students to framework those are useful for diagnosing problems involving human behavior.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.

- To teach students about networking, inventory, queuing, decision and replacement models.
- To introduce students to research methods and current trends in Operations Research.

Course Outcomes:

Student will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.

2. Solve transportation problems using various OR methods.

3. Illustrate the use of OR tools in a wide range of applications in industries.

4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.

5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT - 1

Definition, need and importance of organizational behaviour , nature and scope , frame work , organizational behaviour models.

UNIT - 2

Organization structure, formation, groups in organizations, influence, group dynamics, emergence of informal leaders and working norms, group decision making techniques, interpersonal relations, communication, control.

UNIT - 3

Evolution of Management thoughts, Contribution of Selected Management Thinkers, Various approaches to management, contemporary management practice, Managing in global environment, Managerial functions.

UNIT - 4

Importance of planning, Types of planning, decision making process, Approaches to decision making, Decision models, Pay off Matrices, Decision trees, Break Even Analysis.

UNIT - 5

Departmentation, Span of Control, Delegation, Centralisation and Decentralisation, Commitees, Line and Staff relationships, Recent trends in organisation structures.

UNIT - 6

Process of Recruitment, Selection, Induction Training, Motivation, Leading, Leadership styles and qualities, Communication, process and barriers. Managements control systems, techniques, Types of control.

TEXT/REFERENCE BOOKS

1. Bateman Snell, Management: Competing in the new era, McGraw,Hill Irwin, 2002.

2. Chandan J.S., Management Concepts and Strategies, Vikas Publishing House, 2002.

3. Hellriegel, Jackson and Slocum, Management: A Competency,Based Approach, South Western, 9th edition, 2002.

4. Koontz, Essentials of Management, Tata McGraw,Hill, 5th Edition, 2001.

5. Stephen P. Robbins and David A. Decenzo, Fundamentals of Management, Pearson Education, Third Edition, 2001.

6. Tim Hannagan, Management Concepts and Practices, Macmillan India Ltd., 1997.

BTEXOE605D	Android Programming	3 Credits

Course Objectives:

Android Application Development course is designed to quickly get you up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle

Course Outcomes:

At the end of the course, students will demonstrate the ability to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.

UNIT - 1

Introduction to Mobile Operating Systems and Mobile Application Development Introduction to Mobile OS:

Palm OS, Windows CE, Embedded Linux, J2ME (Introduction), Symbian (Introduction), Overview of Android: Devices running android, Why Develop for Android, Features of android, Architecture of Android, Libraries

How to setup Android Development Environment: Android development Framework - Android-SDK, Eclipse, Emulators – What is an Emulator / Android AVD? , Creating & setting up custom Android emulator, Android Project Framework, My first android application.

UNIT - 2

Android Activities, UI Design and Database

Understanding Intent, Activity, Activity Lifecycle and Manifest, Form widgets, Text Fields, Layouts: Relative Layout ,Table Layout, Frame Layout, Linear Layout, Nested layouts.

UI design: Time and Date, Images and media, Composite, Alert Dialogs & Toast, Popup.

Menu: Option menu, Context menu, Sub menu.

Database: Introducing SQLite, SQLite Open Helper, SQLite Database, Cursor,

Content providers: defining and using content providers, example- Sharing database among two different applications using content providers, Reading and updating Contacts, Reading bookmarks.

UNIT - 3

Preferences, Intents and Notifications

Preferences: Shared Preferences, Preferences from xml, Intents:Explicit Intents, Implicit intents. Notifications: Broadcast Receivers, Services (Working in background) and notifications, Alarms.

UNIT - 4

Telephony, SMS and Location Based Services

Telephony: Accessing phone and Network Properties and Status, Monitoring Changes in Phone State, Phone Activity and data Connection.

SMS: Sending SMS and MMS from your Application, sending SMS Manually, Listening for incoming SMS Location based Services: Using Location Based Services, Working with Google Maps,Geocoder.

UNIT - 5

Accessing Android Hardware

Networking: An overview of networking, checking the network status, communicating with a server socket, Working with HTTP, Web Services.

Bluetooth: Controlling local Bluetooth device, Discovering and bonding with Bluetooth devices, Managing Bluetooth connections, communicating with Bluetooth.

UNIT - 6

Audio Video Handling

Playing Audio and Video, Recording Audio and Video, Using Camera and Taking Picture.

TEXT/REFERENCE BOOKS

1. Reto Meier "Professional Android™ Application Development", Wrox Publications.
2. Lauren Dercy and Shande Conder "Sams teach yourself Android application development" , Sams publishing
3. Hello Android, Introducing Google‟s Mobile Development Platform, Ed Burnette, Pragmatic Programmers, ISBN: 978-1-93435-617-3

BTHM606	Employability & Skill Development	2 Credits

Course Objectives:

- To develop analytical abilities.
- To develop communication skills.
- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- To expose the students to leadership and team-building skills.

Course Outcomes:

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT - 1

Soft Skills & Communication basics

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills. Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT - 2

Arithmetic and Mathematical Reasoning

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

UNIT - 3

Analytical Reasoning and Quantitative Ability

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

UNIT - 4

Grammar and Comprehension

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT - 5

Skills for interviews

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT - 6

Problem Solving Techniques

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, Wiley.
2. Wren and Martin, "English grammar and Composition", S. Chand publications.
3. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
4. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
5. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
6. Eugene Ehrlich, Daniel Murphy, "Schaum‟s Outline of English Grammar", McGraw Hills.
7. David F. Beer, David A. Mc Murrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

BTEXC701	Antennas and Wave Propagation	3 Credits

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

UNIT - 1

Uniform Plane Waves

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

UNIT - 2

Wave Propagation

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth‟s curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth‟s magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT - 3

Antenna Fundamentals

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

UNIT - 4

Wire Antennas

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT - 5

Antenna Arrays

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT - 6

Antennas and Applications

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS

1. C. A. Balanis, “Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, “Antenna & Wave Propagation”, Satya Prakashan, New Delhi.
5. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill, 2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

BTEXPE702A	Digital Image Processing	3 Credits

Course Objectives:

- To learn the fundamental concepts of Digital Image Processing.
- To study basic image processing operations.
- To understand image analysis algorithms.
- To expose students to current applications in the field of digital image processing.

Course Outcomes:

After successfully completing the course students will be able to

1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications.

UNIT - 1

Fundamentals of Image Processing

Steps in image processing, Human Visual System, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation, Image Histogram, Color fundamentals & models – RGB, HSI YIQ.

UNIT - 2

Image Enhancement and Restoration

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering.

UNIT - 3

Image Compression

Types of redundancy, Fidelity criteria, Lossless compression – Runlength coding, Huffman coding, Bit-plane coding, Arithmetic coding, Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG

UNIT - 4

Image Segmentation and Morphological Operations

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative –Prewitt and Sobe, Second order derivative – LoG, DoG, Canny, Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu‟s Method, Region Growing, Region Splitting and Merging, Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

UNIT - 5

Representation and Description

Representation – Chain codes, Polygonal approximation, Signatures. Boundary Descriptors – Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors – Topological, Texture, Principal Components for Description.

UNIT - 6

Object Recognition and Applications

Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing.

TEXT/REFERENCE BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education.
2. S Sridhar, “Digital Image Processing”, Oxford University Press.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, “Digital Image Processing Using MATLAB”, Second Edition, - Tata McGraw Hill Publication.
4. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, Tata Mc Graw Hill Publication

BTEXPE702B	Data Compression and Encryption/Cryptography	3 Credits

Course Objectives:

- To teach the students Lossless and Lossy compression techniques for different types of data.
- To understand data encryption techniques.
- Network security and ethical hacking.

Course Outcomes:

After successfully completion of the course, students will able to:

1. Implement text, audio and video compression techniques.
2. Understand symmetric and asymmetric key cryptography schemes.
3. Understand network security and ethical hacking.

UNIT - 1

Data Compression

Compression Techniques: Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques Text Compression: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW

UNIT - 2

Audio Compression

High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard.

UNIT - 3

Image and Video Compression

PCM, DPCM JPEG, JPEG –LS, and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG -2 H-264 encoder and decoder.

UNIT - 4

Data Security

Security goals, cryptography, stenography cryptographic attacks, services and mechanics, Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers, Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.

UNIT - 5

Number Theory and Asymmetric Key Cryptography

Primes, factorization, Fermat"s little theorem, Euler"s theorem, and extended Euclidean algorithm, RSA, attacks on RSA, Diffie Hellman key exchange , key management, and basics of elliptical curve cryptography, Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm.

UNIT - 6

System Security

Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.

TEXT/REFERENCE BOOKS

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann, 2000.
2. David Saloman, Data Compression: The complete reference, Springer publication.
3. Behrous Forouzen, —Cryptography and Network Security, Tata McGraw–Hill Education 2011.
4. Berard Menezes, Network Security and Cryptography, learning publication Cengage.
5. William Stallings, Cryptography and Network Security, Pearson Education Asia Publication, 5th edition.

BTEXPE702D	**Parallel Processing**	**3 Credits**

Course Objectives:

- Learn the concepts of parallel processing as it pertains to high-performance computing.
- Learn to design parallel programs on high performance computing.
- Discuss issues of parallel programming.
- Learn the concepts of message passing paradigm using open source APIs.
- Learn different open source tools.
- Learn the concepts of Multi-core processor

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Describe different parallel processing platforms involved in achieving High
2. Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source MPIs.
6. Design algorithms suited for Multicore processor and GPU systems using Open MP and CUDA.

UNIT - 1

Parallel Programming Platforms

Implicit Parallelism: Trends in Microprocessor Architectures ,Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

UNIT - 2

Principles of Parallel Algorithm Design algorithms

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

UNIT - 3

Basic Communication Operations and algorithms

One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

UNIT - 4

Analytical Modeling of Parallel Programs

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity and Data Mapping on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

UNIT - 5

Programming Using the Message Passing Paradigm

Principles of Message-Passing Programming, the Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators

UNIT - 6

Programming Shared Address Space Platforms Thread Basics

Threads, the POSIX Thread Application Programmer Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs.

TEXT/REFERENCE BOOKS

1. Introduction to parallel programming, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson Publication.
2. Introduction to Parallel Processing, M. SasiKumar, Dinesh Shikhare P.Raviprakash, PHI Publication.

BTEXPE703A	IoT 4.0	3 Credits

Course Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space.
- To provide ability to design and develop IOT devices.

Course Outcomes:

1. Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help of various protocols.
3. Learner will be able to understand IOT concept at data link layer.
4. Learner will be able to apply the concept of mobile networking to the internet connected devices.
5. Learner will be able to measure and schedule the performance of networked devices in IOT.
6. Learner will be able to analyze the challenges involve in developing IOT architecture.

UNIT - 1

Introduction

What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT - 2

Fundamental IoT Mechanisms & Key Technologies:

Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT - 3

Radio Frequency Identification Technology:

Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication.

UNIT - 4

Wireless Technologies For IoT : Layer ½ Connectivity :

WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT - 5

Governance of The Internet of Things:

Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

TEXT/REFERENCE BOOKS

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978-3842-19156-5, Springer.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

BTEXPE703B	Wireless Sensor Networks	3 Credits

Course Objectives:

- To introduce the emerging research areas in the field of wireless sensor networks
- To understand different protocols and there uses in WSN.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

UNIT - 1

Introduction

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT - 2

Networks

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT - 3

Protocols

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee

UNIT - 4

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT - 5

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

UNIT - 6

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS

1. Waltenegus Dargie , Christian Poellabauer, " Fundamentals Of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications, 2011.
2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, " Wireless Sensor Networks" , Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

BTEXPE703C	CMOS Design	3 Credits

Course Objectives:

- To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
- To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

UNIT - 1

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, Transistor as a switch, Inverter characteristics.

UNIT - 2

Integrated Circuit Layout: Design Rules, Parasitics

UNIT - 3

Delay: RC Delay model, linear delay model, logical path efforts

UNIT - 4

Power, interconnect and Robustness in CMOS circuit layout

UNIT - 5

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic

UNIT - 6

Sequential Circuit Design: Static circuits, Design of latches and Flip-flops.

TEXT/REFERENCE BOOKS

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4^{th} Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985

BTEXPE703D	**Process Instrumentation**	**3 Credits**

Course Objectives:

Course Outcomes:

At the end of the course the students will be able to

1. Understand various processes.
2. Develop Instrumentation for these processes.

3. Apply the control strategies for various process applications.
4. Mapping with PEOs.

UNIT - 1

Instrumentation for heat exchangers and dryers

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, types and operation of dryers, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.

UNIT - 2

Instrumentation for evaporators & crystallizer

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, types and operation of crystallizers, controlled and manipulated variables in crystallizer control problem, instrumentation for control of various types of crystallizers.

UNIT - 3

Instrumentation for distillation columns

Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, top and bottom composition control, reflux ratio control, pressure control schemes.

UNIT - 4

Boiler Instrumentation

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, air to fuel ratio controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, operation and types of reactors, instrumentation for temperature, pressure control in CSTRs.

UNIT - 5

Instrumentation for pumps

Types and operation of pumps, manipulated and controlled variables in pump control problem, pump control methods and instrumentation for pump control.

UNIT - 6

Instrumentation for compressors

Types and operation of compressors, capacity control methods of compressors, instrumentation for control of different variables in centrifugal, rotary and reciprocating compressors including surge and anti-surge control.

TEXT/REFERENCE BOOKS

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine, McGraw Hill Publishing company.

BTEXPE704A	Microwave Theory and Techniques	3 Credits

Course Objectives:

- To lay the foundation for microwave engineering
- To understand the applications of microwave engineering
- Carryout the microwave network analysis.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes
4. Understand the working principles of all the solid state devices
5. Choose a suitable microwave tube and solid state device for a particular application
6. Carry out the microwave network analysis
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

UNIT - 1

Transmission Lines and Waveguides

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands, Applications of Microwave, General solution for TEM, TE and TM waves, Parallel plate waveguide, and rectangular waveguide, Wave guide parameters, Introduction to coaxial line, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT - 2

Microwave Components

Multi-port junctions: Construction and operation of E-plane, H-plane, Magic Tee and Directional couplers.

Ferrites components: - Ferrite Composition and characteristics, Faraday rotation, Construction and operation of Gyrator, Isolator and Circulator.

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

UNIT - 3

Microwave Network Analysis

Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix

Scattering Matrix:-Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator, Related problems

UNIT - 4

Microwave Tubes

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation

O type tubes.

Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram.

Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning.

M-type tubes

Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications.

Slow wave devices

Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

UNIT - 5

Microwave Solid State Devices

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

UNIT - 6

Microwave Measurements

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

TEXT/REFERENCE BOOKS

1. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson
2. David M. Pozar, “Microwave Engineering", Fourth edition, Wiley.
3. M. Kulkarni, “Microwave and Radar engineering”, 3rd edition, Umesh Publications
4. M L Sisodia & G S Raghuvamshi, “Microwave Circuits and Passive Devices” Wiley, 1987
5. M L Sisodia & G S Raghuvanshi, “Basic Microwave Techniques and Laboratory
6. Manual”, New Age International (P) Limited, Publishers.

BTEXPE704B	Satellite Communication	3 Credits

Course Objectives:

- To provide students with good depth of knowledge in radar and Satellite communication.
- Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
- This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT - 1

Radar Communication

Basic principles and fundamentals, block diagram of basic radar, classification, radar performance factors, radar range equation, f actors influencing maxi mum range, effects of noise, Pulsed radar systems, block diagram and description, antennas and scanning, display methods, moving target indication, radar beacons, other radar systems such as CW Doppler radar, FM CW Doppler radar, phased array radars, planar array radars, various applications of radar such as navigational aids, military, surveillance.

UNIT - 2

Basic Principles satellite communication systems

General features, frequency allocation for satellite services, properties of satellite communication systems, Earth Station: Introduction, earth station subsystem, different types of earth stations

Satellite Orbits

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

UNIT - 3

Satellite Construction (Space Segment)

Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

UNIT - 4

Satellite Links

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

UNIT - 5

The Space Segment Access and Utilization

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

UNIT - 6

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS

1. Skolnik, “Principles of Radar Engineering” MCH.
2. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons
3. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed. 2001
4. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice- Hall, Inc., NJ
5. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY
6. Robert Gagliardi , "Satellite Communication" , CBS Publication
7. Ha, "Digital Satellite Communication", McGraw- Hill.

BTEXPE704C	Fiber Optic Communication	3 Credits

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
- Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Understand the properties of optical fiber that affect the performance of a communication link.
- Understand basic optical amplifier operation and its effect on signal power and noise in the system.
- Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers

UNIT - 1

Introduction

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

UNIT - 2

Types of optical fibers

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT - 3

Optical sources

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

UNIT - 4

Optical switches

Coupled mode analysis of directional couplers, electro-optic switches.

UNIT - 5

Optical amplifiers

EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT - 6

Nonlinear effects in fiber optic links

Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

TEXT/REFERENCE BOOKS

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997

7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York, 1990.

BTEXPE704D	Wireless Communication	3 Credits

Course Objectives:

- The objective of the course is to introduce the Concepts of basic wireless mobile communication systems.
- To learn and understand the basic principles of Telecommunication switching, traffic and networks.
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system.

Course Outcomes:

After successfully completing the course students will be able to

1. Explain and apply the concepts telecommunication switching, traffic and networks.
2. Analyze the telecommunication traffic.
3. Analyze radio channel and cellular capacity.
4. Explain and apply concepts of GSM and CDMA system.

UNIT - 1

Introduction and Cellular Concept

Existing technology, Evolution in wireless systems, Trends in cellular system Frequency Reuse channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Cellular System, Design in worst case with an omni Directional Antenna, Co-Channel Interference Reduction with use of Directional Antenna, Improving Coverage and Capacity in Cellular systems, Trunking and Grade of service

UNIT - 2

Wireless Communication Systems GSM

GS Services and features, GSM Architecture and interfaces, GSM Radio Sub System, GSM Channel Types , Traffic Channels, Control Channels, Example of a GSM call, Frame structure for GSM , Signal Processing in GSM, GPRS.

UNIT - 3

Wideband Modulation Techniques and OFDM

Basic Principles, OFDM Signal Mathematical representation, Block Diagram, Selection Parameters for modulation, Pulse shaping, Windowing, Spectral Efficiency, Synchronization

UNIT - 4

Wireless Communication Systems CDMA IS95

Direct sequence Spread Spectrum, Spreading codes, Multipath Signal Propagation and RAKE receiver, Frame Quality and BER Requirements, Critical challenges of CDMA,TIA IS95 System, Physical and Logical Channels of IS95, CDMA IS95 call processing, soft hand off and power control in CDMA, Access and Paging Channel Capacity, Reverse and Forward Link Capacity of a CDMA System.

UNIT - 5

Wireless Communication Systems

CDMA 2000: CDMA layering structure, CDMA 2000 channels, logical channels, forward link physical, forward link features, reverse physical channels, CDMA 2000 Media Access control and LAC sub layer, Data services, Data services in CDMA 2000, mapping of logical channels to physicals, evolution of CDMA IS95 to CDMA 2000.

UNIT - 6

More Wireless Communication Systems

Bluetooth, Wi-Fi Standards, WIMAX, Wireless Sensor Networks, Zigbee, UWB, IEEE 802.20 and Beyond.

TEXT/REFERENCE BOOKS

1. Wireless Communication: Principles and Practice Theodare. S. Rappaport- Pearson Education.
2. Wireless Communication: Upena Dalal, Oxford Higher Education.
3. Wireless Network Evolution: 2G to 3G, Vijay. K. Garg, Pearson Education.

4. Principles and Application of GSM, Vijay Garg, Joseph. E. Wilkes Pearson Education.
5. Mobile Cellular Telecommunications: Analog and Digital Systems, William C. Y. Lee, Tata McGraw Hill Edition.
6. Introduction to Wireless Telecommunication Systems and Networks- Gary. J. Mullet, DELMAR CENGAGE Learning.
7. Wireless Communications and Networks: 3G and Beyond, ITI Saha Misra, Tata McGraw Hill Edition.
8. Fundamentals of Wireless Communication: David Tse, Pramod Viswanath, CAMBRIDGE University Press.
9. Mobile Wireless communications, Mischa Schwartz, CAMBRIDGE University Press.

BTHM705 Financial Management 2 Credits

Course Objectives :

1. To help the students to deve lop cognizance of the importa nce of Financ ial Management in corporate valuation
2. To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.
3. To provide the students to analyze spec ific characteristics of Supply Cha in Industry and the irfuture action for cash flow
4. To enable students to synthesize related information and eva luate options for most logical and optima l solution such that they would be able to predict and control Debt Equity incurrence and improve results.

Course Outcomes:

1. At the end of this course students will demonstrate the ability to
2. The students would be able to understand and define basic terminology used in financeand accounts
3. The students would be able to prepare& appraise Financ ial Statements and evaluate acompany in the light of different measurement systems.
4. The students would be able to analyze the risk and return of alternative sources of financing.
5. Estimate cash flows from a project, inc luding operating, net working capital, and capita lspending.
6. To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calc ulate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
7. To describe and illustrate the important elements in project finance Using fina ncia l calculator and Excel in a variety of problems.

UNIT – 1 Introduction to Financial Accounting, Bookkee ping & Recording:

Meaning, Scope and importance of Fina ncia l Accounting. Financ ia l Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

UNIT – 2 Financial State me nt Preparation, analysis & Interpretation:

Preparation of financ ial statement and Profit & Loss Account, Bala nce Sheet. , Ratio Analysis - classification of various ratios.

UNIT – 3 Introduction To Financial Management:

Concept of business finance, Goa ls & objectives of financ ial manage ment, Sources of financ ing, Long Term financ ing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds

(Types, features & utility). Short Term Financ ing- bank finance, commercial paper, trade credit

UNIT – 4 Working Capital Management:
Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financ ing approaches for working capita l, Methods of forecasting working capita l requirements, Methods of Forecasting.

UNIT – 5 Time Value of Money & Capital Budgeting:
Concept of time value of money, Compounding & discounting; Future va lue of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

UNIT – 6 Project Financing:
Details of the company, its promoters and project finances required, profitability etc., Loan documentation-Appra isal of terms loans by financialinstitutions. Basic components of project finance.

TEXT & REFERENCE BOOKS

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw HillPublication 5th Edition.
2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5th Edition.
3. Taxman’s Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.
4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy,Himalaya Publishing House
5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2ndEdition.

Dr. Babasaheb Ambedkar Technological University, Lonere.

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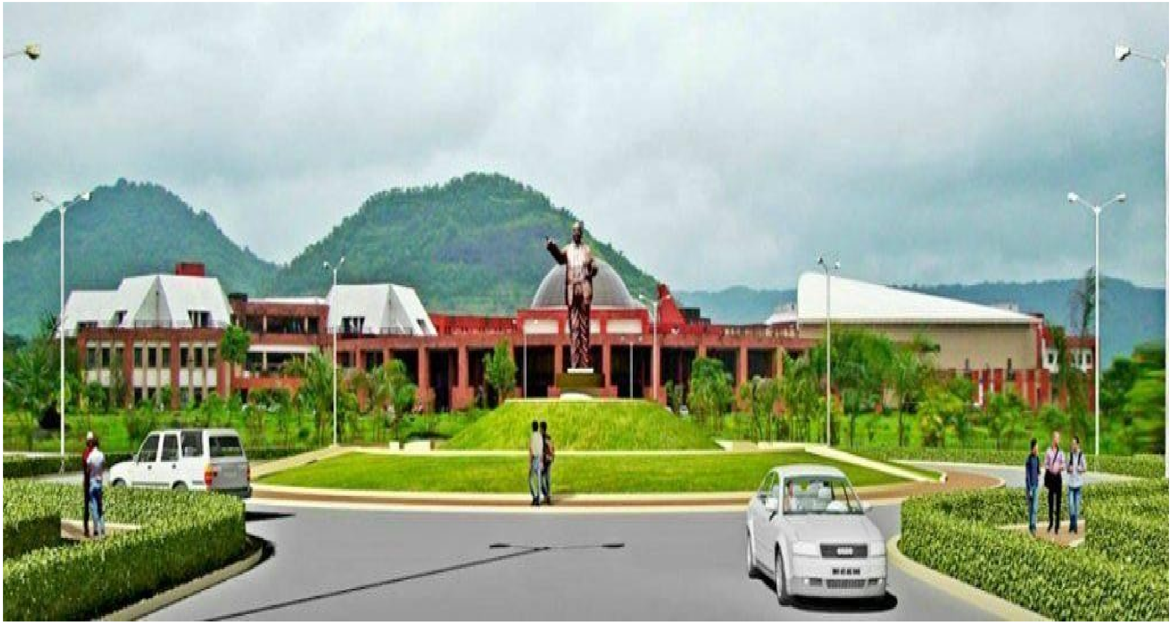
Second Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from the Academic Year 2021-2022



Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Basic Sciences Courses(BSC)		
BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics-III	(3-1-0)4
BTBS404	Analog and Digital Electronics	(3-0-0)3
BTBSL409	Analog and Digital Electronics Lab	(0-0-2)1

Engineering Sciences Courses(BSC)		
BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0)
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0)
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES305	Engineering Material Science	(3-0-0)

Humanities and Social Science Including Management Courses(HSSMC)		
BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM304	Basic Human Rights	Audit
BTHM506	Foreign Languages (A) Japanese Language (B) German Language	Audit
BTHM706	Engineering Operations and Project Management	Audit

Professional Core Course (PCC)		
BTEEC302	Electrical Machines-I	(3-1-0)4
BTEEC303	Electrical and Electronics Measurement	(3-1-0)4
BTEEL306	Electrical Machines Lab	(0-0-2)1
BTEEL307	Electrical and Electronics Measurement Lab	(0-0-2)1
BTEEC401	Network Theory	(3-1-0)4
BTEEC402	Power System	(3-1-0)4
BTEEC403	Electrical Machines-II	(3-1-0)4
BTEEL406	Network Theory Lab	(0-0-2)1
BTEEL407	Power System Lab	(0-0-2)1
BTEEL408	Electrical Machines-II Lab	(0-0-2)1
BTEEC501	Power System Analysis	(3-1-0)4
BTEEC502	Microprocessor and Microcontroller	(3-0-0)3
BTEEC503	Power Electronics	(3-1-0)4
BTEEL507	Power System Analysis Lab	(0-0-2)1
BTEEL508	Microprocessor and Microcontroller Lab	(0-0-2)1
BTEEL509	Power Electronics Lab	(0-0-2)1
BTEEC601	Switchgear Protection	(3-0-0)3
BTEEC602	Electrical Machine Design	(3-1-0)4
BTEEC603	Control System Engineering	(3-1-0)4

BTEEL606	Switchgear Protection Lab	(0-0-2)1
BTEEL607	Electrical Machine Design Lab	(0-0-2)1
BTEEL608	Control System Engineering Lab	(0-0-2)1
BTEEC701	High Voltage Engineering	(3-1-0)4
BTEEC702	Power System Operation and Control	(3-1-0)4
BTEEL707	High Voltage Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)		
BTEEPE405	(A)Electromagnetic Field Theory	(3-0-0)3
	(B)Signals and System	
	©Advance Renewable Energy Sources	
	(D)Electronic Devices and Circuits	
BTEEPE504	(A)Industrial Automation	(3-0-0)3
	(B)Power Quality Issues	
	©HVDC	
BTEEPE604	**(A)Application of Power Electronics in Power System**	(3-0-0)3
	(B)Smart Grid Technology	
	©Modeling, Simulation and Control of Electric Drives	
BTEEPE703	(A)Energy Audit and Conservation	(3-0-0)3
	(B)Electrical System Design for Building	
	©Flexible AC Transmission System	
	(D)Electrical Utilization	

Open Elective Course (OEC)		
BTEEOE505	(A)Embedded System	(3-0-0)3
	(B)Electrical Safety	
	©Condition Monitoring of Electric Apparatus	
BTEEOE605	**(A)E-waste Management**	(3-0-0)3
	(B)Power Plant Engineering	
	©Sensor Technology	
	(D)Lightning Interaction with Power System	
BTEEOE704	(A)Process Control Instrumentation	(3-0-0)3
	(B)Biomedical Instrumentation	
	©Mechatronics	
BTEEOE705	(A)Testing, Maintenance and Commissioning of Electrical Equipment	(3-0-0)3
	(B)Electric and Hybrid Electric Vehicles	
	©Internet of Things (IoT)	

Seminar / Mini Project / Internship		
BTES209S	Seminar	(0-0-2)1
BTES211P	(Internship – I) Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	1
BTEEM308	Miniproject-I	(0-0-4)2
BTEEP410	(Internship – II)	1
BTEEM509	Miniproject-II	(0-0-2)1
BTEES609	Seminar	(0-0-4)2
BTEEP610	(Internship – III)	
BTEEM708	In house project-I / Mini project-III	(0-0-4)2

Project(MP)		
BTEEP802	In house project-I / Internship & Project in Industry	(0-0-26) 13

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Plan of Study:

No.of Courses								
1	I	II	III	IV	V	VI	VII	VIII
2	BTBS101	BTBS201	BTBS301	BTEEC401	BTEEC501	BTEEC601	BTEEC701	BTEEPE801
3	BTBS102	BTBS202	BTEEC302	BTEEC402	BTEEC502	BTEEC602	BTEEC702	BTEEP802
4	BTES103	BTES203	BTEEC303	BTEEC403	BTEEC503	BTEEC603	BTEEPE703	
5	BTHM104	BTES204	BTHM304	BTBS404	BTEEPLE504	BTEEPE604	BTEEOE704	
6	BTES105	BTES205	BTES305	BTEEPE405	BTEEOE505	BTEEOE605	BTEEOE705	
7	BTES106	BTES206	BTEEL306	BTEEL406	BTHM506	BTEEL606	BTHM706	
8	BTBS107L	BTBS207L	BTEEL307	BTEEL407	BTEEL507	BTEEL607	BTEEL707	
9	BTES108L	BTES208L	BTEEP308	BTEEL408	BTEEL508	BTEEM608	BTEEM708	
10	BTHM109L	BTES209S	BTES211P	BTEEL409	BTEEPE509	BTEEP609	BTEEP609	
11		BTES211		BTEEP410	BTEEP409			

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

A. Program Educational Objectives (PEOs)

Graduates will able to–

1.To equip graduates with a strong foundation in engineering sciences and Electrical Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

2.Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.

3.Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes (POs)

Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum of Second Year

Semester III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics-III	3	1	-	20	20	60	100	**4**
PCC1	BTEEC302	**Electrical Machines-I**	3	1	-	20	20	60	100	**4**
PCC2	BTEEC303	Electrical and Electronics Measurement	3	1	-	20	20	60	100	**4**
HSSMC	BTHM304	Basic Human Rights	2	-	-					**Audit**
ESC	BTES305	**Engineering Material Science**	3	-	-	20	20	60	100	**3**
LC	BTEEL306	Electrical Machines-I Lab			2	60		40	100	**1**
LC	BTEEL307	Electrical and Electronics Measurement Lab			2	60		40	100	**1**
Project	BTEEP308	Mini Project-I			4	60		40	100	**2**
Internship	BTES211P	Internship-I Evaluation						50	50	**1**
			14	3	8	260	80	410	750	**20**

Semester IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC3	BTEEC401	**Network Theory**	3	1	-	20	20	60	100	**4**
PCC4	BTEEC402	**Power System**	3	1	-	20	20	60	100	**4**
PCC5	BTEEC403	Electrical Machine-II	3	1	-	20	20	60	100	**4**
BSC	BTBS404	Analog and Digital Electronics	3	-	-	20	20	60	100	**3**
PEC1	BTEEPE405	Group A	3	-	--	20	20	60	100	**3**
LC	BTEEL406	Network Theory Lab	-	-	2	30		20	50	**1**
LC	BTEEL407	Power System Lab	-	-	2	30		20	50	**1**
LC	BTEEL408	Electrical Machine-II Lab	-	-	2	30		20	50	**1**
LC	BTEEL409	Analog and Digital Electronics lab	-	-	2	30		20	50	**1**
Internship	BTEEP410	Internship-II (minimum of 4 weeks which can be completed partially in third or fourth semester or in at one time)	-	-	-	-	-	-	-	-
						220	100	380	700	**22**

Group-A

(A)Electromagnetic Field Theory

(B) **Signals and System**

(C) Advance Renewable Energy Sources

(D) **Electronic Devices and Circuits**

Semester III

(BTBS301) ENGINEERING MATHEMATICS 04 Credits

Unit 1: Vector Calculus 9 Hours

Vector Algebra, Cartesian, Cylindrical and Spherical Co-ordinate System. Transformation of Variables from Cartesian to Cylindrical and Spherical Coordinate System and Vice-Versa Coulomb‘s Law, Electric Field Intensity, Field of _N‘ Point Charges, Field of Line and Sheet of Charge, Electric Flux Density, Gauss‘s Law and Its Applications, Divergence and Divergence Theorem

Unit 2: Complex Numbers 9 Hours

Complex Numbers, geometric representation, powers and roots of complex numbers, Functions of a complex variable, Analytic functions, Cauchy-Riemann equations; elementary functions, Conformal mapping (for linear transformation); Contours and contour integration, Cauchy‘s theorem, Cauchy integral formula; Power Series and properties

Unit 3: Fourier Series 9 Hours

Introduction, Dirichlet Conditions, Fourier Series and its Coefficients for a given range, Even, odd functions and Fourier Series, Half-range Series, problems, Parseval Identity, Complex form of Fourier Series.

Unit 4: Differential Eqns., First Order ODE, 9 Hours

Differential Eqns., First Order ODE, y‘=f(x,y)- geometrical interpretation of solution, Eqns. reducible to separable form, Exact Eqns., integrating factor, Linear Eqns., Orthogonal trajectories,

Unit 5: Bessel functions 9 Hours

Fourier Method for IBV problem for wave and heat equation, rectangular region, Fourier method for Laplace equation in 3 dimensions, Numerical Methods for Laplace and Poisson‘s equation. Biot-Savart, Amperes Circuital Laws and their Applications, Curl, Stoke‘s Theorem, Magnetic Flux Density, Scalar and Vector Magnetic Potential, Maxwell‘s Equations in Steady Electric and Magnetic Fields 30 ,FOURIER TRANSFORMS: Fourier Integral representation, Fourier integrals, Fourier transforms, Sine, Cosine transforms, inverse transforms, Illustrations, Properties, Parseval Identity, evaluation of certain real integrals.

Text Books :

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books :

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O‘ Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

(BTEEC302)ELECTRICAL MACHINE-I **04 Credits**

Unit 1: Single Phase Transformer **7 Hours**

Transformer construction, Ideal and practical transformer, exact and approximate equivalent circuits, no load and on load operation, phasor diagrams, power and energy efficiency, voltage regulation, parallel operation, effect of load on power factor, Per Unit system, excitation phenomenon in transformers, switching transients, Auto transformers, Variable frequency transformer, voltage and current transformers, welding transformers, Pulse transformer and applications

Unit 2: Three Phase Transformers **8 Hours**

Constructional features of three phase transformers, Cooling methodology, Standard and special transformer connections, Phase conversion, Parallel operation of three phase transformers, three winding transformers and its equivalent circuit, On load tap changing of transformers, Modern trends in transformers, Type and routine tests, Standards.

Unit 3: Electromechanical Energy Conversion Principles **6 Hours**

Energy in a magnetic systems, field energy and mechanical force, energy in singly and multiply excited magnetic systems, determination of magnetic force and torque from energy and coenergy, Forces and torques in magnetic field systems, dynamic equations of electromechanical systems and analytical techniques.

Unit 4: DC Generators **9 Hours**

Construction of armature and field systems, Working, types, emf equation, Armature windings, Characteristics and applications, Building of emf, Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction; Commutation process, Causes of bad commutation and remedies: Construction of armature and field systems, Working, types, emf equation, Armature windings, Characteristics and applications, Building of emf, Armature reaction - Demagnetizing and Cross magnetizing mmfs and their estimation; Remedies to overcome the armature reaction; Commutation process, Causes of bad commutation and remedies,

Unit 5: D.C. Motors **9 Hours**

Principles of working, Significance of back emf, Torque Equation, Types, Characteristics and Selection of DC Motors, Starting of DC Motors, Speed Control, Losses and Efficiency, Condition for Maximum Efficiency, Braking of DC Motors, Effect of saturation and armature reaction on losses; Applications, Permanent Magnet DC Motors, Type and Routine test

Unit 6: Special Machines **6 Hours**

Constructional details of reluctance machine, variable-reluctance machines, basic VRM analysis, practical VRM analysis, stepper motors and their analysis, Brushless DC motors.

Text Books :

1. J. B. Gupta," Theory and Performance of Electrical Machines," S. K. Kataria& Sons, New Delhi
2. P. S .Bimbra," Electrical Machinery", Khanna Publishers
3. B. L. Theraja, A. K. Theraja," A text book of Electrical Technology," S. Chand Publishers
4. Asfaq Hussein," Electric Machines," Danpat Rai Publisher

Reference Books :

1. Bhattacharya S. K, “Electrical Machines”,(Tata McGraw Hill Publications)
2. Kothari Nagrath, “Electrical Machines”, (Tata McGraw Hill Publications)
3. M. N. Bandopadhyay, “Electrical Machines”, (Tata McGraw Hill Publications)
4. Fitzaralda, “Electrical Machines”, (Tata McGraw Hill Publications)

BTEEC303 ELECTRICAL & ELECTRONICS MEASUREMENT 04 Credits

Unit 1: Philosophy of Measurement 4 Hours

Introduction to Measurement, Methods of Measurements, Measurement System, Instruments, Classification of Instruments, Characteristics of Instruments & Measurement System, Errors in Measurement, Types of Errors, Calibration, Standards and their classifications.

Unit 2: Analog Measurement of Electrical Quantities 8 Hours

Classification of Analog Instruments, Principle of Operation, Operating Torques, Different types of Damping and Control Systems, Types of Instrument: PMMC, Extension of Range of PMMC Instruments, Moving Iron, Electro-dynamometer, Hot wire, Thermocouple, Induction, Electrostatic, Rectifier.

Power Measurement: Power measurement in AC and DC circuits, Power and Power Factor, Electrodynamometer-type Wattmeter, Induction-type Wattmeter, Power measurement in Poly-phase systems, Power measurement in Three-Phase systems, Reactive Power measurements, Power measurement with Instrument Transformers - Potentiometer and Current Transformer.

Measurement of Energy: Induction-type Energy Meter, Errors in Induction-type Energy Meters and their compensation, Testing of Energy Meters.

Unit 3: A.C. and D.C. Bridges 8 Hours

Measurement Resistance: Wheatstone Bridge, Kelvin Bridge Method, Kelvin Double Bridge Method, Ammeter-Voltmeter Method, Direct deflection method, Loss of charge method, Megohm Bridge, Megger.

Measurement of Inductance and Capacitance: Maxwell Bridge, Hays Bridge, Anderson Bridge, De-Sauty Bridge, Schering Bridge, Wien Bridge.

Localisation of Cable Faults: Murray Loop Test, Varley Loop Test.

Magnetic Measurements: Ballistic Galvanometer, Flux Meter, Maxwell's Bridge Method, AC Potentiometer Method.

Unit 4: Digital Measurement of Electrical Quantities 7 Hours

Concept of Digital Measurement, Block diagram of Digital Instrumentation System, Digital versus Analog Instrument, Digital Voltmeter, Types of Digital Voltmeter, Digital Multi-meter Digital Counter, Digital Frequency Meter, **Power Analyzer &** Harmonic Analyzer, Spectrum & Wave analyzer, Oscilloscopes, Cathode Ray Oscilloscope (CRO), Digital Storage Oscilloscopes (DSO), Signal Generator, Q-Meter.

Unit 5: Transducers 8 Hours

Definition, Classification & selection of transducers, **Characteristics, Transducers for measurement of Displacement (RVDT & LVDT), Speed, Angular Rotation, Altitude, Force, Torque, Humidity and Moisture, Pressure, Strain and Temperature (Thermocouple and RTD method), Position, Hall Effect transducer and applications. Instrumentation amplifiers,** Signal Conditioning, **Data Transmission and Telemetry,** Data Acquisition Systems.

Displays and Recorders: Different types of Display – Different types of Recorder: Graphic Recorder, Strip Chart Recorder, G**alvanometric and** Potentiometer type R**ecorders,** X-Y Recorder, Circular Chart Recorder, Magnetic Tape Recorder, D**igital Recorders,** Printer and Plotter **(Block Diagram, theory and applications only)**

Reference Books/ Text Books:

1. E.W. Golding & F.C. Widdis, "Electrical Measurement &Measuring Instrument", A.H. Wheeler & Co. India.
2. A.K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons.
3. Forest K. Harries, "Electrical Measurement", Willey Eastern Pvt. Ltd. India.
4. M.B. Stout, "Basic Electrical Measurement" Prentice hall of India.
5. W.D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International.
6. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria & Sons.
7. Prithwiraj Purkait, Budhaditya Biswas , Santanu Das and Chiranjib Koley, "Electrical and Electronics Measurements and Instrumentation", McGraw Hill.

BTHM304 BASIC HUMAN RIGHTS **Audit Course**

Unit 1: The Basic Concepts **6Hrs**

Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.

Unit 2: Human Rights and Human Duties: **6 Hrs**

Origin, Civil and Political Rights, Contribution of American Bill of Rights, French Revolution, Declaration of Independence, Rights of Citizen, Rights of working and Exploited people, Fundamental Rights and Economic program, India's Charter of freedom

Unit 3: Society, Religion, Culture, and their Inter-Relationship **6 Hrs**

Impact of Social Structure on Human behaviour, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

Unit 4: Social Structure and Social Problems **6 Hrs**

Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

Unit 5: State, Individual Liberty, Freedom and Democracy **6 Hrs**

The changing of state with special reference to developing countries, Concept of development under development and Social action, need for Collective action in developing societies and methods of Social action, NGOs and Human Rights in India: - Land, Water, Forest issues.

Unit 6: Human Rights in Indian Constitution and Law **6 Hrs**

The constitution of India:

(i) Preamble

(ii) Fundamental Rights

(iii) Directive principles of state policy

(iv) Fundamental Duties

(v) Some other provisions

Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission

Reference Books:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

(BTES 305) ENGINEERING MATERIAL SCIENCE 04 Credits

Unit: 1 Electrical Conducting Materials 7 Hours

Introduction,Crsytal structure, atomic bonding,Electronic and Ionic Conduction , Conductivity in Metals , Ohm‘s Law , Relaxation Time , Collision Time , Mean Free Path of an Electron , Electron Scattering , Resistivity of Metals , Effect of Temperature and Impurity on Conductivity , Joule‘s Law , High Conductivity And Resistivity Materials , Superconductivity and Applications Conducting materials: quantum free electron theory- Fermi-Dirac distribution - Materials for electric resistances.

Unit 2: Dielectric Materials 7 Hours

Crystalline structure-perfection/imperfection, Dielectric as Electric Field Medium, Dielectric constant and polarizability, types of polarization,leakage currents, dielectric loss, dielectric strength,breakdown voltage,temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials

Unit 3: Semiconductor Materials 7 Hours

Semiconductors: Mechanism of conduction in semiconductors. Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI). Properties of Semiconductors: Electron-hole concentration, Fermi level, Generation and recombination, carrier life-time, diffusion length. Scattering and mobility of carriers. Einstein relation.LASER Plain carbon steels and their applications. Alloy steels: High speed steels, stainless steels,HSLA; Non Ferrous alloys: Al alloys, Cu alloys, applications of these alloys

Unit 4: Magnetic Materials 7 Hours

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. factors effecting permeability and hysteresis, Ferromagnetic materials, properties of ferromagnetic materials in static fields,curie point, anti-ferromagnetic materials, piezoelectric materials ,pyro electric materials Magnetic Properties of Materials: Atomic Interpretation of Diamagnetic, Paramagnetic, Anti-Ferromagnetic and Ferromagnetic Materials. Ferromagnetic Domain, Magnetic Materials for Ferromagnetic Tape And Memory Devices, Magnetic materials: magnetic materials used in electrical machines instruments.

Unit 5: Special Purpose Materials 05 Hours

Refractory Materials, Structural Material‘s, Radioactive Materials, Galvanization and Impregnation of materials, Non Destructive Testing: Ultrasonic Radiography, X-ray diffraction- Bragg‘s law.

Text Books:

1. Material Science and Engineering – V. Raghavan

Reference Books

1. Electrical Engineering Materials – A.J. Dekker
2. Science of Engineering Materials and Carbon Nanotubes - C.M. Srivastava and C. Srinivasan
3. Solid State Physics – A.J. Dekker.

(BTEEL306)ELECTRICAL MACHINE-I LABORATORY **01 Credits**

Perform Any eight experiment from given list as a part of practical submission

List of Experiments

1. To perform the polarity test on single phase transformer
2. To perform the transformation ratio test on single phase transformer
3. To perform the following three phase transformer connections:

   1) Star-star 2) Star-Delta

   3) Delta – Delta 4) Delta –Star

   5)Open Delta 6) Scott Connection
4. To perform the direct loading test on three phase transformer to calculate efficiency and regulation
5. To perform the indirect loading test on three phase transformer to calculate efficiency
6. To perform the parallel operation of two single phase transformers.
7. To study D. C. Machine
8. To draw the speed characteristics of DC shunt motor by- (1) Armature Control method (2) Field Control method
9. To perform the load test on DC Shunt motor.
10. To study the load characteristics of DC generator
    I) Cumulative compound generator.
    II) Differential compound Generator
11. To study the magnetization ,internal and External characteristics of a D. C. generator
12. To Study Starters for DC Shunt Motor.

BTEEL307 ELECTRICAL & ELECTRONICS MEASUREMENTS LABORATORY 1 Credit

List of Experiments: (Perform minimum 8-10 experiments from following list)

1) Measurement of Low resistance by Kelvin Double bridge.
2) Measurement of High resistance and Insulation resistance using Megger.
3) Measurement of Inductance by Maxwell bridge, Hays bridge, Anderson bridge.
4) Measurement of Capacitance by De Sauty bridge, Schering bridge.
5) Measurement of Earth resistance using Earth Tester.
6) Study the extension of Voltmeter, Ammeter and Wattmeter.
7) Measurement of three phase power by Two Wattmeter and One Wattmeter method.
8) Study of types of instrument: PMMC, Moving Iron, Electro-dynamometer, Hot wire, Thermocouple, Induction, Electrostatic, Rectifier.
9) Study of Energy Meter.
10) Study of Instrument T/F and its types.
11) Characterize the temperature sensor (RTD):
    a) Static Characteristics of RTD: Study the change in resistance of RTD probe depending on the process temperature.
    b) Dynamic characteristics: Study the dynamic response of RTD probe
12) Characterize the Thermocouple:
    a) Static Characteristics of Thermocouple: Study the change in EMF of a thermocouple in response to the process temperature.
    b) Dynamic characteristics of Thermocouple: Study the dynamic response of Thermocouple.
13) Characterize of LVDT: To find the effect of various parameters like change in supply voltage, change in supply frequency on output of given LVDT
14) Characterize the strain gauge sensor:
    a) Study of Strain Gauge: To study the working principle of strain gauge.
    b) Study of effect of change in position of weight applied on Strain Gauge performance.
    c) Study of effect of change in temperature on the performance of Strain Gauge.
15) Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
16) Study of storage oscilloscope and determination of transient response of RLC circuit.

BTEEP308 Miniproject-I **2 Credits**

Guidelines:

Stages	**Work to be carried**	**Time**
I	• Selection of a mini viable project idea (Hardware or Software Based) on recent trends in Electrical Engineering.	**4 hours**
II	• Study various resources and components in electrical engineering projects • Application of those components in Selected Project	**6 hours**
III	• Study of Circuit Diagram • Study datasheet of basic circuit components of a project • Study various software in building of project like SCILAB, MATLAB or other circuit Simulator	**6 hours**
IV	• Designing of PCB for selected Project once tested on breadboard	**4 hours**
V	• Verification of the results obtained of the working model or the simulation results. • Compare with desired results and take corrective action	**4 hours**
VI	• Completion of project by developing the Project Report and submitting the report to the concerned to receive the final credits.	**6 hours**

Semester IV

BTEEC401 NETWORK THEORY 04 Credits

Unit 1:Active & Passive Circuit Element 7 Hours

Independent & dependent voltage & current sources, R, L, C, self and mutual inductance circuit parameters, Their mathematical models, Voltage- current- power relations, Independent voltage and current sources, dependent sources, Source transformation, star-delta conversion. Classification of element: Lumped and distributed, Linear and non-linear, Unilateral and Bilateral, Time invariant and variant.

Unit 2: Network theorems 12Hours

Kirchhoff's laws (KCL and KVL), Mesh analysis, nodal analysis, Solution of D.C. resistive network, writing loop equations, Node equations directly in matrices form, super node and super mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Maximum power transfer theorem, Substitution theorem, Millman's Theorem, Tellegen's theorem for D.C and A.C. circuits.

Graph Theory: Network topology, graph, Tree, Branches, Chords, incidence, cut set and tie set matrix using network topology, Concept of duality & dual networks.

Unit 3: Transient Response Analysis in circuit 7 Hours

Initial and final condition of circuit, procedure for evaluating initial conditions, solution of first and Second order differential equations of series & parallel R-L, R-C, R-L-C circuits, Time constant, General & particular solutions, Particular integral & complimentary functions, Numerical

Unit 4: Application of Laplace's Transform 7 Hours

Standard test input signal- Unit step, Impulse & ramp functions and their Laplace transform, Solution of differential equation using Laplace transform, solve of R-L, R-C, R-L-C circuits using Laplace transform, Transient and steady state response of RL and RC circuit to various functions using Laplace transform.

Two port network: Terminals& terminal pairs, Driving points & transfer admittance, Transfer functions, Concept of poles & zeroes, Two port networks, Z, Y & the transmission parameters relationship between parameter sets.

Unit 5: Sinusoidal Steady State A. C. Circuit 7 Hours

R-L-C series circuits, Series resonance Variation of Z with frequency, maximum value of VC & VL, Magnification, Bandwidth, Q factor. Parallel Resonance: Resonance frequency for tank circuit frequency, Locus diagram of series R-L, R-C with variable R & X.

Filter: Introduction classification, Low pass, High pass, Band pass & band reject filter, active & passive filters. Application of Fourier series, Expansion for periodic & non-sinusoidal waveforms.

Text/Reference Books:

1. N Balabanian and T.A. Bickart, "Linear Network Theory: Analysis, Properties, Design andSynthesis", Matrix Publishers, Inc. 1981.
2. L.O. Chua, C.A. Desoer, E.S. Kuh, "Linear and Nonlinear Circuits", McGraw – HillInternational Edition 1987.

3. Van Valkenburg, “Network Analysis”, Third Edition, 2009, Prentice Hall of India.
4. Sudhakar, A.Shyammohan, “Circuits and Network”, Third Edition, 2006, Tata McGrawHill
5. D. Roy Choudhury, “Networks and systems”.New Age International Publishers
6. Kelkar and Pandit, “Linear Network Theory”, Pratibha Publication.
7. Mahmood Nahvi, Joseph AEdminister, “Schaum's Outline of Electric Circuits”, 6th edition,Tata McGraw-Hill.

(BTEEC402) POWER SYSTEM 04 Credits

Unit 1: Electrical Power Generation 9 Hours

Evolution of Power Systems, Typical Layout of an Electrical Power System–Introduction to different sources of energy. Construction and working of thermal power plants, Hydro power station, Nuclear Power Plant with neat block diagram of main parts. Descriptive treatment of alternator exciter & excitation systems, major electrical equipments in generating stations.

Unit 2: Electrical Design of Overhead Transmission Lines 9 Hours

Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, concept of GMD and GMR, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance. skin effect, proximity effect, Ferranti Effect.

Corona: Introduction, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona.

Unit 3: Mechanical Design of Transmission Lines 8 Hours

Types of conductors, Choice of conductor materials, Stranded copper & ACSR conductor, Insulation consideration, Different types of insulator, supports, distribution of voltage across the insulator string, String efficiency, Effect of wind & ice coating on transmission line, sag due to equal & unequal supports, with their derivation, Numericals.

Unit 4: Performance of Transmission Lines 8 Hours

Classification of overhead transmission lines, important terms, performance of single phase short transmission lines, three phase short transmission lines, effect of load power factor on regulation and efficiency, different types of medium transmission line, Analysis of long transmission lines, generalized constant of transmission line, determination of generalized constant of transmission lines, percentage regulation, Transmission efficiency, numerical based on above.

Unit 5: AC & DC Distribution 8 Hours

Classification of Distribution system, Requirement of distribution system, design consideration in distribution system. AC Distribution: Calculations, method of Solving AC Distribution problem, three phase unbalanced load, four wire unbalanced star connected load, ground detector, DC Distribution: types, DC distribution calculation, three wire DC system.

Text/References :

REFERENCES:

1. V.K Mehta & Rohit Mehta. “ Principles of Power System” S Chand Publications
2. Gupta B. R. ” Power Plant Engineering”.(Eurasia publications)
3. Nag P. K. “ Power Plant Engineering”,(Tata McGraw Hill Publications)
4. Kothari Nagrath, “Electric Power System”, (Tata McGraw Hill Publications)
5. Wadhva S. L.,“Electric Power System”,(Tata McGraw Hill Publications)
6. Stevension W. B., “Power System”, (English Language Book Society publications)

(BTEEC403)ELECTRICAL MACHINE-II **04 Credits**

Unit 1: Basic Concepts in A.C. Machines **5 Hours**

Classification of A.C. Machines, principle of operation and constructional features of synchronous and induction machines, rotating mmf waves in A.C. Machines

Unit 2: Constructional Armature windings **5 Hours**

Introduction, ac machine windings, winding factors, the emf equation, harmonics in generated emf, causes of harmonics and their suppressions

Unit 3: Synchronous Machines **9 Hours**

Synchronous Machines : Construction, types, armature reaction, circuit model of synchronous machine, determination of synchronous reactance, phasor diagram, power angle characteristics, parallel operation of synchronous generators, synchronizing to infinite bus bars, two axis theory, synchronous motor operation, characteristic curves, synchronous condenser, dynamics.

Unit 4: Three phase Induction (Asynchronous) Motor **9 Hours**

Types of induction motor, flux and mmf waves, development of circuit model, power across air gap, torque and power output, oc and sc tests, circle diagram, starting methods, cogging and crawling, speed control, deep bar/ double cage rotor, induction generator, induction machine dynamics, high efficiency induction motors

Unit 5: Fractional Kilowatt Motors **6 Hours**

Introduction, single phase induction motors, double revolving field theory, circuit model of single phase induction motor, determination of circuit parameters

Unit 6: Special Machines **6 Hours**

Single phase synchronous motors, permanent magnet ac motors, ac servomotors, linear induction motor

Text Books :

1. J. B. Gupta," Theory and Performance of Electrical Machines," S. K. Kataria& Sons, New Delhi
2. P. S .Bimbra," Electrical Machinery", Khanna Publishers
3. B. L. Theraja, A. K. Theraja," A text book of Electrical Technology," S. Chand Publishers
4. Asfaq Hussein," Electric Machines," Danpat Rai Publisher

Reference Books :

1. 1.Say M. G., "Design & performance of A.C. Machines", (Book Publications,3rd edition)
2. 2..Bhimra P. S., "Electric Machines", (South Ex Publications, New Delhi)
3. D. P. Kothari, I. J. Nagrath,"Electric Machines ", Tata McGraw Hill Publication, Fourth edition, reprint 2012.
4. A. F. Puchstein, T.C. Lloyd, A.G. Conrad, "Alternating current machines", John Wiley and Sons, New York 1954.
5. 5.A.E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans ,"Electric Machinery ", Tata McGraw Hill Publication, sixth edition 2002 4. Fitzaralda, "Electrical Machines", (Tata McGraw Hill Publications))

BTBS404 ANALOG AND DIGITAL ELECTRONICS 04 Hours

Unit 1: Transistor as an Amplifier **5 Hours**

Load line, Small signal low frequency analysis of single stage amplifier in different configuration, High frequency equivalent circuit of transistor (hybrid pi), Cascade amplifier, High input resistance circuits- C coupled amplifier Frequency response, Definition of 3 dB bandwidth, Effect of cascading on gain & BW, Classification of amplifiers

Unit 2: operational amplifier **6 Hours**

Block diagram of operational amplifier, Properties of ideal operational amplifier, Explanation of different terms appearing in OP-Amp application (offset, bias, quantities, PSRR, CMRR, Ad, AC, Slew rate etc.), Operation of circuit diagram of OP-Amp using discrete components & I.C. diagram, Different types of current of current sources in I.C. technology, frequency response of OP-Amp, OP-Amp parameters & minimization technique of temperature effect, Inverting & Non-inverting operation of Op-Amp & analysis for AG, RI, RO, Linear & non-linear circuit application of OP-Amp

Unit 3: Number Systems **6 Hours**

Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion. Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and Vica-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion.

Unit 4: Digital Logic Gate Characteristics **6 Hours**

TTL logic gate characteristics: Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic. TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, and C-MOS & MOSFET. Interfacing logic families to one another. Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops Counters: Synchronous & asynchronous ripple and decade counters, Modulus counter, skipping state counter, counter design, state diagrams and state reduction techniques. Ring counter. Counter applications. Registers: buffer register, shift register

Unit 5: Minimization Techniques **7 Hours**

Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic Conversion of truth tables in POS and SOP form Incomplete specified functions. Variable mapping Quinn-McKlusky minimization techniques c functions with K-map

Unit 6: Combinational Systems **6Hours**

Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders BCD adder Binary multiplier Decoder: Binary to Gray decoder, BCD to decimal, BCD to 7- segment decoder‘ Multiplexer, DE multiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode Switching matrix. Design of logic circuits by multiplexers, encoders, decoders and DE multiplexers.

Text/Reference Books:

1. Mandal, Digital Electronics: Principles and Applications, TMH 2009

2. Leach, Digital Principles and Applications, ed. 7, TMH 2008

3. M. Morris Mano, Digital Logic and Computer Design, Pearson Edu. 2014

(BTEEPE405A)ELECTROMAGNETIC FIELD THEORY 03credits Credits

Unit 1: vector calculus **7 Hours**

Scalars and vectors, Vector algebra, Vector components and unit vectors, Vector field Vector field Dot, cross products circular, cylindrical and spherical coordinate systems Coulomb's Law and electric field intensity Electric field due to a continuous Volume Charge Distribution field of a line charge field of a Sheet of a charge streamlines and sketches of fields

Unit 2: Electromagnetic field 1 **8 Hours**

Constructional Gauss's Law and its Applications: to some symmetrical charge distribution and differential volume element divergence Maxwell's first equation (electrostatics), the vector operator and the Divergence theorem Energy and Potential Energy expended in moving a point charge in an electric field line integral, potential difference potential, potential gradient, potential field of a point charge and system of charges dipole, energy density in electrostatic field

Unit 3: Electromagnetic field 2 **6 Hours**

Current and current density, continuity of current, metallic conductors conductor properties and boundary conditions method of images, semiconductors, nature of dielectric, boundary conditions for perfect dielectric capacitance, and capacitance of two-wire line. Poisson's and Laplace Equations Uniqueness theorem examples in rectangular, spherical and cylindrical coordinates, product solutions of Laplace equations, and solutions of Poisson's equations

Unit 4: Magneto statics 1 **8 Hours**

Biot-Savart's law Amperes circuital law curls strokes theorem magnetic flux and magnetic flux density scalar and vector magnetic potentials

Unit 5: Magneto statics 2 **7 Hours**

Force on moving charge, differential current element force between differential current element and torque on a closed circuit nature of magnetic materials, magnetization permeability, magnetic boundary conditions, magnetic circuit, potential energy and forces on magnetic materials, self and mutual inductance

Unit 6: Maxwell's equations **4 Hours**

Faradays law, Maxwell's equations in point form, Maxwell's equations in integral form, Retarded potentials.

Text Books :

1) "William H. Hayt & John. A. Buck, "Engineering Electromagnetics" Mc. Graw-Hill Companies, 7th Editon.2006.
2) "Sadiku- "Electromagnetic Fields" , Oxford Publications.

Reference:

3) D. J. Griffiths, ‗Introduction to Electrodynamics', Addison Wesley, 1999.
4) D. K. Cheng, ‗Field and Wave Electromagnetics', Addison Wesley, 1999.
5) N. N. Rao, ‗Elements of Engineering Electromagnetics', Pearson Education, Inc, 2004.
6) Mathew N.O. Sadiku,Elements of Electromagnetics,Oxford Univ Press
7) N.N. Rao, Basic electromagnetic and applications, McGraw Hill

BTEEPE405BSignals and System **03 Credits**

Unit 1: Elements of Signal Space Theory **7 Hours**

Objective and overview, signal and system types and classifications, Different types of signals; Linearity, time invariance and causality; Impulse sequence, impulse functions and other singularity functions

Unit 2: Classification of System **9 Hours**

CT and DT system, basic properties of system – linear time invariant system and properties, LTI system: Causality, stability, step response, impulse response.

Unit 3: Convolution **7 Hours**

Convolution sum, convolution integral and their evaluation; Time-domain representation and analysis of LTI systems based on convolution and differential equations. Convolution for CT & DT signals and systems; Necessity of representations of Signals & Systems in Time- and Transformed-domains

Unit 4: Transform domain considerations **7 Hours**

Laplace transforms, inverse Laplace transforms and Z-transforms; Applications of transforms to discrete and continuous systems-analysis; Transfer function, block diagram representation.

Unit 5: Fourier series and Fourier Transform **7 Hours**

Sampling theorem, Discrete Fourier transform (DFT), estimating Fourier transform using DFT Analysis of discrete time signal: sampling of CT signals and aliasing, DTFT and properties.

Reference Books:

1. Signals and Linear Systems, Gabel R.A. and Robert R.A, John Wiley and Sons, New York
2. Signals and Systems , Oppenheim, Wilsky and Nawab, Prentice Hall, New Delhi
3. Systems and Signal Analysis, C.T.Chen, Oxford University Press, New Delhi
4. Probabilistic Methods of Signals and System Analysis, Cooper G.R and McGillem C.D, Oxford University Press, Cambridge.
5. Signals and Systems, Ziemer R.E., Tranter W.H., and Fannin D.R., Pearson Education Asia, Singapore

(BTEEPE405C) ADVANCED RENEWABLE ENERGY SOURCES 04 Credits

Unit 1: Introduction 7 Hours

Renewable Sources of Energy- Introduction to renewable energy, various aspects of energy conversion, principle of renewable energy systems, Grid-Supplied Electricity-Distributed Generation-Renewable Energy Economics-Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

Fuel Cells: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues-Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electrolyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit-Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

Unit 2: Wind Power Plants 7 Hours

Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, windspeed monitoring, Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose ofthe Energy Generated -General Classification of Wind Turbines-Rotor Turbines-Multiple-BladeTurbines -Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind PowerEnergy -Analysis of Small Generating Systems. Aerodynamics of wind turbine rotor, site selection,wind resource assessment, wind energy conversion devices: classification, characteristics, andapplications. Hybrid systems, safety and environmental aspects.

Unit 3: Photovoltaic Power Plants 7 Hours

Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV CellCharacteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parametersfor Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar EnergyEconomical.

Analysis of Solar Energy. environment and social implications Solar Energy: Solarradiation its measurements and prediction, solar thermal flat plate collectors, concentratingcollectors, applications, heating, cooling, desalination, power generation, drying, cooking etc,principle of photovoltaic conversion of solar energy, types of solar cells and fabrication.

Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping,power generation schemes.

Unit 4: Bio-Energy 8 Hours

Biomass resources and their classification, chemical constituents and physicochemical characteristics of biomass, biomass conversion processes, thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction. Biochemical conversion: anaerobic digestion, alcohol production from biomass. Chemical conversion process: hydrolysis and hydrogenation.

Biogas: generation, types of Biogas Plants, applications

Induction Generators: Principles of Operation-Representation of Steady-State Operation-Power andLosses Generated-Self-Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process-Interconnected and Stand-alone operation Speed and Voltage Control-Economical Aspects.

Unit 5: Storage Systems **8 Hours**

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels -SuperconductingMagnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage-Storage Heat -Energy Storage as an Economic Resource.Integration of Alternative Sources of Energy: Principles of Power Injection-Instantaneous Activeand Reactive Power Control Approach-Integration of Multiple Renewable Energy SourcesIslandingandInterconnectionControl-DGControlandPowerInjection.

Interconnectionof Alternative Energy Sources with the Grid: Interconnection Technologies Standardsand Codes for Interconnection-Interconnection Considerations -InterconnectionExamples for Alternative Energy Sources.

Text/Reference Books :

1. Rao and Parulekar, Energy Technology, Khanna Publishers, New Delhi, Second reprint 2002
2. G.D Rai, Non-conventional Energy Sources,Khanna Publishers, New Delhi, tenth reprint 2002
3. C. S. Solanki, ―Solar Photovoltaics Fundamentals, Technologies and Applications‖, PHI, 2011
4. B. H. Khan,―Non-conventional Energy Resources‖,TataMcGrawhill Publishing Co.Ltd.,2006
5. S.P. Sukhatme, J.K. Nayak, ―Solar Energy-Principals of Thermal Collection and Storage,Tata Mc Graw hill Publishing Co. Ltd., New Delhi 2008
6. J. Twidell and T. Weir, ―Renewable Energy Resources‖, E & F N Spon Ltd, London, 1999
7. Thomas Ackermann, ―Wind Power in Power System‖, John Willey &Sons.

BTEEL406 NETWORK THEORY LAB 1 Credits

Any Eight Experiments from the following list

Expt. No.	Title of Experiment
1	Verification of Kirchhoff’s Laws
2	Verification of Superposition Theorem
3	Verification of Thevenin’s Theorem
4	Verification of Norton’s Theorem
5	Verification of Maximum Power Transfer Theorem
6	Verification of Reciprocity Theorem
7	Determination of transient response of RL & RC series circuits
8	To study Resonance in RLC series Circuit.
9	To study Resonance in parallel RLC Circuit.
10	Determination of driving point and transfer functions of a two port ladder network and verifywith theoretical values
11	To calculate and verify ‘Z’Parameters of a Two-Port Network.
12	To calculate and verify 'Y' parameters of Two-Port Network.

BTEEL407 : Power System Lab **1 Credit**

Sr. No	Experiment Title
1	To study the layout of a Thermal Power Plant with its components.
2	To study the layout, classification and components of a Hydro Power Plant.
3	To study the alternator excitation system
4	To study the types and properties of various Overhead insulators
5	To study the types and properties of various Overhead Conductors.
6	To study the Power cable and its various components and types.
7	To study the layout of a substation along with its components
8	To determine the ABCD parameters of a medium and long transmission line.
9	To Visit a Thermal Power plant and write a technical report on the observations

(BTEEL408)ELECTRICAL MACHINE-II LABORATORY 01 Credits

Perform Any Eight experiment from given list as a part of practical submission

List of Experiment

1. Determination of sequence impedances of salient pole synchronous machine To perform
2. Determination of Xd and Xq of a salient pole synchronous machine from slip test.
3. V and inverted V curves of a3-phasesynchronous motor 1
4. Regulation of alternator by Direct loading method (R,L,C load)
5. Regulation of alternator by synchronous impedance method
6. Regulation of alternator by MMF method
7. Parallel operation of Synchronous generator
8. To study different types of starters for three phase Squirrel cage induction motor
9. Rotor resistance starter for slip ring induction motor.
10. To conduct no load and blocked rotor test and to determine performance characteristics of three phase induction motor from circle diagram
11. Load and block rotor tests on squirrel cage induction motor
12. Brake test on slip ring induction motor
13. To control speed of wound rotor induction motor by rotor resistance control method
14. To control speed of induction motor by V/F
15. To control speed of induction motor by i) star-delta ii) autotransformer

(BTEEL409) ANALOG AND DIGITAL ELECTRONICS LAB 01 Credits

Perform Any Eight experiment from given list as a part of practical submission

List of Experiment

1. To plot input characteristics and Output characteristics of common emitter configuration.
2. To plot frequency response of RC coupled and Transformed coupled amplifier
3. To measurement of OP-AMP parameter
4. To verify the operation of op amp in Inverting & Non-inverting mode on AC input
5. Verify truth table of following basic and derived gates
   a. AND, OR, AND
   b. Ex-OR, NAND, NOR
6. Verification of truth table of flipflop
7. Design and implementation of 3-bit synchronous up/down counter
8. Design and implementation of half and full adder using logic gates
9. Design and implementation of Multiplexer and De-multiplexer and study of IC74150 and IC 74154
10. Design and implementation of code converters
    a. Binary to gray code converter
    b. BCD to Excess 3

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(underMaharashtra Act No. XXIX of 2014)

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COURSE STRUCTURE AND SYLLABUS

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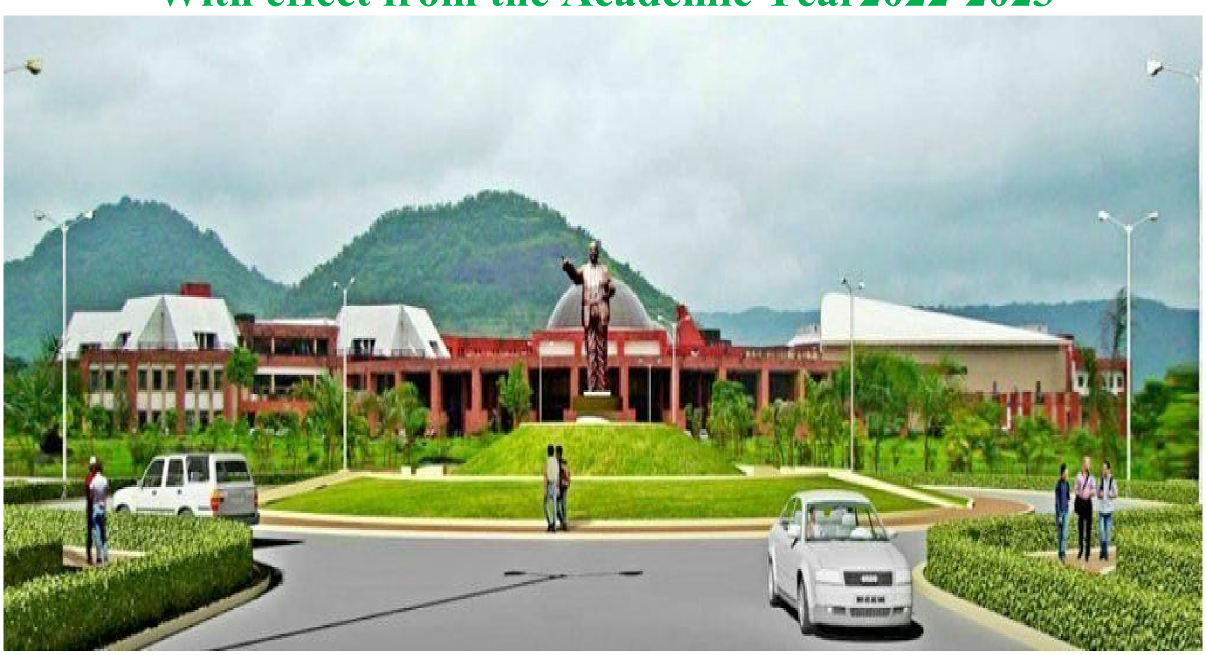

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Basic Sciences Courses(BSC)		
BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107 L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207 L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics-III	(3-1-0)4
BTBS404	Analog and Digital Electronics	(3-0-0)3
BTBSL40 9	Analog and Digital Electronics Lab	(0-0-2)1

Engineering Sciences Courses(BSC)		
BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0)
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0)
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES305	Engineering Material Science	(3-0-0)

Humanities and Social Science Including Management Courses(HSSMC)		
BTHM104	Communication Skills	(2-0-0)2
BTHM109 L	Communication Skills Lab	(0-0-2)1
BTHM304	Basic Human Rights	Audit
BTHM506	Foreign Languages (A) Japanese Language (B) German Language	Audit
BTHM706	Engineering Operations and Project Management	Audit

Professional Core Course (PCC)		
BTEEC302	Electrical Machines-I	(3-1-0)4
BTEEC303	Electrical and Electronics Measurement	(3-1-0)4
BTEEL306	Electrical Machines Lab	(0-0-2)1
BTEEL307	Electrical and Electronics Measurement Lab	(0-0-2)1
BTEEC401	Network Theory	(3-1-0)4
BTEEC402	Power System	(3-1-0)4
BTEEC403	Electrical Machines-II	(3-1-0)4
BTEEL406	Network Theory Lab	(0-0-2)1
BTEEL407	Power System Lab	(0-0-2)1
BTEEL408	Electrical Machines-II Lab	(0-0-2)1
BTEEC501	Power System Analysis	(3-1-0)4
BTEEC502	Microprocessor and Microcontroller	(3-0-0)3
BTEEC503	Power Electronics	(3-1-0)4
BTEEL507	Power System Analysis Lab	(0-0-2)1
BTEEL508	Microprocessor and Microcontroller Lab	(0-0-2)1
BTEEL509	Power Electronics Lab	(0-0-2)1
BTEEC601	Switchgear Protection	(3-0-0)3
BTEEC602	Electrical Machine Design	(3-1-0)4
BTEEC603	Control System	(3-1-0)4

	Engineering	
BTEEL606	Switchgear Protection Lab	(0-0-2)1
BTEEL607	Electrical Machine Design Lab	(0-0-2)1
BTEEL608	Control System Engineering Lab	(0-0-2)1
BTEEC701	High Voltage Engineering	(3-1-0)4
BTEEC702	Power System Operation and Control	(3-1-0)4
BTEEL707	High Voltage Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)		
BTEEPE405	(A)Electromagnetic Field Theory	(3-0-0)3
	(B)Signals and System	
	©Advance Renewable Energy Sources	
	(D)Electronic Devices and Circuits	
BTEEPE504	(A)Industrial Automation	(3-0-0)3
	(B)Power Quality Issues	
	©HVDC	
BTEEPE604	(A)Application of Power Electronics in Power System	(3-0-0)3
	(B)Smart Grid Technology	
	©Modeling, Simulation and Control of Electric Drives	
BTEEPE703	(A)Energy Audit and Conservation	(3-0-0)3
	(B)Electrical System Design for Building	
	©Flexible AC Transmission System	
	(D)Electrical Utilization	

Open Elective Course (OEC)		
BTEEOE505	(A)Embedded System	(3-0-0)3
	(B)Electrical Safety	
	©Condition Monitoring of Electric Apparatus	
BTEEOE605	(A)E-waste Management	(3-0-0)3
	(B)Power Plant Engineering	
	©Sensor Technology	
	(D)Lightning Interaction with Power System	
BTEEOE704	(A)Process Control Instrumentation	(3-0-0)3
	(B)Biomedical Instrumentation	
	©Mechatronics	
BTEEOE705	(A)Testing, Maintenance and Commissioning of Electrical Equipment	(3-0-0)3
	(B)Electric and Hybrid Electric Vehicles	
	©Internet of Things (IoT)	

Seminar / Mini Project / Internship		
BTES209S	Seminar	(0-0-2)1
BTES211P	(Internship – I) Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	1
BTEEM308	Miniproject-I	(0-0-4)2
BTEEP410	(Internship – II)	1
BTEEM509	Miniproject-II	(0-0-2)1
BTEES609	Seminar	(0-0-4)2
BTEEP610	(Internship – III)	
BTEEM708	In house project-I / Mini project-III	(0-0-4)2

Project(MP)

BTEEP802	In house project-I / Internship & Project in Industry	(0-0-26) 13

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Plan of Study:

No.of Cour ses								
1	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
2	**BTBS101**	**BTBS201**	**BTBS301**	**BTEEC401**	**BTEEC501**	**BTEEC601**	**BTEEC701**	**BTEEPE801**
3	**BTBS102**	**BTBS202**	**BTEEC302**	**BTEEC402**	**BTEEC502**	**BTEEC602**	**BTEEC702**	**BTEEP802**
4	**BTES103**	**BTES203**	**BTEEC303**	**BTEEC403**	**BTEEC503**	**BTEEC603**	**BTEEPE703**	
5	**BTHM104**	**BTES204**	**BTHM304**	**BTBS404**	**BTEEPLE504**	**BTEEPE604**	**BTEEOE704**	
6	**BTES105**	**BTES205**	**BTES305**	**BTEEPE405**	**BTEEOE505**	**BTEEOE605**	**BTEEOE705**	
7	**BTES106**	**BTES206**	**BTEEL306**	**BTEEL406**	**BTHM506**	**BTEEL606**	**BTHM706**	
8	**BTBS107L**	**BTBS207 L**	**BTEEL307**	**BTEEL407**	**BTEEL507**	**BTEEL607**	**BTEEL707**	
9	**BTES108L**	**BTES208 L**	**BTEEP308**	**BTEEL408**	**BTEEL508**	**BTEEM608**	**BTEEM708**	
10	**BTHM109 L**	**BTES209S**	**BTES211P**	**BTEEL409**	**BTEEPE509**	**BTEEP609**	**BTEEP609**	
11		**BTES211**		**BTEEP410**	**BTEEP409**			

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B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

A. Program Educational Objectives (PEOs)

Graduates will able to–

1.To equip graduates with a strong foundation in engineering sciences and Electrical Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.

2.Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.

3.Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes (POs)

Engineering Graduate will be able to –

1. **Engineering knowledge**:Apply the knowledge of mathematics, science,engineering fundamentals, and anengineering specialization to the solution ofcomplex engineering problems.
2. **Problem analysis**:Identify, formulate, review research literature, and analyzecomplex engineering problems reaching substantiated conclusions using firstprinciples of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**:Design solutions for complex engineeringproblems and design systemcomponents or processes that meet the specifiedneeds with appropriate consideration for the public health and safety, and thecultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:**Use research-based knowledgeand research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:**Create, select, and apply appropriate techniques, resources,and modern engineering and IT tools including prediction and modeling to complexengineering activities with an understanding of the limitations.
6. **The engineer and society:**Apply reasoning informed by the contextualknowledge to assess societal, health, safety, legal and cultural issues and theconsequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:**Understand the impact of the professionalengineering solutions in societal and environmental contexts, and demonstrate theknowledge of, and need for sustainable development.
8. **Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively oncomplex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports anddesign documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering andmanagement principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.
12. **Life-long learning:**Recognize the need for, and have the preparation and ability to engage in independentand life-long learning in the broadest context of technological change.

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Curriculum for Semester V

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC4	BTEEC501	Power System Analysis	3	1	-	20	20	60	100	4
PCC5	BTEEC502	Microprocessor and Microcontroller	3	-	-	20	20	60	100	3
PCC6	BTEEC503	Power Electronics	3	1	-	20	20	60	100	4
PCC2	BTEEPLE504	Group B	3	-	-	20	20	60	100	3
OEC1	BTEEOE505	Group C	3	-	-	20	20	60	100	3
HSSMC	BTHM506	Foreign Language #	-	-	-	-	-	-	-	Audit
LC	BTEEL507	Power System Analysis Lab	-	-	2	60	-	40	100	1
LC	BTEEL508	Microprocessor and Microcontroller Lab	-	-	2	60	-	40	100	1
LC	BTEEL509	Power Electronics Lab	-	-	2	60	-	40	100	1
Project	BTEEPE510	Mini project-II	-	-	2	60	-	40	100	1
Internship	BTEEP410	Internship-II Evaluation	-	-	-	-	-	50	50	1
		Total	**15**	**2**	**10**	**340**	**100**	**510**	**950**	**22**

Semester VI

PCC7	BTEEC601	Switchgear and Protection	3	-	-	20	20	60	100	3
PCC8	BTEEC602	Electrical Machine Design	3	1	-	20	20	60	100	4
PCC9	BTEEC603	Control System Engineering	3	1	-	20	20	60	100	4
PEC3	BTEEPE604	Group D	3	-	-	20	20	60	100	3
OEC2	BTEEOE605	Group E	3	-	-	20	20	60	100	3
LC	BTEEL606	Switchgear and Protection Lab	-	-	2	60		40	100	1
LC	BTEEL607	Electrical Machine Design Lab	-	-	2	60		40	100	1
LC	BTEEL608	Control System Engineering Lab	-	-	2	60		40	100	1
Seminar	BTEEM609	Seminar	-	-	4	60		40	100	2
Internship	BTEEP610	Internship-III (minimum of 4 weeks which can be completed partially in third or fourth semester or in at one time)	-	-	-	-	-	-	-	Credits to be evaluated in VII sem.
		Total	**15**	**2**	**10**	**340**	**100**	**460**	**900**	**22**

BSC= Basic Science Course, ESC= Engineering Science Course, PCC= Professional Core Course, PEC= Professional Elective Course, OEC= Open Elective Course, LC= Laboratory Course, HSSMC= Humanities and Social Science including Management Course

 # Online NPTEL Course

Semester V

BTEEPE504 Professional Elective (Group B)	BTEEOE505 Open Elective (Group C)
(A)HVDC	(A) Embedded System
(B) Power Quality Issues	(B) Electrical Safety
(C) Industrial Automation	(C) Condition Monitoring of Electric Apparatus

BTHM506 Foreign Language
(A) Japanese Language
(B)German Language

Semester VI

BTEEPE604 Professional Elective (Group D)	BTEEOE605 Open Elective (Group E)
(A) Flexible AC Transmission System	(A) E-waste Management
(B) Smart Grid Technology	(B) Power Plant Engineering
(C) Modeling, Simulation and Control of Electric Drives	(C) Sensor Technology
	(D) Lightning Interaction with Power System

Semester V

BTEEC501 POWER SYSTEM ANALYSIS 4 Credits

Unit 1: Modeling of Power System 7 Hours

Complex power flow, balanced and reactance diagrams of a power system, per unit system per unit representation of transformers, synchronous machines, representation of loads. Graph theory and its applications for formation of primitive network and Z and Y matrices, incidence matrices, Y-bus and Z-bus matrices.

Unit 2: Load Flow Studies: 7 Hours

Introduction, network model formulation, formation of Y-bus by singular transformation, load flow problem, Iterative methods of load flow such as Gauss Gauss-Seidel, Newton-Raphson method, decoupled load flow and fast decoupled load flow, Automatic Generation control.

Unit 3: Symmetrical Fault Analysis: 7 Hours

Transients on a transmission line, short circuit of a synchronous machine on no load and on load. Short circuit current computation on no load and on load, selection of circuit breakers, Z-bus formulation, algorithm of short circuit studies.

Unit 4: Symmetrical Components: 7 Hours

Fundamentals of symmetrical components, sequence impedance and sequence network of star connected loads, transmission lines, synchronous machines and transformer sequence network of a loaded generator.

Unit 5: Unsymmetrical Faults Analysis 7 Hours

single line to ground (l-g), Line to line (L-L), double line to ground (L-L-G) faults analysis of above faults using bus impedance matrix, bus voltage and line current during faults. open conductor faults.

Unit 6: Security Analysis 7 Hours

Basic Concepts, Security analysis, Load Dispatch centre, Contingency Analysis, preventive and emergency control, Electrical Power Quality, causes, affects and mitigation methods.

Text books:

1. I.J. Nagrath& D.P. Kothari, “Modern System Analysis”, Tata McGraw- Hill

2. Stevenson W.D “Elements of Power System Analysis”, McGraw- Hill Wadhawa C.L “Elements Power System”, John Wiley & sons.

Reference Books:

1. “Power System Analysis”, T.K. Nagsarkar, M.S. Sukhiya. (OXFERD U. P.)
2. Stevenson W.D. and Grainger J.J. “Power System Analysis” McGraw- Hill
3. A.R. Bergen and Vijay Vittal, Power Systems Analysis, Pearson Education Asia, 2001.
4. Stagg W.D. & EI-AbiadA.H.,”Computer Method in Power System Analysis”, McGraw- Hill
5. H.Saadat “Power System analysis”, McGraw- Hill
6. Elgred O.I. electrical Energy System Theory”, McGraw-Hill.

7. J.D. Glover, M. Sarma and T.J. Overbye, Power System Analysis and Design, Fourth Edition, Thomson Engineering Press, 2008.

BTEEC502 MICROPROCESSOR AND MICROCONTROLLER 04 Credits

Unit 1: Microprocessor architecture 7 Hours

8085 architecture, functional block diagram, Arithmetic Logic Unit (ALU), Timing and control Unit, Registers, Data and Address bus, Interface unit, 8085 instructions, Instruction word size: one byte, two byte and three byte instructions, addressing modes of 8085, assembly language programming Timing and control signals, Fetch operations, Execution operations, Machine cycle and state, Instruction and data flow, System timing diagram– interrupts.

Unit 2: Memory interfacing 7 Hours

Types of main memories, Compatibility between memory and system BUS, Address space, Partitioning of address space, Special chips for address decoding, ROM and RAM interfacing, i/o interfacing: memory map i/o, i/o map i/o scheme. Programmable peripheral interface. Data transfer techniques and their implementation: Programmed data transfer, DMA mode of transfer, I/O port, Device polling in interrupt driven mode of data transfer, DMA controller and data transfer in DMA mode, Serial mode of data transfer

Unit 3: Applications of microprocessors 7Hours

Interfacing of A/D converters, interfacing of D/A converter, wave generator, multiplex seven segment LED display system, measurement of frequency, phase angle and power factor. Traffic light controller and stepper motor controller.

Unit 4: 8051 Microcontroller 8 Hours

Intel 8051 architecture, memory organization, flags, stack, and special function registers, I/O, ports - connecting external memory, counters and timers, serial data I/O, Interrupts. Microcontroller instructions - addressing modes, moving data, logical operations, arithmetic operations, jump and call instructions – subroutines - Interrupts and returns.

Unit 5: Microcontroller programming 8 Hours

Assembly Language Programming, timer and counter programming, connection to RS 232 and RS 485, Interrupt programming. Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, ADC/DAC interfacing.

Text/Reference Books:

1. Systems and Microprocessors, John P. Hayes, Digital McGraw-Hill I.E.
2. Microprocessor Architecture, Programming and Applications, R.S.Gaonkar, Wiley Eastern.
3. Microprocessor and Interfacing: Programming and Hardware, D.V. Hall, McGraw-Hill I.E
4. Digital Systems and Microprocessors , John P. Hayes, McGraw-Hill I.E.

BTEEC 503 POWER ELECTRONICS **04 Credits**

Unit 1: Introduction **7 Hours**

Concept of Power Electronics, Different types of power electronics devices, converter systems, areas of application, recent developments. Device characteristics, protection and operation: Terminal characteristics of major power electronics devices(SCR, BJT, MOSFET, IGBT, GTO, TRIAC,), ratings, protection, heating, cooling and mounting, series and parallel operation, firing circuits, Snubber circuits

Unit 2: Phase controlled rectifiers **7 Hours**

Analysis and design of diode rectifier circuits and controlled rectifier circuits (for R, RL, RLE load), Phase control, power factor, DC load voltage, Polyphase rectifiers, Current and voltage waveforms analysis, Applications for DC motor drives. Effect of source impedance on the performance of converters, dual converters.

Unit 3: Choppers **7 Hours**

Principle of chopper operation, Control strategies, Types of chopper circuits and steady state analysis. Commutation in chopper circuits, buck, boost and buck-boost chopper, Discontinuous current analysis, Non-ideal effects and dynamic performance, Applications for DC motor drives. PWM control and operation

Unit 4: Inverters **7 Hours**

Classification of inverters, Single-phase and three-phase Voltage source Inverters, Methods of controlling output voltage, frequency and phase, Reduction of harmonics in the inverter output voltage, Current source inverters and operations. Applications for AC motor drives, Pulse Width Modulation (PWM): Types of PWM.

Unit 5: AC Voltage Controller **10 Hours**

Types of AC voltage controllers, Single phase voltage controllers, Sequence control of ac voltage controllers, 3-phase AC voltage controller operation Application of AC-AC Phase Control, Singlephase and poly phase control circuits, Applications for AC motor drives, Cycloconverters: Principles of cycloconverter operation, Methods of controlling output voltage and frequency in cases of: Single phase to single phase, three phases to single phase, three phases to three phase operation.

Applications: Power supply applications, few applications in residential and industrial systems, Electric utility.

Reference Books:

1. Power Electronics , P C Sen, TMH
2. Power Electronics, Dubey, TMH
3. Thyristorised Power Controllers, Dubey et. al., TMH
4. Power Electronics, Rashid Mohammed, PHI

5. Power Electronics & Drives, V. Subrahmanyam, New Age

BTEEPE504A HVDC **03 Credits**

Unit 1: Introduction to HVDC transmission **7 Hours**

Development of HVDC Technology, DC versus AC Transmission, DC System components and their functions, Converter configuration, Selection of Converter Configuration, Firing angle, Current and extinction angle control, DC link power control, Reactive power control and VAR sources, MTDC system types

Unit 2: Bridge converters **7 Hours**

Rectifier and inverter operation, equivalent circuit representation, power reversal, desired features of control and actual control characteristics.

Unit 3: Basic HVDC controllers **7 Hours**

Converter faults, commutation failure, bypass action in bridges, protection issues in HVDC - DC reactors, voltage and current oscillations, DC circuit breakers and over voltage protection.

Unit 4: Harmonics in HVDC **7 Hours**

Characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive filters. Introduction to Hybrid HVDC and Off-shore wind power evacuation schemes .

Unit 5: Component models for analysis of AC DC system **7 Hours**

Power flow analysis Of AC DC system, transient stability analysis, dynamic stability analysis, advances in HVDC Transmission, application in wind power generation.

Text/ Reference Books:

1. K. R. Padiyar, ―HVDC power transmission system‖, Willey eastern limited, Second edition.

2. 2. E. W. Kimbark, ―direct current transmission‖, Wiley- inter science, NewYork.

BTEEPE504B POWER QUALITY ISSUES **03 Credits**

Unit 1: Introduction **7 Hours**

Definition of Power quality, Power Quality –Voltage & Current Quality, Importance of Power Quality, Power quality Evaluation. General Classes of Power quality Problems, Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage fluctuation, Power Quality Terms, CBEMA and ITI Curves. Voltage Sags and Interruptions: Sources of Sags and Interruptions, estimating voltage Sag Performance, Fundamental Principles of Protection, Solution at the End-User Level, Motor –Starting Sags.

Unit 2: Transient over Voltages **7 Hours**

Sources of Transient Over voltages, Principles of Over voltage Protection, Devices for over voltageProtection, Utility Capacitor-Switching transients, Utility System Lightning Protection, ManagingFerro-resonance, Switching Transient Problems with Loads, Computer Tools for TransientsAnalysis.

Unit 3: Fundamentals of Harmonics **7 Hours**

Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, HarmonicIndexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads,Locating Harmonic Sources, Effects of Harmonic distortion, interharmonics, Harmonic distortionEvaluations, Principles for Controlling Harmonics, Harmonic Filter design: A Case Study,Standards of Harmonics.

Unit 4: Long-Duration Voltage Variations **7 Hours**

Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulatorapplication, Capacitors for Voltage Regulation, End-Users Capacitors Application, and RegulatingUtility Voltage with distributed Resources Flicker.

Unit 5: Power Quality Monitoring **7 Hours**

Monitoring considerations, Historical Perspective of Power quality Measuring Instruments, PowerQuality Measurement Equipment, Assessment of Power Quality Measurement Data, Application of intelligent Systems, Power Quality Monitoring Standards, Monitoring considerations.

References/Books:

1. Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2. Haytt G. T., ―Electric Power Quality‖, Stars In Circle Publication.
3. NPTEL courses

BTEEP504C INDUSTRIAL AUTOMATION 03 Credits

Unit 1: Introduction to Industrial Automation 6 Hours

Architecture of Industrial Automation Systems, Elements of an Automated System, Functional hierarchy of an Industrial Automation system, Levels of Automation.

Unit 2: Programmable Logic Controllers 8 Hours

Introduction, Architecture of PLC, PLC Operation, **PLC Hardware Components-** Input-Output module (Discrete and Analog), **PLC Programming -** Ladder Logic, Functional Block Diagram (FBD), Ladder Logic Programming (NO-NC, Timer and Counter), PLC Communication, Application of PLCs.

Unit 3: Industrial Drives Control 7 Hours

Classification of Industrial Drives, DC Motor Drives, Induction Motor Drives, Variable Speed Drives, Servo Motor Drives, Step Motor Drives, BLDC Motor Drives, Control of Drives, Industrial Application of Drives.

Unit 4: SCADA 8 Hours

SCADA system Architecture, Elements of SCADA System, Human Machine Interface, Master Terminal Unit, Remote Terminal Unit. Alarm Handling and Trending, Access Control, Automation Logging, Archiving, Report Generation. Types of interfaces, SCADACommunication.SCADA Applications: Operation and control of interconnected power system, Automatic substation control, Electric Power Generation, Transmission and Distribution sector operation.

Unit 5: Distributed Control System 7 Hours

Introduction and Overview, System Architecture, System Elements, Difference between Centralized and Distributed Control System. Displays: Group Display, Overview Display, Detail Display, Data Highways, Field Buses, Multiplexers and Remote Sensing Terminal Units, I/O Hardware, Case study of any one DCS.

Text Books/ Reference Books:

1. C. D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall of India.
2. B. G. Liptak, Instrument Engineer's Handbook, Process Control, Chilton Book Company.
3. W. Bolton, “Programmable Logic Controllers”, Elsevier.
4 Hughes, “Programmable Controllers”, ISA Publications.
5 Frank D. Petruzella, “Programmable Logic Controllers”, McGraw-Hill Book Company.
6 John W. Webb and Ronald A. Reis, “Programmable Logic Controllers”, PHI.
7 Stuart A. Boyer “Supervisors Control and Data Acquisition”, ISA.

BTEEOE505A EMBEDDED SYSTEM **03 Credits**

Unit 1: Embedded System Architectures **7 Hours**

Introduction, Components of Embedded Systems ARM processor - architectural design -memory organization -data operation-bus configurations. System on-chip, scalable bus architectures, Design example: Alarm clock, hybrid architectures.

Unit 2: Sensor and Actuator I/O 7 Hours

ADC, DAC, timers, Servos, Relays, stepper motors, H-Bridge, port.

Unit 3: Real time operating systems (RTOS) **7 Hours**

real time kernel – OS tasks – task states – task scheduling –interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control – kernel services.

Unit 4: Embedded Networks **7 Hours**

Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network-based design–Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

Unit 5: System Design **7 Hours**

Specification, Requirements and Architectural design of PBX systems, Set-top box, Ink-jet printer, Laser printer, Personal digital Assistants.

Embedded Hardware : memory map, i/o map, interrupt map, processor family, external peripherals, memory- RAM , ROM, types of RAM and ROM, memory Testing, CRC, Flash memory.

Text/ References Books:

1. Sloss Andrew N, Symes Dominic, Wright Chris, ―ARM System Developer's Guide: Designing and Optimizing‖, Morgan Kaufman Publication,2004.
2. Raj Kamal,―Embedded Systems – Architecture: Programming and Design‖, Tata McGraw-Hill Education, 3rded.,2003.

BTEEOE505B ELECTRICAL SAFETY 03 Credits

Unit 1: Primary and secondary hazards arc 7 Hours

blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eyeprotection-rubber insulating equipment, hot sticks, insulated tools, barriersandsigns,safety tags,locking devices- voltage measuring instruments- proximity and contact testers-safety electricalone-line diagram- electrician 's safety kit.

Unit 2: General requirements for grounding and bonding 9 Hours

definitions-grounding of electrical equipment bonding of electrically conducting materials andother equipment-connection of grounding and bonding equipment- system grounding- purpose ofsystem grounding- grounding electrode system grounding conductor connection to electrodes-useof grounded circuit conductor for grounding equipment- grounding of low voltage and highvoltage systems

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system-lockout-tag out- flash hazard calculation and approach distances- calculating there required level of arc protection-safetyequipment, procedure for low, medium and high voltagesystems- the one-minute safety audit.

Unit 3: Electrical safety programmer structure 7 Hours

development- company safety team- safety policy programme implementation- employee electrical safety teams-safety meetings- safety audit accident prevention- first aid- rescuetechniquesaccident investigation.

Unit 4: Safety related case for electrical maintenance 6 Hours

reliability cantered maintenance (RCM) -eight step maintenance programme- frequency of maintenance- maintenance requirement for specific equipment and location.

Unit 5: Regulatory bodies 6 Hours

National electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text / Reference Books:

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, =Electrical SafetyHandbook ', McGraw-Hill Education, 4th Edition, 2012.
2. Maxwell Adams.J, =Electrical Safety- a guide to the causes and prevention of electrichazards ', The Institution of Electric Engineers, IET 1994.
3. Ray A. Jones, Jane G. Jones, =Electrical Safety in the Workplace ', Jones & BartlettLearning, 2000

BTEEOE505C CONDITION MONITORING OF ELECTRICAL APPARATUS 3 Credits

Course Outcomes:

By the end of the course, students will be able to

1. Understand the necessity of condition monitoring and reliability.
2. Have knowledge about the conventional and modern methodologies/techniques.
3. Develop basic functional models for condition monitoring system to different kind of power apparatus.
4. Determine life expectancy of the equipment

Unit 1: Basic Considerations and Maintenance 07 Hours

Basic definitions, terminologies, symbolic representation, Necessity from technical social, financial aspect, types of faults in electrical equipments {Electrical equipments such as transformer, CT/PT and rotating electrical machines, CBs, etc.}, maintenance strategies, breakdown maintenance, planned, preventative and condition based maintenance

Unit 2: Testing of Electrical Equipments 6 Hours

Cables, Transformers, Induction motor, Capacitor banks, conventional methods, Measurement of insulation resistance, Diagnostic Testing: Routine tests, type tests, special tests, offline tests, Causes of failure and remedies.

Unit 3: Analysis tools 6 Hours

Recent methods (offline), Dissolved Gas Analysis (DGA), Dissipation Factor (tan δ), Sweep Frequency Response Analysis (SFRA), Partial Discharge (PD), Time Domain Dielectric Response (TDDR), Frequency Domain Spectroscopy (FDS), Chemical analysis. Image processing techniques

Unit 4: Online condition monitoring and instrumentation 6 Hours

Recent methods (online), vibration, chemical and temperature monitoring, sensor and data acquisition system, Modern algorithms, GA, and signal processing techniques. Application to various equipments such as transformer, induction motor, synchronous generator and motor, DC motor, CT and PT, case studies.

Unit 5: Current, Flux and Power Analysis 6 Hours

Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response. Introduction to DFT in time domain and frequency domain, Derivation of DFT from DTFT, Inverse DFT, Convolution using DFT, Computational Complexity of the DFT, Decimation-in-time FFT Algorithm, Decimation In Frequency FFT Algorithm, Wavelet transform, Lab view platform.

Unit 6: Reliability and failure rate Assessment 8 Hours

Comparison of DIT AND DIF algorithms. Introduction to FIR and IIR Filter Design. Calculation of Power Equipment Reliability for Condition-based Maintenance Decision-making, Optimum

Reliability- Centered Maintenance, Cost Related Reliability Measures for Power System Equipment, Reliability based replacement refurbishment/planning

Text Books:

1. P. Vas, “Parameter estimation, condition monitoring and diagnosis of electrical machines”, Clarendon Press Oxford, 1993.
2. P. Tavner, Li Ran, J. Penman and H. Sedding, “Condition monitoring of rotating electrical machines”, IET press, 2008.

Reference Books:

1. Xose M Lo´pez, Ferna´ndez, H Bu¨lentErtan, J Turowski, “Transformers analysis, design, and measurement”, CRC Press, 2012
2. S.V. Kulkarni and S. A. Khaparde, “Transformer Engineering: Design, Technology and Diagnostics”, Second edition, CRC Press, 2013
3. R. Billinton and R. N. Allan*, “* Reliability Evaluation of Power Systems, 2nd ed. New York”, NY, USA: Plenum, 1996.
4. Videos on Transformer condition evaluation with ABBs Mature Transformer Management Program
5. Induction motor condition monitoring with ABBs, Siemens, General Electricals (source You Tube

BTEEL507 POWER SYSTEM ANALYSIS LAB **1 Credit**

Any Eight Experiments from the following list.(Any Experiment from the following list can be performed either SCILAB/MATLAB/Any Other Software.)

1. Write a program to draw the per unit reactance diagram of a given power system.
2. Solution of building the Bus Admittance matrix for given power system network.
3. Solution of power flow problem of a given power system using Gauss-Siedel method.
4. Solution of power flow problem of a given power system using Newton Raphson Method.
5. Solution of power flow problem of a given power system using Fast Decoupled method.
6. Single Line to Ground Fault (L-G) analysis of a Three Phase Transmission Line at no load and light load conditions.
7. Line to Line Fault (L-L) analysis of Three Phase Transmission Line at No load and Light load conditions.
8. Double Line to Ground Fault (LLG) analysis of Three Phase Transmission Line at No load and Light load conditions.
9. Symmetrical L-L-L Fault analysis of Three Phase Transmission Line at No load and Light load conditions.

BTEEL508 MICROPROCESSOR AND MICROCONTROLLER LAB 01 Credit

1 Study of Architecture of 8085

2 Assembly language program for addition and subtraction of 8 bit &16 bit numbers based on 8085 microprocessor

3 Assembly language program for multiplication of two numbers based on 8085 microprocessor

4 Assembly language program for Multiplication and division of two numbers based on 8085 microprocessor

5 Assembly language program for determination of smaller and larger no based on 8085 microprocessor

6 Assembly language program for ascending and descending order based on 8085 microprocessor

7 Assembly language program for rolling/flash LED based on 8085 microprocessor

8 Interfacing of 7 segment LED to 8085 microprocessor

9 Interfacing of Stepper motor with microprocessor

10 Programs based on arithmetic instructions for 8051 microcontroller

11 Interfacing of stepper motor to 8051 microcontroller

12 Interfacing of DC motor to 8051 microcontroller

13 Interfacing of converters ADC 0808/0809 and DAC 0808

14 Generate Delay using Timer section of 8051 microcontroller.

Conduct any 4 practicals fro 1 to 7 and 4 practicals from 8 to 14.

BTEEL509 POWER ELECTRONICS LAB 01 CREDIT

1.V-I characteristics of various power electronics devices.(At least two devices SCR/MOSFET/IGBT/TRIAC/GTO)

Group A (minimum four)

2.Experimental analysis of single phase uncontrolled converter

3.Experimental analysis of single phase Half controlled converter

4.Experimental analysis of single phase fully controlled converter

5.Experimental analysis of three phase bridge inverter.

6.Experimental analysis of BUCK /BOOST/BUCK -BOOST converter

Group B

7.Simulation of Single phase Semi controlled converter

8.Simulation of Single phase Fully controlled converter

9.Simulation of Single phase inverter

BTEEPE510 MINI PROJECT II **01 Credits**

Guidelines:

Stage	Work to be carried
I	• Selection of a project (Hardware or Software Based) on recent trends in Electrical Engineering. • Planning the outcome of the project and listing out the expected outcome of the project. • Literature Survey
II	• Development of Project Idea in the form of working model (Hardware based projects) or production of appropriate simulation results of the proposed idea (Software based projects).
III	• Verification of the results obtained of the working model or the simulation results. • Comparing if the outcomes as defined in Phase I are met and taking corrective action.
IV	• Completion of project by developing the Project Report and submitting the report to the concerned to receive the final credits.

Semester VI

BTEEC601 SWITCHGEAR AND PROTECTION **04 Credits**

Unit 1: Introduction to Switchgear and Protection **7 Hours**

Introduction, Need for power system protection, effects of faults, Requirement of Relays, Relays Terminology, basic circuit, relay connection with trip circuit and circuit breaker, types of relay, Protective Devices: Philosophy of protection, zones of protection, primary and backup protection, Methods of earthing and their effect on fault conditions. Different types of relays: attracted armature type, balanced beam type, induction type.

Unit 2: Static and Numerical Relays **7 Hours**

Amplitude and phase comparator techniques, Differential relays, directional relay, impedance relay, admittance relay, MHO relay, description of numerical relays, relaying algorithms, use of numerical relays as fault locator and disturbance recorder. Microprocessor Based Relays: Advantages, over current relays, directional relays, distance relays.

Unit 3: Circuit Breakers and Fuses **7 Hours**

Introduction, arcing in circuit breakers, arc interruption, re-striking and recovery voltage, current chopping, resistance switch, Air blast circuit breakers, minimum and bulk oil circuit breakers, SF6 and Vacuum Circuit breakers, circuit breakers rating, testing of CB, point on wave switching, Definitions of terms in fuses, HRC fuses. Introduction, fuse characteristics, types of fuses, application of HRC fuses. Selection of circuit breakers, high voltage d.c. breakers.

Unit 4: Protection of Transmission Lines **7 Hours**

Over current protection, construction and operation of instantaneous over current relay. Directional Over current relay , distance protection, unit protection schemes, carrier aided distance protection, protection of feeders, protection of ring main and parallel feeders, protection of radial feeders by over current relays, distance relays and carrier current protection scheme. Protection of induction motor‘s against overload, short-circuits, thermal release, miniature circuit breaker

Unit 5: Protection of Alternators & Transformers **7 Hours**

Differential protection of alternator, protection of stator against phases to ground fault, phase to phase faults, inter turn fault, protection against unbalanced loading, protection of rotor against ground fault, field failure, reverse power, back up protection, field suppression, protection of bus bars, frame leakage protection. Differential protection of transformer for different winding configurations, difficulties encountered in differential protection and their remedies. Standards and specifications related to switch gear and protection

Text/References Books:

1. Power system protection and switchgear‖, Ravindranath and Chander, TMH

2. Fundamentals of power system protection‖, Paithankar and Bhide, PHI

3. J. L. Blackburn and T. J. Domin, Protective Relaying: Principles & Applications, CRC Press, 2006.

4. Electrical power system‖, Wadhwa, New Age. 2. ―Power system protection‖, Badri Ram, TMH.

BTEEC602 ELECTRICAL MACHINE DESIGN 04 Credits

Unit I: Principles of Electrical Machine Design: 6 Hours

Principles of design, design factors, limitations, Ratings, Specifications, Standards, Performance and other criteria to be considered, Brief study of magnetic, electric, dielectric and other materials, Introduction and advantages of various approaches of Computer Aided Designing.

Unit II: Design of Simple Electrical Apparatus& AC and DC Windings: 6 Hours

Detailed design of heating coils, starters, chokes and lifting magnets, Numerical examples.

AC & DC Windings: Constructional features, types of ac windings, Choice and design of simple/ duplex lap and wave winding, Concept of multiplex windings and reasons for choosing them, Single and double layer three phase AC winding (mush) with integral slots

Unit III: Design of Induction Motor (Stator): 10 Hours

Calculation of Ampere-Turns for flux distribution in rotating machines, Calculation of Ampere-Turns for flux distribution in rotating machines, output equation of three phase IM, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots, calculations for main dimensions, stator design parameters, Numerical examples.

Unit IV: Design of Induction Motor (Rotor): 6 Hours

Selection of length of air gap, factors affecting length of air gap, design of rotor, Unbalanced magnetic pull and its estimation, harmonic field effect on the performance of3-phase induction motor, Design of squirrel cage and wound rotor

Unit V: Heating and Ventilation of Electrical Machines: 6 Hours

Study of different modes of heat generation, Temperature rise and heat dissipation, Heating and Cooling cycles, heating and cooling time constants, their estimation, dependence and applications, Methods of cooling / ventilation of electrical apparatus, Thermal resistance, radiated heat quantity of cooling medium (Coolant) Numerical examples.

Unit VI: Design of Transformer: 10 Hours

Design of Transformer: Design of distribution and power transformers, Types, Classification and specifications, Design and main dimensions of core, yoke, winding, tank (with and without cooling tubes), Estimation of leakage reactance, resistance of winding, No load current, Losses, Mechanical force developed during short circuits, their estimation and measures to reduce them, Numerical examples.

Textbooks:

1. Sawhaney. A. K– A Course in Electrical Machine Design (DhanpatRai).

Reference Books:

1. .Deshpande. M. V- A Course in Electrical Machine Design (Prentice Hall Of India).

2. Siskind – Electrical Machine Design (Mcgraw Hill).

BTEEC603 CONTROL SYSTEM ENGINEERING 04 Credits

Unit 1: Introduction 10 Hours

Concept of open & closed loop control system, Transfer Function: Concept of system: Physical system, Physical model, Linear and Nonlinear systems, Time variant and Time invariant system. Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series & parallel circuit) Transfer Function, Procedure of obtaining transfer function.

Block diagrams and Signal flow graphs: a) Block diagram, Block Diagram reduction, and Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of Negative and Positive feedback, Sensitivity of the system to parameter variation and with negative and positive feedback.

Unit 2: Time Domain Analysis 7 Hours

Typical test signals, Time domain specifications, Steady state response, Types of system, Steady State Error constants and Steady State Error, Transient Response, Concept of stability, Determination of stability by Routh - Hurwitz criterion.

Unit 3: Frequency Domain Analysis 10 Hours

Introduction to Frequency Domain Analysis, Polar plots,Bode plots, Nyquist criterion, Relative stability from Nyquistcriterion. Root Locus, Construction of Root Locus, and Stability from Root Locus plots, Effect of addition of poles & zeros on Root Locus plots, Compensation network: Lag, Lead & Lag-Lead.

Unit 4: PID Controllers 4 Hours

Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance.

Unit 5: State Variable Technique 8 Hours

Concept of State, State Variable & State Vector, State Variable Analysis: Different forms of state variable representations (Phase, Physical & Canonical form), Concept of Diagonalization, Obtaining StateEquations from Transfer Function representation and vice versa, Solution of State Equations, StateTransition Matrix (STM), Methods of finding STM, Power Series Method, Laplace Transform Method, Calay Hamilton Method, Controllability & Observability of linear system, Kalman‘s test.

Text Books/ReferenceBooks:

1. Ogata K., “Modem Control Engineering”, Prentice Hall of India.
2. Kuo B. C., “Automatic Control System”, Prentice Hall of India.
3. Nagarath I. J. and Gopal M., “Control System Engineering”, Willey Eastern.
4. Norman S. Nice, “Control System Engineering”, Wiley.

5. Smarajit Ghosh, “Control Systems Theory & Applications”, Pearson.
6. Gopal M., “Control System”, Prentice Hall of India.

BTEEPE604A FLEXIBLE AC TRANSMISSION SYSTEM 3 Credits

Unit 1: Transmission Interconnection 7 Hours

Flow of power in the AC system, factors affecting loading capability, power flow and dynamicstability consideration of a Transmission interconnection, Description and application of HVDCtransmission, DC System components and their functions, Converter configuration, Principles ofDC Link control and Converter control characteristics, Firing angle, Current and extinction anglecontrol, DC link power control

Unit 2: Flexible AC Transmission 7 Hours

Benefits of FACTS, Basic Realities & Roles, Types of FACTS Controller, Principles of Series and Shunt Compensation. Introduction to Voltage source and Current source converter. Shunt compensation (SVC): Objectives of shunt compensation, Midpoint voltage regulation for long transmission line, voltage instability prevention, improvement of transient stability

Unit 3: Reactive power control and VAR sources 7 Hours

Reactive power control and VAR sources Methods of controllable VAR generation, Description ofStatic VAR Compensators (SVC), Variable impedance type VAR generators. Thyristor controlledreactor (TCR), Thyristor Switched Capacitor (TSC), TSC-TCR, Fixed capacitor TCR (FC-TCR).Shunt compensation

Unit 4: Variable impedance type series compensator 7 Hours

Thyristor Switches Series Capacitor (TSSC), Thyristor Controlled Series Compensators (TCSC). Switching Converter type Series Compensator. Introduction to interline power flow controller, Special purpose FACTS controllers, Thyristor controlled voltage limiter and voltage regulator, Thyristor controlled braking resistor and current limiter.

Unit 5: (STATCOM) 7 Hours

Switching type VAR generator, Static Synchronous Compensator (STATCOM), Basic operatingprinciple, Configuration. Basic control approach, Comparison between SVC and STATCOM.Series Compensator: Objectives of series compensation, improvement of transient stabilitySynchronous Series Compensator: (SSSC) and Controller for SSSC, Basic configuration andworking of Unified Power Flow Controller (UPFC). Unified Power Flow Controller, CircuitArrangement, Basic Principle of P and Q Control, independent real and reactive power flow control, Applications GCSC, TSSC, TCSC & SSSC

Text Books/Reference Books:

1. N.G Hingorani, L. Gyugyi, ―Understanding FACTS: Concepts and Technology of FlexibleAC Transmission Systems‖, IEEEPress Book, Standard Publishers and Distributors, Delhi,2001.
2. Padiyar K.R., ―HVDC Power Transmission System‖, Wiely Eastern PVT Limited.

3. Thyristor Based FACTS Controllers for Electrical Transmission System, R.M. Mathur, and R. K.Verma
4. FACTS: Controller in Power Transmission & Distribution, K. R. Padiyar, New AgeInternational.
5. HVDC and F ACTS controllers, Application of Static converter in Power System, V.K. Sood
6. E.W. Kimbark ―Direct Current transmission‖, Vol.1, John Wielly, New York
7. T,J.E Miller, ―Reactive Power Control in Electric Systems‖, John Wiley & Sons.

BTEEPE604B SMART GRID TECHNOLOGY 03 Credits

Unit 1: Introduction to Smart Grid 9 Hours

Introduction, working definitions of Smart Grid, Need of Smart Grid, Present development & International policies in Smart Grid. Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Vehicle to Grid, Smart Sensors, Home & Building Automation Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage**,**Indian Smart Grid –Key Challenges for Smart Grid. Application and standards, Impacts of Smart Grid on reliability, Impacts of Smart Grid on air pollutant emissions reduction.

Unit 2: Smart Grid Architecture 6 Hours

Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs –Transmission Automation – Distribution Automation –Renewable Integration Tools and Techniques for Smart Grid: Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms – Artificial Intelligence techniques

Unit 3: Distribution Generation Technologies 6 Hours

Introduction to Renewable Energy Technologies –Micro grids –Electric Vehicles and plug–in hybrids –Environmental impact and Climate Change –Economic Issues

Unit 4: Communication Technologies and Smart Grid 7 Hours

Introduction to Communication Technology – Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Synchro Phasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS). Two-way Digital Communications Paradigm, Network Architectures, IP- based Systems Power Line Communications.

Unit 5: Control of Smart Power Grid System 7 Hours

Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids. Security and Privacy: Cyber Security Challenges in Smart Grid, Load Altering Attacks, False Data Injection Attacks, Defense Mechanisms, Privacy Challenges.

Reference Books:

1. James Momoh, ―Smart Grid Fundamentals of Design and Analysis, Wiley, 2012

2. Keyhani, ―Smart Power Grid Renewable Energy Systems, Wiley 2011
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, ―Smart Grid: Technology and Applications, Wiley 2012.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, ―Smart Grids‖, Wiley ISTE 2012.

BTEEPE604C MODELING, SIMULATION AND CONTROL OF ELCTRICAL DRIVES 3 Credits

Unit 1: Introduction **7 Hours**

Introduction to Electric drives: Advantages of Electrical Drives, Parts of Electrical drive. Choice of Electric drives. Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation Classes of motor duty & criteria for selection of motor.Load equalization, stability of electrical drives, sensors in drive systems.

Unit 2: DC motor drives: **6 Hours**

Review of basic characteristics of DC motors, Single phase andThree phase rectifier controlled drives.DC-DC converter drives:Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives.

Unit 3: AC Drives: **8 Hours**

Speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control.Principle of Scalar andVector control of Induction motor, Static rotor resistance control method, static slip power recovery control.Direct torque control of Induction motor, direct torque control of PM synchronous motor drives

Unit 4: Sensor less control of IM drives **7 Hours**

Sensor less control of PMSM drives, Predictive torque control of induction motor drive, Multiphase machine drives, Fractional-slot concentrated winding machines and drives.

Unit 5:Machine Modeling **7 Hours**

DC, induction motor and synchronous machines; simulation of transients; simulation tools: SABER, PSPICE, and MATLAB-SIMULINK; Simulations of converters, inverters and cyclo-converters etc.

Text/References Books:

1. Dubey G. K., "Fundamentals of Electrical Drives", Narosa Publishing house
2. De N. K., Sen P. K., "Electric Drives", Prentice Hall of India
3. VedamSubramanyam, "Electrical Drives and Control", TMH Publications
4. Mohammed Fazlur Rahman, ―Modeling, Simulation And Control Of Electrical Drives‖, Institution of Engineering And Technology Publication

BTEEOE605A E-WASTE MANAGEMENT 03 Credits

Unit 1: Sources 7 Hours

Composition and characteristic of hazardous waste, Hazardous Waste (Management and Handling) Rules, 1989 and amendments, Federal Hazardous Waste Regulations under RCRA, Superfund, CERCLA and SARA. Toxicology, public health impact, Protocols, issues and challenges in transportation of hazardous waste.

Unit 2: E-waste 7 Hours

Introduction, toxicity due to hazardous substances in e-waste and their impacts, domestic e-waste disposal, e-waste management, technologies for recovery of resource from electronic waste.

Unit 3: Guidelines for environmentally sound management of e-waste 7 Hours

Occupational perspectives of recycling e-waste in India, Environmental health perspectives of recycling e-waste.

Unit 4: Hazardous substances waste Electrical and Electronic Equipment 7 Hours

Characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment.

Unit 5: E-Waste Recycling 7 Hours

Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials.

Text/References Books:

1. New Delhi. Johri R., ―E-waste: implications, regulations, and management in India and current global best practices‖, TERI Press, New Delhi.

2. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press

3. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press

4. Tchobanoglous G., Theisen H., Viquel S.A., ―Integrated Solid Waste Management: Engineering, Principles and Management issues‖, Tata McGraw Hill Publishing Company Ltd

BTEEOE605B POWER PLANT ENGINEERING 3 Credits

Unit 1: Power Generation from conventional sources 7 Hours

Introduction to conventional energy sources, Thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems;

Alternate sources of power generation - solar, wind, geo-thermal, ocean-thermal, tidal, wave and MHD.

Economic considerations in power systems-Load and Energy survey, load duration curve, plant factor and plant economics,

Unit 2: Thermal and Hydro Power Plants 7 Hours

Thermal Steam and Hydro Power Plants: Selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.

Hydro-electric Power Plants – selection of site, elements of power plant, classification, water turbines, governor action, hydro-electric generator, plant layout, pumped storage plants.

Unit 3: Nuclear Power Plants 7 Hours

selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.

Diesel and Gas Power Plants: Advantage and limitations, types of diesel plants, general layout, and applications. Components of gas power plant, gas turbine, fuels, materials, working and applications.

Unit 4: Renewable power plants 7 Hours

Solar power generation – Photo-voltaic and solar thermal generation – solar concentrators,

Wind power generation – types of wind mills, wind generators, tidal, biomass, geothermal and magneto hydro dynamic power generation, micro-hydel power plants, fuel cells

5: Combined operation of power plants 7 Hours

Plant selection, choice of size and number of generator units, Concept of parallel operation of various generating sources and load sharing, interconnected systems, concept of

Grid, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.

Text/Reference Books:

1. Wadhwa, C.L.,"Generation Distribution and Utilisation of Electrical Energy", New Age International Publishers, 3rd Edition, 2010.
2. J.B.Gupta, "A Course in Power Systems", S.K.Kataria and Sons, Reprint 2010-2011.
3. M. M. El-Wakil, "Power Plant Technology", Mcgraw Hill, Digitized on Dec 2000
4. B. G. A. Skrotzki& W. A. Vopat, "Power Station Engineering & Economy", McGraw Hill, Digitized on Dec 2007.

5. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., "A Text Book on Power Systems Engg", DhanpatRai and Sons, New Delhi, 2nd Revised Edition, 2010.
6. Nag P. K., "Power Plant Engineering", Tata McGraw Hill Publications
7. R. K. Rajput, "Power Plant Engineering", Shree Laxmi Publications

BTEEOE605C SENSOR TECHNOLOGY 03 Credits

Unit 1: Measurement and Characteristics **7 Hours**

Elements of a Measurement System; Classification of Instruments; Static Performance Parameters; Loading and Impedance Matching; Errors and Uncertainties in Measurement; Process and Standards of Calibration; Dynamic Characteristics Transfer Function Representation of a Measurement System, Impulse and Step Responses of First and Second Order Systems, Frequency Response of First and Second Order Systems.

Unit 2: Mechanical Transducers **7 Hours**

Temperature- Bimetallic Element and Fluid Expansion type Thermometers; Pressure- Manometers and Bourdon Gauges; Force- Balances, Helical Spiral Springs, Load Cells and Elastic Force Devices; Torque- Torsion Bars and Flat Spiral Springs; Liquid Level- Float Systems and Level to Pressure Converters; Flow- Pitot Static Tubes and Turbine type Flow Meters. Hot Wire Anemometer. Proximity Sensors- Reed Sensors, Inductive proximity sensor, capacitive proximity sensor, Optical sensor with through beam, Ultrasonic sensors.

Unit 3: Electrical Transducers **7 Hours**

Resistance Thermometers; Interfacing Resistive Transducers to Electronic Circuits; Thermistors- Measurement of Temperature and Thermal Conductivity, Temperature Control; Resistance Strain Gauges- Gauge Factor, Bonded and Unbonded Strain Gauges; Self Generating and Non Self Generating Inductive Transducers; Linear Variable Differential Transformers; Capacitive Transducers – Potentiometric Transducers; Thermoelectric Transducers and Sources of Errors in Thermocouples; Piezoelectric Transducers

Unit 4: Basic Signal Conditioning Elements **7 Hours**

Amplifiers- Non Electrical and Electrical types; Op Amps Inverting, Non Inverting, Summing, Differential, and Charge Amplifiers; Differentiating and Integrating Elements; Filters;
Data Transmission Elements- Electrical, Pneumatic, Position and Radio Frequency Transmission types; Compensation Elements for First and Second Order Systems – Basic Indicating, Recording, and Display Elements .

Unit 5: Feedback in Instruments **7 Hours**

Principles of Feedback and Advantages & Disadvantages of Feedback; Digital Voltmeters-Ramp and Dual Slope types; Servo type Potentiometric and Magnetic Tape Recorders; Digital Recorders of Memory type; Data Displays-Analog and Digital types.

Text/References Books:

1. Electronic Measurements and Instrumentation, K. Lal Kishore, Pearson Education Publications
2. Electronic Instrumentation, H. S. Kalsi-TMH Publications

3. Albert D Helfrick and William D Cooper; Modern Electronic Instrumentation and Measurement Techniques; 2004, PHI
4. BC Nakra, and Chaudhry; Instrumentation, Measurement and Analysis; 2004, Tata McGrawHill.
5. DVS Murthy; Transducers and Instrumentation; 2003, PHI.
6. CS Rangan, GR Sarma, and VSV Mani; Instrumentation Devices and Systems; Tata McGraw-Hill
7. Doeblin and Ernest; Measurement Systems Application and Design; 2004, Tata McGraw-Hill.
8. Tilak Thakur ― Mechatronics ‖ Oxford University Press 2016

BTEEOE605D Lightning Interaction with Power System 03 Credits

Unit 1: Lightning and Climate Change 7 Hours

Lightning Phenomenon and Parameters for Engineering Applications, Lightning Return stroke models for electromagnetic field calculations, Lightning Interaction with Power Substations, Lightning Interaction with Power Transmission Lines

Unit 2: Lightning Interaction with Medium 7 Hours

Voltage Overhead Power Distribution Systems, Flash collection rate, Effects of various parameters on lightning overvoltage, Lightning protection of MV systems, Lightning performance of overhead distribution lines, Lightning Interaction with Low-Voltage Overhead Power Distribution Networks, Typical configurations of LV networks, Lightning surges on LV power systems, Lightning protection of LV networks,

Unit 3: Lightning Protection of Structures and system inside of buildings 7 Hours

Lightning currents, Lightning protection of buildings, Volume protected against direct lightning strike, Air-termination and down-conductor system, Earth-termination system, Lightning equipotential bonding, Separation distance, Currents and voltages on lines, Grid-like spatial shield, Smart Grid functions and technologies, Lightning and digital recording technology, Lightning protection of Smart Grid sensors..

Unit 4: Impact on Renewable Energy Systems 7 Hours

Wind turbine components and overview of the lightning protection system, Lightning phenomenology and wind turbines, Lightning damage to wind turbines due to direct impacts, Lightning protection of wind turbine components, Overvoltages in wind farms, Solar energy: solar radiation, parameters, hourly and daily parameters, PV systems: off-grid and grid-connected, considerations of the grid connection, Internal and overvoltage lightning protection, External lightning protection

Unit 5: Measurement of Lightning Currents and Voltages 7 Hours

Lightning current measurements, Measurement method of lightning voltage, Application of various lightning overvoltage sensors in power systems, Application of the FDTD Method to Lightning Studies, Fundamentals, Representations of lightning source, Applications, Software Tools for the Lightning Performance Assessment, FLASH program, Lightning-induced overvoltages–electromagnetic transients program.

Text/References Books:

1. Alexandre Piantini, ―Lightning Interaction with Power Systems- volume 1, Institution of Engineering and Technology

2. Alexandre Piantini, ―Lightning Interaction with Power Systems- volume 2, Institution of Engineering and Technology

3. Vernan Cooray. ” Lightning Protection”.Power and Energy services, IET.

BTEEL606 SWITCHGEAR AND PROTECTION LAB 01 CREDITS

Conduct any 8practicals from given list

1. To verify characteristics of Static Overcurrent Relay.
2. To verify the characteristics Static over Voltage Relay.
3. To verify the characteristics of IDMT Relay.
4. To verify the characteristics of Reverse Power Overcurrent Relay/ Negative Sequence Relay.
5. To demonstrate working of Distance Protection Scheme for long transmission line.
6. To demonstrate working of Differential Protection of Transformer and sketch the schematic diagram for protection scheme.
7. To demonstrate working of Differential Protection of Alternator and sketch the schematic diagram for protection scheme.
8. Identify the components of different types of circuit breakers with their specifications (through visits/ videos/models)
9. To verify the characteristics of MCB, ELCB and HRC fuses.

BTEEL 607 ELECTRICAL MACHINE DESIGN LAB 01 Credit

Conduct any eight practical from given list

1 Symbols used in Electrical Engineering

2 Design and assembly of Choke with design report.

3 Design and assembly of Starter with design report.

4 Design and layout of simplex lap winding (Detailed Drawing Sheet)

5 Design and layout of wave winding (Detailed Drawing Sheet)

6 Design and layout of ac lap winding (Detailed Drawing Sheet)

7 Design and assembly of transformer with design report. (Detailed Sheet for General Assembly of transformer)

8 Design and assembly of three phase induction Motor with design report.(Detailed Sheet for General Assembly of Induction Motor)

9 Complete any two drawings sheets with the help of Computer Aided Design Software like AUTOCAD)

BTEEL608 CONTROL SYSTEM ENGINEERING LAB 01 Credit

Any Eight Experiments from the following list.

1. Write a program to obtain: i) pole, zero and gain values from a given transfer functionii)Transfer function model from pole, zero, gain values.
2. Write a program to determine of step & impulse response for a first order unity feedback system
3. Write a program to generate various standard test signals.
4. Write a program to plot the root locus for a given transfer function of the system using MATLAB.
5. Write a program to plot the Bode Plot for a given system using MATLAB.
6. Write a program to plot the Nyquist Plot for a given system using MATLAB.
7. Write a program to design Proportional, Proportional + Integral, Proportional+ Derivative and P-I-D Controller for second order system.
8. Write a program to determine of step & impulse response for a second order unity feedback system
9. Write a program to determine state space model from transfer function model & vice versa.
10. Write a program to determine state space model from transfer function model & vice versa

BTEEM609 SEMINAR **02 credit**

mmmm

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech. Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering

With effect from the Academic Year 2020-2021(Final Year)

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VII [Final Year]

Sr. No.	Course Code	Type of Course	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEEC701	PCC1	Power System Operation & Control	3	0	0	20	20	60	100	3
2	BTEEC702	PCC2	High Voltage Engineering	3	0	0	20	20	60	100	3
3	BTEEC703	PCC3	Electrical Drives	3	0	0	20	20	60	100	3
4	BTEEE704	PEC1	Elective-IX	3	0	0	20	20	60	100	3
5	BTEEE705	PEC2	Elective-X	3	0	0	20	20	60	100	3
6	BTEEL706	Lab	Power System Operation & Control Lab	0	0	2	--	30	20	50	1
7	BTEEL707	Lab	High Voltage Engineering Lab	0	0	2	--	30	20	50	1
8	BTEEL708	Lab	Electrical Drives Lab	0	0	2	--	30	20	50	1
9	BTEES709	Seminar	Seminar	0	0	2	--	30	20	50	1
10	BTEEP710	Project	Project Part-I	0	0	6	--	30	20	50	3
11	BTEEF711	--	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1
			Total	**15**	**0**	**14**	**100**	**250**	**450**	**800**	**23**

Elective-IX	Elective-X
A) Special Purpose Electrical Machines	A) Digital Signal Processing
B) Electrical Traction and Utilization	B) Energy Audit and Conservation
C) Engineering System Design and Optimization	C) Electrical Power Quality
D) Financial Management	D) HVDC Transmission and FACTS

Dr. Babasaheb Ambedkar Technological University, Lonere.

B.Tech (Electrical Engineering / Electrical Engineering (Electronics and Power)/ Electrical & Electronics Engg / Electrical & Power Engineering)

Curriculum for Semester VIII [Final Year]

Sr. No.	Course Code	Course Title	Hours per week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
		1.Power Management Integrated Circuits 2.DC Power Transmission Systems 3.High Power Multilevel Converters 4.Fuzzy Sets, Logic and Systems & Applications 5.The Joy of Computing using Python 6.Introduction to Industry 4.0 and Industrial Internet of Things 7.Entrepreneurship Essentials **# Student to opt any two subjects from above list**	3	0	0	20*	20*	60*	100	3
			3	0	0	20*	20*	60*	100	3
6	BTEEP803	Project - II	0	0	30	--	100	150	250	15
		Total	**6**	**0**	**30**	**40**	**240**	**270**	**450**	**21**

** Six months of Internship in the industry*

**Students doing project at institute will have to appear for CA/MSE/ESE*

** Student doing project at Industry will give NPTEL examination / Examination conducted byuniversity i.e. CA/MSE/ESE*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

 # Project Load: 2hrs/week/project.

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

S.N.	Course Name	Duration	Name of Professor	Institute offering Course
1	Power Management Integrated Circuits	12 Weeks	Prof. Qadeer Ahmad Khan	IITM
2	DC Power Transmission Systems	12 Weeks	Prof. Krishna S	IITM
3	High Power Multilevel Converters	12 Weeks	Prof. Anandarup Das	IITD
4	Fuzzy Sets, Logic and Systems & Applications	12 Weeks	Prof. Nishchal Kumar Verma	IITK
5	The Joy of Computing using Python	12 Weeks	Prof. Sudarshan Iyengar Prof. Yayati Gupta	IIT Ropar
6	Introduction to Industry 4.0 and Industrial Internet of Things	12 Weeks	Prof. Sudip Misra	IIT KGP
7	Entrepreneurship Essentials	12 Weeks	Prof. Manoj Kumar Mondal	IIT KGP

BTEEC701: POWER SYSTEM OPERATION AND CONTROL	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

1. Power System-II

Course Objectives:

1. To understand the fundamental concepts of power system.
2. To obtain mathematical model of Synchronous machine, excitation and speed governing system.
3. To analyze the transient stability of power system.
4. To understand the economic operation of power system.
5. To explain various techniques of reactive power and voltage Control

Course Outcome:

1. Explain the fundamental concept of power system.
2. Design the mathematical model of synchronous machine.
3. Design the mathematical model Excitation system and speed governing system.
4. Analyze the transient stability of power system using swing equation and equal area criteria.
5. Analyze the economic operation of power system.
6. Explain the methods of Voltage control.

UNIT I. FUNDAMENTALS OF POWER SYSTEM: (6hr)

Concepts of real and reactive powers, complex power, per-unit representation of power system, Transmission capacity, load characteristics, real power balance and its effect on system frequency, load frequency mechanism, reactive power, balance and its effect, on-load tap changing transformer and regulating transformer

UNIT II. SYNCHRONOUS MACHINE MODELLING (8hr)

Schematic diagram, Physical description: armature and field structure, machines with multiple pole pairs, MMF waveforms, direct and quadrature axes, Mathematical Description of a Synchronous Machine: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, electrical power and torque, physical interpretation of dq0 transformation

UNIT III. MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEM (8hr)

Elements of an Excitation System; Types of Excitation System; Control and protective functions; Functional Block Diagram of Power Generation and Control, Schematic of a hydroelectric plant, classical transfer function of a hydraulic turbine, special characteristic of hydraulic turbine, electrical analogue of hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a transient droop, Block diagram of governor with transient droop compensation, Steam turbine modelling: Single reheat tandem compounded type and cross compound type.

UNIT IV. TRANSIENT STABILITY: (6hr)

Solution of Swing equation using classical model, application of equal area creation on point by point solution

UNIT V. ECONOMIC OPERATION OF POWER SYSTEM: (6hr)

Distribution of load between units within a plant, transmission loss as function of plant generation, calculation of loss-coefficient, distribution of loads between plants with special reference to steam and hydro plants, automatic load dispatching, Unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming.

UNIT VI. REACTIVE POWER AND VOLTAGE CONTROL: (6hr)

Production and absorption of reactive power- Methods of Voltage Control – Shunt reactors – Shunt Capacitors – Series Capacitors – Synchronous condensers – Static Var systems – Principles of Transmission system compensation – Modeling of reactive compensating devices

Reference Books:

1. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1993.
2. Gross C. A., ‘Power System Analysis’ McGraw Hill
3. Arrilaga J., ‘Computerised Power system Analysis’ McGraw Hill
4. Foud Anderson, ‘Power system control dynamics’ McGraw Hill
5. Kaushik, ‘Computerised Power system Analysis’ McGraw Hill
6. Padiyar K. R., ‘Power system dynamics, ‘ New Age International

BTEEC702: HIGH VOLTAGE ENGINEERING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre-requisite: Electrical Engineering Materials,Power systems I, Power Systems II

Course Objectives:

1. To study conduction and breakdown in gases, liquids and solids.
2. To understand the methods and measurement of high voltage generation and measurement
3. To explain the lightening phenomenon and insulation co-ordination.
4. To know different non-destructive testing and standards in HV.

Course Outcomes:

1. Illustrate the concept of electric field stresses, applications of insulating materials and methods for Non-destructive testing of equipment like transformers, insulators, isolators, bushings, lightning arrestors, cables, circuit breakers and surge diverters.
2. Explain the breakdown process in solid, liquid, and gaseous materials
3. Analyze methods for generation and measurement of High Voltages and Currents (both ac and dc)
4. Describe the phenomenon of over-voltage and choose appropriate insulation co-ordination levels based on IS & IEC Standards.

UNIT I: INTRODUCTION TO HIGH VOLTAGE ENGINEERING (2hr)

Electric Field Stresses,Poisson's equation, Estimation and Control of Electric Stress, Surge Voltages, their distribution and control.

UNIT II:CONDUCTION & BREAKDOWN IN GASES: (6hr)

Gases as insulation media, ionization processes, Townsend's current growth equation, current growth in presence of secondary processes, Townsend's criterion for breakdown in electronegative gases, time lags for breakdown, Streamers theory, Paschen's law, breakdown in non-uniform fields and corona discharge, corona under positive & negative polarities, glow & arc discharge, considerations in using gases for insulation purpose.

UNIT III: BREAKDOWN IN DIELECTRIC MATERIALS: (8hr)

Conduction & breakdown in liquid dielectrics: Pure and commercial liquids, breakdown in pure and commercial liquids, theories of breakdown in liquids. Breakdown in solid dielectrics: Intrinsic, electromechanical& thermal breakdown, chemical, electrochemical deterioration, treeing, tracking, internal discharges, breakdown in composite insulation, properties of solid insulators & other materials used in practice. Insulating materials: In power transformers, rotating machines, circuit breakers, cables, power capacitors & other equipment.

UNIT IV: OVER VOLTAGE DUE TO LIGHTENING PHENOMENON: (8hr)

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, propagation of lightning voltage & current waves on transmission lines, reflection & transmission of traveling wave at junction, system control of over voltage due to switching protection of transmission lines against over voltage. Insulation co-ordination, surge diverters, equipment insulation level & co-ordination of substations.

UNIT V:GENERATION & MEASUREMENT OF HIGH VOLTAGES & CURRENTS: (10hr)

Generation of a) high d. c voltage b) power frequency high alternating voltage c) high frequency a. c. d) impulse voltages Standard impulse waves shapes and it's equation, multistage impulse generator, matrix circuit, generation of switching surges, tripping & control of impulse generators, generation of impulse currents.

Measurement of High Direct Current voltages, Abraham Voltmeter Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements

UNIT VI:NON DESTRUCTIVE TESTING: (6hr)

I.E.C. & IS codes for high voltage tests on electrical appliances & power apparatus &electrical motors, non- destructive testing, testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverter, layout of high voltage laboratories & test facilities.

Reference Books:

1) High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition
2) High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3) High Voltage Engineering, Theory and Practice by Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, RoshdyRadwan, Marcel Dekker

Text Books:

1. Kamaraju V. & Naidu M. S., 'High Voltage Engineering', Tata-McGraw Hill
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Pvt. Ltd

BTEEC703: ELECTRICAL DRIVES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite : Electrical machine-II, Power Electronics

Course objective :

Students will be able to understand the dynamics of drive system.
Students will be able to use various methods of speed control of AC and DC Drive.
Students will be have the ability to analyze the drive system
Students will be able to select proficiently and the proper drive system for particular application.
Students will be able to have basic knowledge of recent advancement in Electric Drive.

Course outcomes:

Analyze the dynamics of Electrical Drives system.
Use various control techniques for controlling the speed of AC and DC motors.
Analyze the AC and DC drives.
To Select/recommend the appropriate Drive according to the particular applications.
State the recent technology of AC and DC drive

UNIT I: . INTRODUCTION (8hr)

Advantages of Electrical Drives, Parts of Electrical drive, Choice of Electric drives Dynamics of Electrical drives: fundamental torque equations, multiquadrant operation, nature and classification of load torques, steady state stability, concept of load equalization in drives

UNIT II. .CONTROL OF ELECTRICAL DRIVES (6hr)

Modes of operation: Steady state, Acceleration, Deceleration, Drive classification. Closed loop control of drives : Current limit control, torque control, speed control, position control, Control of multi motor drives, speed sensing, current sensing, Classes of motor duty & criteria for selection of motor.

UNIT III. DC MOTOR DRIVES (7hr)

Review of basic characteristics of DC motors, Single phase drives : Single phase half wave converter drives, semi converter drives, Full converter drives, Dual converter drives. Three phase drives : Three phase half wave drives, semi-converter drives, full converter drives, dual-converter drives, DC-DC converter drives: Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.

UNIT IV: INDUCTION MOTOR DRIVES (7hr)

Review of starting, braking and speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control, Current control, Closed loop control of Induction motors, Principle of Scalar and Vector control of Induction motor, Multiquadrant operation of induction motor drives fed from Voltage Source Inverters. Static rotor resistance control method, static slip power recovery control-Static Scherbius drive and StaticKramer drive.

UNIT V: SYNCHRONOUS MOTOR DRIVES (6hr)

Review of starting, pull in and braking of Synchronous motor,Static variable frequency control for Synchronous motors,Load commutated inverter fed Synchronous motor drive, Introduction to closed loop control of Load commutated inverter fed Synchronous motor drive.

UNIT VI: DRIVES FOR SPECIFIC APPLICATIONS (6hr)

Textile Mill: various stages and drive requirements control of ac motors for controlling torque. Steel Rolling Mill : reversing and continuous hot and cold rolling mills, Drive requirements, motors for mill drive. Cement mill : Stages in cement production, requirements of mill motors, Kiln drives, crusher drives, fan/blower drives, compressor drive. Sugar Mill : Requirements for various drive motors, selection of motors for various processes

Ref Books:

1. Dubey G. K., “Fundamentals of Electrical Drives”, Narosa Publishing house
2. De N. K., Sen P. K., “Electric Drives”, Prentice Hall of India
3. VedamSubramanyam, “Electrical Drives and Control”, TMH Publications

BTEEE704A: SPECIAL PURPOSE ELECTRICAL MACHINES	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial: 0	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Prerequisite:

AC Machines and DC Machines

Course Objectives:

To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors, stepping motors, switched reluctance motors, Permanent magnet brushless D.C. motors , Permanent magnet synchronous motors.

Course Outcome:

After Completion of this Course, student will be able

1. Demonstrate construction, working principle, and application of various types of special purpose electrical machines
2. Select a special Machine for a particular application
3. Demonstrate behaviour of induction generator and induction machine.

UNIT I. SYNCHRONOUS RELUCTANCE MOTORS (6hr)

Constructional features , Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram - Characteristics – Vernier motor.

UNIT II. STEPPING MOTORS (6hr)

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Drive circuits.

UNIT III. SWITCHED RELUCTANCE MOTORS (6hr)

Constructional features – Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control - Characteristics – Computer control.

UNIT IV. PERMANENT MAGNET BRUSHLESS D.C. MOTORS (8hr)

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

UNIT V. PERMANENT MAGNET SYNCHRONOUS MOTORS (8hr)

Principle of operation – EMF and torque equations – Reactance – Phasor diagram – Power controllers - Converter - Volt-ampere requirements – Torque speed characteristics - Microprocessor based control.

UNIT VI. INDUCTION MACHINES (6hr)

Induction generator–self excitation requirement – voltage regulation – different methods of voltage control –doubly fed induction machine – generation operating mode– linear Induction Motor

Text Books:

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.

References:

1. R.Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
3. T.J.E.Miller,Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, 1989.
4. R.Srinivasan, Special Electrical Machines, Lakshmi Publications, 2013.

BTEEE704B: ELECTRIC TRACTION & UTILIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

- Basics of Electrical Engineering and Electrical Machine-II.

Course Objectives:

1. To possess knowledge of advanced and emerging topics in traction mechanism and illumination engineering and their applications in the field.
2. An ability to design a traction system, a component, to meet desired needs of locomotive industry within realistic constraints and confirms manufacturability, and sustainability.
3. To mold students professionally to possess in-depth and advanced knowledge by course contents along with emerging topics.

Course Outcomes:

After Completion of this Course, student will be able to

1. Identify types of Traction System.
2. Interprete Various Power supply in Electric Traction.
3. Analyze Various Traction Motors.
4. Define methods of Traction motor Control.
5. Elobrate Train movement & Breaking in Traction system.
6. Classify the indoor and outdoor Illumination system.

UNIT I: ELECTRIC TRACTION SYSTEM: (8hr)

Electrical transmission: Electrical transmission system employing D.C. generator D.C. series motor, Electrical transmission system employing 3 phase alternator supplying D.C. traction motors, electrical transmission employing 3 phase alternator supplying induction motors, Choice of traction system-battery drive, hybrid drive, flywheel drive, tramways, trolley bus. Track electrification: D.C. System, single phase low frequency A.C. system, single phase high frequency A.C. system, 3 phase A.C. system and composite system.

UNIT II: POWER SUPPLY FOR ELECTRIC TRACTION: (6hr)

Current collection system, current collectors for Over Head Systems, Overhead construction for Tramways and trolley buses and railways, Sag and Tension calculation for a trolley wire, Traction substations, location of substations, feeding and distributing system, substation equipment’s. Block Diagram of AC Electric locomotive, Signaling interference in tele-communication circuits.

UNIT III: TRACTION MOTORS: (6hr)

Characteristics of traction motors, straight D.C. series motor, suitability of series motor for traction duty, constructional details of D.C. Traction Motors, Series motor using undulating D.C, suitability of shunt motor for traction duty, single phase series motors, Repulsion motor, compensated repulsion motor, Induction motor with variable frequency with SCR, Linear Induction motor.

UNIT IV: TRACTION CONTROL: (6hr)

Traction control: Duty cycle, Methods of traction motor control, series-Parallel and other types of controllers, use of interlocks, run back prevented, multiple unit control, Master controllers, Reverses, Dead man's handle, use of Metaldyne and Megavolt.

UNIT V: TRAIN MOVEMENT AND BRAKING: (8hr)

Speed time curve, its analysis and construction, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, average acceleration and speed, energy output and consumption.

Braking: Mechanical versus electric breaking, rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes.

UNIT VI: ILLUMINATION: (6hr)

Requirement of good lighting, Classification of light fitting & luminaries, factors to be considered for design of indoor & outdoor lighting scheme, Design Procedure for factory lighting, street lighting.

Reference Books:

1) Utilization of Electrical Power and Electic Traction by J.B. Gupta. (Katson Book publisher)
2) H. Partab: Modern Electric Traction, Dhanpat Rai & sons.
3) Upadhayay J. & Mahindra S.N., Electric Traction, Allied Publishers Ltd., 1st Ed.
4) Rao P.S., Principle of 25 KV Overhead Equipments. R. (Nasik) Printpack Pvt Ltd,, 1st Ed.
5) Electric Traction for Railway Trains, by Edward P. Burch. McGraw Hill Book Co. Inc.
6) C.L.Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Publishers.

BTEEE704C: ENGINEERING SYSTEM DESIGN OPTIMIZATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Linear Algebra, Non-linear Problems

Course Outcome:

1. To understand different level optimization problem formulation.
2. To study novel methods in optimization.
3. To understand and develop genetic algorithm for engineering problems.

UNIT I: INTRODUCTION (8hr)

Introduction to Optimization problem formulation, optimization algorithms, applications and examples, different optimization methods available

UNIT II: SINGLE VARIABLE OPTIMIZATION (6hr)

Optimization criteria, bracketing methods– Exhaustive search method, bound phase method, Region Elimination methods– Fibonacci search method, Golden search method, Gradient based methods– Newton Raphson method, Bisection method, Root finding using optimization technique

UNIT III: MULTI OBJECTIVE OPTIMIZATION (6hr)

Optimization criteria, Different search methods, Unidirectional search, Direct search method – Evolutionary optimization method, Powell's conjugate direction method, Gradient based methods– Newton's method and Variable metric method.

UNIT IV: SPECIALIZED METHODS (6hr)

Integer programming, Geometric programming, simulated annealing, Global optimization using -steep descent method, simulated annealing.

UNIT V: GENETIC ALGORITHMS AND EVOLUTIONARY APPROACHES (6hr)

Differences and similarities between genetic algorithms and traditional techniques, operators of GA's, Computer program for simulated annealing, Newton Raphson method, Evolutionary optimization method.

References

1. Kalyanmoy Deb, "Optimization for Engineering design", Prentice Hall,India, 2005.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionaryalgorithms", John Wiley,2001

BTEEE704D: FINANCIAL MANAGEMENT	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Course Objectives:

• To help the students to develop cognizance of the importance of Financial Management in corporate valuation

• To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.

• To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow

• To enable students to synthesize related information and evaluate options for most logical and optimal solution such that they would be able to predict and control Debt Equity incurrence and improve results.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. The students would be able to understand and define basic terminology used in finance and accounts
2. The students would be able to prepare& appraise Financial Statements and evaluate a company in the light of different measurement systems.
3. The students would be able to analyze the risk and return of alternative sources of financing.
4. Estimate cash flows from a project, including operating, net working capital, and capital spending.
5. To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
6. To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems.

UNIT I: INTRODUCTION

Introduction to Financial Accounting, Book keeping & Recording: Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

UNIT II: FINANCIAL STATEMENT PREPARATION, ANALYSIS & INTERPRETATION

Preparation of financial statement and Profit & Loss Account, Balance Sheet. , Ratio Analysis - classification of various ratios.

UNIT III: INTRODUCTION TO FINANCIAL MANAGEMENT

Concept of business finance, Goals & objectives of financial management, Sources of financing, Long Term financing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility). Short Term Financing- bank finance, commercial paper, trade credit

UNIT IV: WORKING CAPITAL MANAGEMENT

Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financing approaches for working capital, Methods of forecasting working capital requirements, Methods of Forecasting.

UNIT V: TIME VALUE OF MONEY & CAPITAL BUDGETING

Concept of time value of money, Compounding & discounting; Future value of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

UNIT VI: PROJECT FINANCING

Details of the company, its promoters and project finances required, profitability etc., Loan documentation-Appraisal of terms loans by financial institutions. Basic components of project finance.

TEXT & REFERENCE BOOKS:

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw Hill Publication 5th Edition.
2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5th Edition.
3. Taxman's Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.
4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy, Himalaya Publishing House
5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2nd Edition.

BTEEE705A: DIGITAL SIGNAL PROCESSING	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

Digital Systems, Interfacing, Z-Transform, Fourier Transform

Course Objectives:

To understand the design and implementation of digital Signal processing systems

Course Outcomes:

After Completion of this Course, student will be able to

1. Represent signals, systems and digital processing of analog signals.
2. Represent discrete time signals, systems and analysis of Discrete-Time Linear Time-Invariant Systems.
3. Apply digital signal processing techniques to analyze discrete time signals in time domain.
4. Apply digital signal processing techniques to analyze discrete time signals in frequency domain.
5. Design different filter structure
6. Validate system functionality and evaluate results.

UNIT I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (8 hr)

Signals, Systems and Signal Processing: Basic Elements of a Digital Signal Processing System, Advantages of Digital over Analog Signal Processing.

Classification of Signals: Multichannel and Multidimensional Signals, Continuous-Time versus Discrete-Time Signals, Continuous-Valued Versus Discrete-Valued Signals, Deterministic Versus Random Signals.

The Concept of Frequency in Continuous-Time and Discrete-Time Signals: Continuous-Time Sinusoidal Signals, Discrete-Time Sinusoidal Signals, Harmonically Related Complex Exponentials.

Analog-to-Digital and Digital-to-Analog Conversion: Sampling of Analog Signals, the Sampling Theorem, Quantization of Continuous-Amplitude Signals, Quantization of Sinusoidal Signals, Coding of Quantized Samples, Digital-to-Analog Conversion, Analysis of Digital Signals and Systems versus Discrete-Time Signals and Systems.

UNIT II: DISCRETE-TIME SIGNALS AND SYSTEMS (8 hr)

Discrete-Time Signals: Some Elementary Discrete-Time Signals, Classification of Discrete-Time Signals, Simple Manipulations of Discrete-Time Signals.

Discrete-Time Systems: Input-Output Description of Systems, Block Diagram Representation of Discrete-Time Systems, Classification of Discrete-Time Systems, Interconnection of Discrete-Time Systems.

Analysis of Discrete-Time Linear Time-Invariant Systems: Techniques for the Analysis of Linear Systems, Resolution of a Discrete-Time Signal into Impulses, Response of LTI Systems to Arbitrary Inputs: The Convolution Sum, Properties of Convolution and the Interconnection of LTI Systems, Causal Linear Time-Invariant Systems, Stability of Linear Time-Invariant Systems, Systems with Finite-Duration and infinite-Duration Impulse Response.

Discrete-Time Systems Described by Difference Equations: Recursive and Nonrecursive Discrete-Time Systems, Linear Time-Invariant Systems Characterized by Constant-Coefficient Difference Equations, Solution of Linear Constant-Coefficient Difference Equations, The Impulse Response of a Linear Time-Invariant Recursive System

UNIT III: Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS (6 hr)

Z-Transform: Direct z-Transform, Inverse z-Transform. Properties of z-transform. Rational z-Transforms: Poles and Zeros. Pole Location and Time-Domain Behavior for Causal Signals, System Function of a Linear Time-Invariant System. Inversion of the z-Transform: Inverse z-Transform by Contour Integration, Inverse z-Transform by Power Series Expansion, Inverse z-Transform by Partial-Fraction Expansion, Decomposition of Rational z-Transforms, One-sided z-Transform: Definition and Properties, Solution of Difference Equations.

UNIT IV: FREQUENCY ANALYSIS OF SIGNALS AND SYSTEMS (4 hr)

Properties of the Fourier Transform for Discrete-Time Signals: Symmetry Properties of the Fourier Transform, Fourier Transform Theorems and Properties.

UNITV:DISCRETE FOURIER TRANSFORM: PROPERTIES AND APPLICATIONS (8 hr)

Frequency Domain Sampling: The Discrete Fourier Transform: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform (DFT), DFT as a Linear Transformation, Relationship of the DFT to Other Transforms. Properties of the DlT: Periodicity. Linearity and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

UNIT VI: IMPLEMENTATION OF DISCRETE- TIME SYSTEMS (6 hr)

Structures for the Realization of Discrete-Time Systems. Structures for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures, Lattice Structure.

Structures for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures, Latticc and Lattice-Ladder Structures for IIR Systems.

Reference Book:

1) John G. Proakis, Dimitris G.Manolakis, “Digital Signal Processing”.
2) Shalivahanan, Vallavaraj and Gnanapriya, “Digital Signal Processing”

Text Book:

1) N.G.Palan, “Digital Signal Processing”
2) Ramesh Babu, “Digital Signal Processing”
3) Alon V. Oppenhelm, “Digitsl Signal Processing”, PHI Pub.
4) S.K.Mitra, “Digital Signal Processing”, TMH Pub.

BTEEE705B: ENERGY AUDIT AND CONSERVATION	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Pre Requisite:

Basics of Electrical Machines, Power Plant Engineering

Course Objectives:

1. To understand the basic process involved in the energy audit and the terminologies associated in the process.
2. To be able to develop audit reports of any firm including large and small scale industries, residential and commercial establishments.
3. To select and comment on the appropriate method for the planning and monitoring of any energy conservation project.

Course Outcomes:

After Completion of this Course, student will be able

1. To recognize Global Environmental Issues and Role of Renewable & non-conventional energy sources
2. To estimate Energy efficiency opportunities in Thermal- Mechanical Systems and Electrical System.
3. To analyze Energy Conservation Proposals economically and prepare audit reports.

UNIT I: SOURCES OF ENERGY: (6hr)

Energy resources, Stored & running resources, Environmental Concerns – Global Warning , Depletion of Ozone layer, Kyoto Protocol, UNFCCC, CDM, Carbon Emissions, Role of Renewable Energy Sources

UNIT II: (7hr)

Energy Conservation Act 2001, Designated Consumers, Energy Policy, BEE and its role in Energy Conservation, Energy Audit – Need, Types , Methodology, Steps involved in Energy Audit, Energy Costs and Benchmarking , Measurements for Energy Audit, Energy Management Duties and Responsibilities.

UNIT III: THERMAL MECHANICAL SYSTEMS (8hr)

Boiler Efficiency by direct and indirect methods, Energy efficiency opportunities in boilers, HVAC, and refrigeration systems, compressed air systems, pumps, cooling towers, fans and blowers, Cogeneration – Need and Principle , Prime movers for cogeneration, Waste heat recovery systems – Recuperators, economizer heat recovery boilers.

UNIT IV: ELECTRICAL SYSTEMS **(7hr)**

Utilities: Energy conservation in generation, transmission,distribution & utilization, Electrical billing , load management ,maximum demand control, APFC Panel , PF improvement and benefits , Energy Efficient motors and starter, lightning systems, Electronic Ballast

UNIT V: **(6hr)**

Planning, Implementation & monitoring of energy conservation project, Time Value of money, Financial Investment – Simple payback period, ROI (Return on Investment), Net Present value, Internal rate of return, profitability index. All calculations and numerical interpretation.

UNIT VI: **(6hr)**

Case studies on various industrial sectors like Steel Plant, Thermal Plant, Industries Building and Commercial Establishments and preparing audit reports

Text Books:

1. "Industrial Energy Conservation" Charles M Gottschalk ,John Willey and Sons
2. "Energy Management" Paul O Callagham, Tata Mc Grawhill
3. "Energy Technology" – S Rao and B Parulekar , Khanna Publisher

References:

1. "Energy Management Handbook" – Wayne C Turner

BTEEE705C: ELECTRICAL POWER QUALITY	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits:3	End Term Exam: 60 Marks

Prerequisite:

1. Basic Electrical concepts
2. Power Electronics concepts
3. Power system concepts

Course Objectives:

1. To study the various power quality issues, their production, monitoring and mitigation.
2. To study the various power quality standards.
3. To study various power quality monitoring methods.
4. To apply appropriate solution techniques for power quality Problems.

Course Outcome:

After Completion of this Course….

1. Student will be able to get the in-depth understanding of power quality issues & standards.
2. Students will be able to understand working of power quality improving Equipment's.

UNIT I: INTRODUCTION (7hr)

Understanding Power quality, definitions, growing concerns to Power Quality, Evaluation Procedure,General Classes of Power Qualitydisturbances, causes and effects of Power Quality disturbances

UNIT II: TRANSIENT OVER VOLTAGES (7hr)

Sources, causes and effects, Principle of Overvoltage protection and solutions. VoltageSag and Interruptions: causes and effects, estimation of voltage sag performance, principle ofprotection and solutions.

UNIT III: LONG-DURATION VOLTAGE VARIATIONS (7hr)

Long Duration Voltage variations, principles of regulating voltage Devices for voltage regulation, flickers, flicker sources and mitigation, quantifying flicker.

UNIT IV: FUNDAMENTALS OF HARMONICS (7hr)

Harmonic distortion, sources of harmonics, effects of harmonic distortion, Voltage Vs Current Harmonics,Active, Reactive, Volt-Amp power under non sinusoidal conditions, Harmonic Indices (THD and TDD),principles of harmonic control, mitigating devices, interharmonics, IEEE standard 519.

UNIT V: WIRING AND GROUNDING (4hr)

Reasons for Grounding, wiring and grounding problems and solutions

UNIT VI: POWER QUALITY MONITORING (7hr)

Monitoring Considerations, site survey, Monitoring Quality, monitoring location, PQ measuringinstruments, assessment of power quality measurement data, IEEE 1159 Standard. Impact of poor power quality on Reliability Indices.

References/Books:

1.Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2.Haytt G. T., ―Electric Power Quality‖, Stars In Circle Publication.
3. NPTEL courses
   a) NOC:Power Quality Improvement Technique, IIT Roorkee by Avik Bhattacharyya.
   b) Power Quality in Power Distribution Systems, IIT Madras by Dr. Mahesh Kumar.

BTEEE705D: HVDC TRANSMISSION AND FACTS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20 Marks
Tutorial:	Internal Assessment: 20 Marks
Total Credits: 3	End Term Exam: 60 Marks

Pre requisite: Power System-II, Power Electronics

Course Outcome:

1. To understand importance, configuration and types of HVDC transmission.
2. To analyst the operation of HVDC converter, system control and protection.
3. To understand the concept of FACTS, their role, type and functionality.
4. To analyze the operation of static series and shunt compensator.

UNIT I: DC POWER TRANSMISSION FUNDAMENTALS (8hr)

Introduction, Economics of Dc Power transmission, comparison with AC system, Types of DC links, major components of converter station, planning of HVDC system.

UNIT II: HVDC CONVERTER (6hr)

Choice of converter configuration, analysis of Gratz circuit with and without overlap, working of converter as rectifier and inverter, equivalent circuit for HVDC link

UNIT III: HVDC SYSTEM CONTROL (6hr)

HVDC System Control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Starting and stopping of HVDC link

UNIT IV: CONVERTER FAULTS AND PROTECTION (6hr)

Converter Faults and Protection: Types of faults-commutation failure, Arc through, Misfire, short circuit in bridge, Over current and over voltage protection, Detection of line faults, Principle of DC circuit interruption, DC breakers, Types and characteristics of DC breakers, effects of proximity of AC and DC transmission lines.

UNIT V: FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATIONS (6hr)

Transmission Interconnections, Flow of Power in an AC System, Loading Capability limits, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic types of FACTS Controllers, Description and Definitions of FACTS Controllers, Benefits from FACTS Technology, Comparison between HVDC & FACTS.

UNIT VI: STATIC SHUNT COMPENSATORS (6hr)

Static Shunt Compensators: Objective of shunt compensation, Methods of Controllable VAR Generation, Static VAR Compensators: SVC and STATCOM, Comparison of SVC and

STATCOM, Static VAR Systems (SVS)Static Series Compensation: Objective of series compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators

References

1. Padiyar K. R., “HVDC Power Transmission Systems”, New Age International.
2. Kimbark, “ HVDC Transmission”, John Willey AndSons.
3. Hingorani N. G., “ Understanding FACTS”, IEEE Press2001
4. Yong Hua Song, ‘ Flexible AC transmission systems(FACTS)’IEEE

BTEEL706: POWER SYSTEM OPERATION AND CONTROL LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of the Experiment
1	Write a program for economic dispatch in power systems using
2	Simulation of Automatic voltage regulator using MATLAB.
3	Write a program to compute the voltage and power factor for a given system using MATLAB.
4	Write a program to solve Swing Equation by Classical Method.
5	Write a program to plot power angle curve of synchronous machine using MATLAB.
6	Write a program to solve the given Equal Area Criteria problem using MATLAB.
7	To demonstrate the Excitation System for Synchronous machine using MATLAB
8	Simulation of single area load frequency control using MATLAB.

BTEEL707: HIGH VOLTAGE ENGINEERING LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Sr. No.	List of Experiment
1	Study of Faraday Cage for HV labs.
2	Study of Standard HV Laboratory layouts.
3	One min. (1-min.) DC high voltage withstand test on Equipment. (Max. up to 10 KV).
4	Effect of gap length on liquid insulating material.
5	Breakdown Strength of composite dielectric material.
6	Study of impulse generator.
7	High voltage withstand test on cables/safety gloves/shoes, as per IS. (Max. 2.25 KV DC)
8	Horn gap arrangement as surge diverter.
9	Measurement audible and visible corona inception and extinction voltage
10	Development of tracks and trees on polymeric insulation.
11	Study of Effect of EHV field on Human, Animals & Plants.

BTEEL708: ELECTRICAL DRIVES LAB	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Pre requisite	Basic electronics engineering, basic electronics engineering Course
Course Outcome	• Efficiently use various AC and DC drive. • Simulate various drive system
Sr.No	List of Experiments
1	Study the ramp comparator firing circuit.
2	Study of single phase half wave converter and semi converter DC Drive .
3	Study of single phase full controlled converter (Bridge converter) DC Drive.
4	Speed control of DC motor using chopper.
5	Simulation of single phase half wave and semiconductor controlled DC drive.
6	Simulation of chopper fed DC Drive .
7	Study of AC Drive .
8	Study of V/f control of AC drive
9	Study the inverter fed induction motor drive.
10	Simulation of AC drive .

BTEES709: SEMINAR	
Teaching Scheme:	Examination Scheme:
Practical: 2hr	Continuous Assessment: 30 Marks
Total Credits: 1	End Term Exam: 20 Marks

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Instrumentation Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTEEP710: PROJECT PART-I	
Teaching Scheme:	Examination Scheme:
Practical: 6hr	Continuous Assessment: 30 Marks
Total Credits: 3	End Term Exam: 20 Marks

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarize the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project may be industry-based.

BTEEF711: FIELD TRAINING/INTERNSHIP/INDUSTRIAL TRAINING III	
Teaching Scheme:	Examination Scheme:
Practical: --	Continuous Assessment: --
Total Credits: 1	End Term Exam: 50 Marks

Students are expected to undergo industrial training for at least four weeks at factory / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / industry expert. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of industrial training shall be submitted. Evaluation shall be based on report and power point presentation.

POWER MANAGEMENT INTEGRATED CIRCUITS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Total Credits: 3	Internal Assessment: 20* Marks
	End Term Exam: 60* Marks

Prof. Qadeer Ahmad Khan | IIT Madras
Course Duration: 12 weeks

CourseOutline:

This course is intended to develop understanding of why power management circuits are needed in a VLSI system, what are the different components of a power management system with focus on voltage regulators. By the end of this course, students should be able to understand the concept behind power management circuits and design a linear (LDO) and switching regulator (dc-dc converter) for a given specifications using behavioral and circuit level simulators.

Course Plan:

Week 1 : Introduction to Power Management - Application, Need, Discrete vs. Integrated PMIC; DC-DC Converters, Types of DC-DC Converters, Linear versus Switching Regulator, Choosing between Linear and Switching Regulators, Choosing the Type of Regulator in a Multi-Chip System; Performance Parameters - Efficiency, Accuracy, Line and Load Regulation, Line and Load Transient, PSRR; Remote versus Local Feedback, Point-of-Load Regulator, Kelvin Sensing, Droop Compensation; Current Regulators and their Applications; Bandgap Voltage Reference - Designing a Bandgap Reference using PTAT and CTAT Voltage References, Brokaw Bandgap Circuit.

Week 2: Sub-1-volt Bandgap Reference; Introduction to Linear Regulator, Applications of Linear Regulator; Review of Feedback Systems and Bode Plots, Loop Gain AC Analysis, Stability Criterion and Phase Margin, Review of First-Order and Second-Order Systems, Relationship between Damping Factor and Phase Margin; Parasitic Capacitances in a MOS transistor, Finding the Poles of the Error Amplifier; Stabilising a Linear Regulator - Frequency Compensation Techniques, Dominant Pole Compensation.

Week 3 : Miller Compensation, R.H.P. zero due to Miller Compensation, Intuitive Methods of Determining Poles and Zeros after Miller Compensation, Pole Splitting due to Miller Compensation, Reducing the Effect of R.H.P. zero; LDO with NMOS Pass Element; Load Regulation and Output Impedance of LDO; Line Regulation and PSRR of LDO; Sources of Error in a Regulator, Static Offset Correction, Dynamic Offset Cancellation.

Week 4 : Digital LDO, Avoidance of Limit-Cycle Oscillations in a Digital LDO, Hybrid LDO; Short-Circuit Protection and Foldback Current Limit in an LDO; Basic Concept of a Switching Regulator, Inductor volt-second Balance, Power Stage of a Buck Converter and Calculation of Duty Cycle; Transformer Model of a Buck Converter, Resistive Losses, Efficiency of a Switching Regulator, Efficiency considering only Conduction Losses; Synchronous and Non-Synchronous Switching Converters; PWM Control Techniques (Voltage-Mode and Current-

Mode Control); Losses in Switching DC-DC Converter- Conduction Loss, Gate-Driver Switching Loss, Segmented Power FETs, Dead-Time Switching Loss.

Week 5 : Hard Switching Loss, Magnetic Loss, Relative Significance of Losses as a Function of the Load Current; Inductor Current Ripple and Output Voltage Ripple in a DC-DC Converter, Ripple Voltage versus Duty Cycle, Ripple Voltage versus Input Supply Voltage; Choosing the Inductor and Capacitor of a Buck Converter; Continuous and Discontinuous Conduction Modes - Boundary Condition, Voltage Conversion Ratio in DCM; Concept of Pulse Frequency Modulation (PFM); Classification of Pulse Width Modulators -- Trailing, Leading and Dual-Edge PW Modulators; Control Techniques for DC-DC Converters; Voltage Mode Control, Small-Signal Modeling of a DC-DC Converter, Loop Gain and Stability Analysis using Continuous-Time Model.

Week 6 : Compensating a Voltage-Mode-Controlled Buck Converter; Designing Type-I (Integral), Type-II (PI) and Type-III (PID) Compensators; Implementation of Compensators using Op Amp-RC and Gm-C Architectures, Finding Compensation Parameters; Design Examples with Simulation Demonstrations.

Week 7 : Designing Type-III Compensator using Gm-C Architecture and Design Example; Ramp Generator with Feed-Forward Line Compensation, Loop Gain Compensation via Gm-modulation; Designing a Buck Converter - Power Loss Budgeting, Sizing of Power FETs, Estimation of Switching Losses and Choice of Switching Frequency, Choosing the External Passive Components (L and C); Choice of C in Relation to Factors that Limit the Load Transient Response; Inductor and Capacitor Characteristics, Reducing the Effect of Capacitor ESL.

Week 8 : Designing the Gate-Driver (Gate Buffer and Non-Overlap Clock Generator), Designing the Ramp Generator in a Pulse-Width Modulator, Design Considerations of the Error Amplifier; Delays Associated with Pulse-Width Modulators; PFM/PSM for Light Load, Using PSM in CCM to Avoid Duty Cycle Saturation; DCM Operation using an NFET; Designing a Zero-Cross Detector/Comparator; Introduction to Current Mode Control; Peak, Valley and Average CMC; Sub-Harmonic Oscillations, Avoiding Current Loop Instability via Slope Compensation in a Current-Mode-Controlled Buck Converter.

Week 9 : Non-Linear Control Techniques for DC-DC Converters; Hysteretic Control - Stability Issues due to Phase Shift between Inductor Current and Capacitor Voltage; Voltage-Mode versus Current-Mode Hysteretic Control, Stabilising a Voltage-Mode-Controlled Hysteretic Converter using R_esr, Relation between Hysteresis Window and Switching Frequency, Using R-C Circuit as Ripple Generator in a Current-Mode-Controlled Hysteretic Converter, Hybrid Voltage-Mode and Current-Mode Hysteretic Control, Fixed-Frequency Hysteretic Control, Effect of Loop Delay, Frequency-Regulation and Voltage-Regulation Loops in a Fixed-Frequency Hysteretic Converter; Constant ON/OFF-Time Control; Basic Concept of a Boost Converter, RHP zero in a Boost Converter.

Week 10 : Introduction to the Buck-Boost Converter, Tri-Mode Buck-Boost Converter, Boundary Conditions for Mode Transition in a Tri-Mode Buck-Boost Converter, Generation of Buck and Boost Duty Cycles; Introduction to Switched-Capacitor DC-DC Converters, Applications of SC DC-DC Converters in Open-Loop, Output Regulation in SC DC-DC Converters using Feedback Control, H-Bridge SC DC-DC Converter, Multiple Gain Settings in SC DC-DC Converters; Current-Sensing Techniques in DC-DC converters.

Week 11 : Selecting the Process Node for a PMIC, Chip-Level Layout and Placement Guidelines, Board-Level Layout Guidelines, EMI Considerations; Introduction to Advanced Topics in Power Management --- Digitally-Controlled DC-DC Converters, Adaptive Compensation Techniques, Limitations of Analogue and Digital Controllers, Time-Based Control Techniques and their Drawbacks, Multi-Phase DC-DC Converters; Dynamic Voltage and Frequency Scaling (DVFS); Single-Inductor Multiple-Output (SIMO) DC-DC Converters.

Week 12 : Introduction to Advanced Topics in Power Management (continued) - DC-DC Converters for LED Lighting, LCD/AMOLED Display Drivers, LED Drivers for Camera Flash, Lithium-ion Battery and its Charging Phases, Battery Charger ICs.

DC POWER TRANSMISSION SYSTEM	
Teaching Scheme:	Examination Scheme:
Theory: 03	Mid-term Test: 20* Marks
Tutorial: 00	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Krishna S, IIT Madras
Course Duration: 12 weeks

CourseOutline:

This course gives an introduction to the DC power transmission system using the conventional line commutated converters. The topics covered include a detailed analysis of the 6 pulse line commutated converter (LCC), 12 pulse LCC, capacitor commutated converter, DC link control, and design of single tuned filter.

Course Plan:
Week 1: Introduction, choice of converter configuration
Week 2: Converter configuration for pulse number equal to 6, analysis of 6 pulse LCC neglecting overlap
Week 3: Fourier series, analysis of 6 pulse LCC neglecting overlap
Week 4: 2 and 3 valve conduction mode of 6 pulse LCC
Week 5: Extinction angle, 3 and 4 valve conduction mode and 3 valve conduction mode of 6 pulse LCC
Week 6: Commutation margin angle, normalization, characteristics of 6 pulse LCC, steady state analysis of a general LCC
Week 7: 6 pulse LCC with other circuits on the AC and DC sides
Week 8: Capacitor commutated converter, 12 pulse LCC
Week 9: Mode of operation of 12 pulse LCC, purposes of transformer, applications of DC transmission, types of DC link, DC link control
Week 10: Converter control characteristics, MTDC systems, non-characteristic harmonics
Week 11: Design of single tuned filter
Week 12: Double tuned and damped filters, reactive power requirement, comparison of AC and DC transmission

HIGH POWER MULTILEVEL CONVERTERS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Anandarup Das, IIT Delhi

Course Duration: 12 weeks

CourseOutline:

The course covers different types of high power converters used in the industry for applications in HVDC, FACTS, Motor Drives, Power quality improvement. Traditional converters like NPC and emerging converters like modular multilevel converters will be covered. Operational issues and design considerations for these medium/high voltage high power converters will be covered. The course will discuss many practical issues faced in the industry while designing and operation of these converters.

Course Plan:

Week 1 : (a) Half bridge, Full bridge and three phase converters, sinusoidal PWM

Week 2 : (a) 3rd harmonic addition, space vector PWM

Week 3 : (a) Different types of multilevel converters
(b) Cascaded H-Bridge converter – Basic operation

Week 4 : (a)PWM Techniques for CHB converter
(b) Fault tolerant operation of CHB converter

Week 5 : (a) Modular Multilevel converter- Topology, operation and PWM

Week 6 : (a) Capacitor voltage balancing in MMC
(b) Design of components of MMC

Week 7 : (a) NPC converter – Basic operation
(b) NPC (3 level) Space vector diagram

Week 8 : NPC - PWM technique and midpoint balancing

Week 9 : (a) Case study of High Power converters for Motor drive and HVDC application

Week 10 : (a) Multi –pulse transformers

Week 11 : (a) Gate Drive circuit designing, protection and condition monitoring in high power converters

Week 12 : (a) Other topologies : conclusion

FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Nishchal Kumar Verma, IIT Kanpur

Course Duration: 12 weeks

CourseOutline:

The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Plan:

Week 1 : Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10: Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning

THE JOY OF COMPUTING USING PYTHON	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial: 1hr	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof.Sudarshan Iyengar, Department of Computer Science and Engineering, IIT Ropar
Course Duration: 12 weeks

CourseOutline:

ThisisamostfundamentalDigitalCircuitDesigncourseforpursingamajorinVLSI. We do not deal with any Verilog coding during this course and instead discuss transistor level circuit design concepts in greatdetail.

Learning objectives of this course are:

- Characterize the key delay quantities of a standardcell
- Evaluate power dissipated in a circuit (dynamic andleakage)
- Design a circuit to perform a certain functionality with specifiedspeed
- Identify the critical path of a combinationalcircuit
- Convert the combinational block to pipelinedcircuit
- Calculate the maximum (worst case) operating frequency of the designedcircuit

Course Plan:

Motivation for Computing
Variables and Expressions: Design your own calculator
Loops and Conditionals: Hopscotch once again
Lists, Tuples and Conditionals: Let’s go on a trip
Abstraction Everywhere: Apps in your phone
Counting Candies: Crowd to the rescue
Birthday Paradox: Find your twin
Google Translate: Speak in any Language
Currency Converter: Count your foreign trip expenses
Monte Hall: 3 doors and a twist
Sorting: Arrange the books
Searching: Find in seconds
Substitution Cipher: What’s the secret !!
Sentiment Analysis: Analyse your Facebook data
20 questions game: I can read your mind
Permutations: Jumbled Words
Spot the similarities: Dobble game
Count the words: Hundreds, Thousands or Millions.
Rock, Paper and Scissor: Cheating not allowed !!
Lie detector: No lies, only TRUTH

Calculation of the Area: Don’t measure.
Six degrees of separation: Meet your favourites
Image Processing: Fun with images
Tic tac toe: Let’s play
Snakes and Ladders: Down the memory lane.
Recursion: Tower of Hanoi
Page Rank: How Google Works !!

INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	
Teaching Scheme:	**Examination Scheme:**
Theory: 3hr	Mid-term Test: 20* Marks
Tutorial:	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. SudipMisra, IIT Kharagpur

Course Duration: 12 weeks

CourseOutline:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Plan:

Week 1 : Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II

Week 2 : Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3 : Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4 : Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5 :IIoT-Introduction, Industrial IoT: Business Model and ReferceArchiterture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6 : Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

Week 7 : Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8 : Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9 : Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10 : Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11 : Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory

Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12 : Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries
Case study - II: Manufacturing Industries - Part I
Case study - III : Manufacturing Industries - Part II
Case study - IV : Student Projects - Part I
Case study - V : Student Projects - Part II
Case study - VI : Virtual Reality Lab
Case study - VII : Steel Technology Lab

ENTREPRENEURSHIP ESSENTIALS	
Teaching Scheme:	Examination Scheme:
Theory: 3hr	Mid-term Test: 20* Marks
	Internal Assessment: 20* Marks
Total Credits: 3	End Term Exam: 60* Marks

Prof. Manoj Kumar Mondal, IITKharagpur

Course Duration: 12 weeks

CourseOutline:

The course provides foundational knowledge on various aspects of entrepreneurial venture creation and management during its life-cycle. It has been designed to address multidisciplinary audiences. The objective of the course is to teach key issues faced by entrepreneurs and managers at different stages of the life-cycle of an enterprise and is relevant both for aspiring entrepreneurs and for decision makers in established enterprises. Topics can be classified in some major themes such as : Making a choice to create an entrepreneurial venture, current trend of technology entrepreneurship, how to start a start-up, identifying opportunities, factors driving competitive advantages, organizational structure, basic knowledge of financial statements and project report,introductory knowledge on marketing management, human resource management, & strategic management, risk analysis, legal aspect of business, how to raise fund during life-cycle of a new ventures.

Course Plan:

Week 1 : Introduction
DhirubhaiAmbani& Sofia
Myths & Realities about entrepreneurship
entrepreneurial qualities
Why start-ups fail?

Week 2: Mission, vision, entrepreneurial qualities – I
Mission, vision, entrepreneurial qualities – II
Value proposition
Business Model canvas
Business model generation

Week 3: Competitive advantage
Lean start-up – 1
Lean start-up – 2
Team and early recruit
Legal forms of business

Week 4: Marketing management 1
Marketing management 2
Market research –I
Market research –II
Market research –Example

Week 5: Introduction to financial statements
Profit & Loss statement
Balance sheet

Cash flow
Example – 1
Example – 2
Cost-volume-profit & Bread-Even analysis
Capital budgeting

Week 6: Business plan-I
Business plan-II
Pitching
Go-to-market strategies
Does & Don'ts

Week 7: How to innovate
Design Thinking
Design-Driven Innovation, Systems thinking
Open innovation, TRIZ
How to start a start-up?

Week 8: Government incentives for entrepreneurship (1 lecture)
Incubation, acceleration
Funding new ventures – bootstrapping, crowd sourcing, angel investors, VCs, debt financing (3), due diligence
Legal aspects of business (IPR, GST, Labour law)

Week 9: Cost, volume, profit and break-even analysis
Margin of safety and degree of operating leverage
Capital budgeting for comparing projects or opportunities
Product costing
Product pricing

Week 10: Funding new ventures – bootstrapping, crowd sourcing, Angel investors, VCs, debt financing (3), and due diligence
Incubation and acceleration
Government incentives for entrepreneurship
Project cost and Financial Closure

Week 11: Dos &Donts in entrepreneurship
Growth Hacking
Growth Strategy
Legal aspects of business (IPR, GST, Labor law)
Negotiation skill

Week 12: Human Resource management in startups
Pivoting
Entrepreneurial cases
Risk assessment and analysis
Strategy management for entrepreneurial ventures
Factors driving success and failure of ventures
Concluding remarks

BTEEP803: PROJECT-II	
Teaching Scheme:	Examination Scheme:
Practical: 30hr	Continuous Assessment: 100 Marks
Total Credits: 15	End Term Exam: 150 Marks

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Dr. Babasaheb Ambedkar Technological University, Lonere

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No XXIX of 2014)
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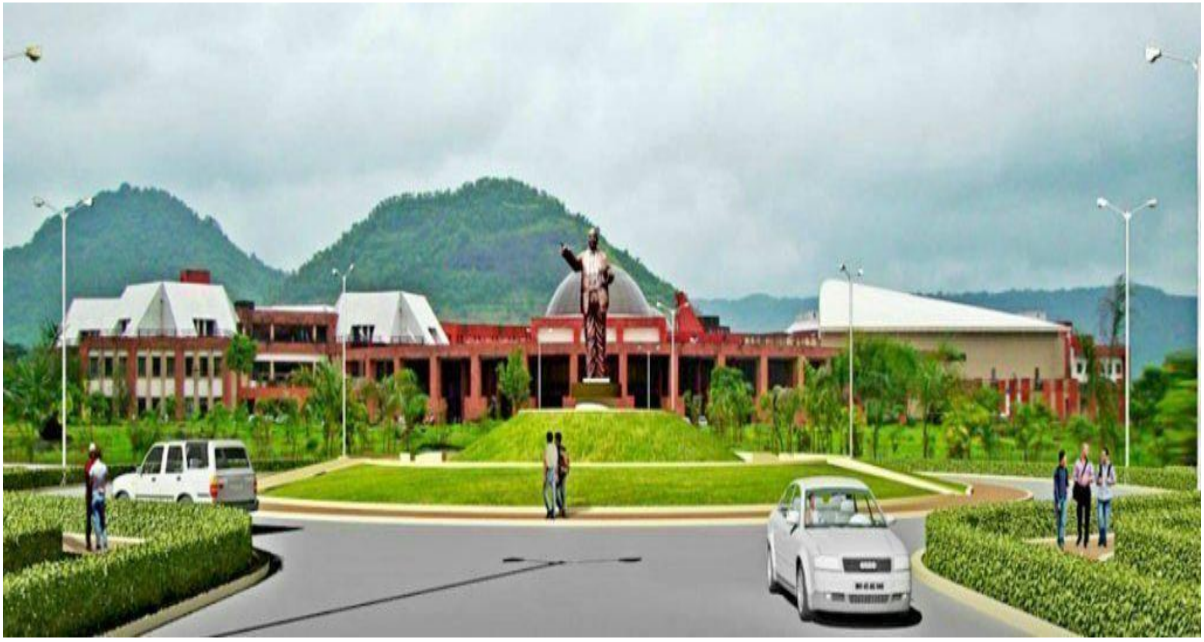
CURRICULUM

UNDERGRADUATEPROGRAMME

S. Y. B. Tech. (Instrumentation Engineering)

With effect from the Academic Year2021-2022



B. Tech in Instrumentation Engineering

Curriculum for Second Year

Semester III												
SR. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
2	PCC 1	BTINC302	Sensor and Transducer	3	1	-	20	20	60	100	4
3	PCC 2	BTINC303	Network Analysis and Synthesis	3	1	-	20	20	60	100	4
4	ESC	BTINES304	Analog Electronics	3	1	-	20	20	60	100	4
5	LC	BTINL305	Sensor and Transducer Lab	-	-	2	60	-	40	100	1
6	LC	BTINL306	Analog Electronics Lab	-	-	2	60	-	40	100	1
7	Seminar	BTINS307	Seminar I	-	-	4	60	-	40	100	2
8	Internship	BTINS211P	Internship – 1 Evaluation	-	-	-	-	-	50	50	1
Total				**12**	**4**	**8**	**260**	**80**	**410**	**750**	**21**

Semester IV											
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC401	Digital Electronics	3	1	-	20	20	60	100	4
2	PCC 2	BTINC402	Feedback Control System	3	1	-	20	20	60	100	4
3	HSSMC	BTHM403	Industrial Management and Economics	4	-	-	20	20	60	100	4
4	BSC	BTINBS404	Electrical and Electronics Measurement	3	1	-	20	20	60	100	4
5	PEC 1	BTINPE405	Group A	3	1	-	20	20	60	100	4
6	LC	BTINL406	Digital Electronics Lab	-	-	2	60	-	40	100	1
7	LC	BTINL407	Feedback Control System Lab	-	-	2	60	-	40	100	1
8	Seminar	BTINM408	Mini Project I	-	-	4	60	-	40	100	2
9	Internship	BTINP409	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	**-**	**-**	**-**	-	-	-	-	Credits To be evaluated in V Sem.
Total				**16**	**4**	**8**	**220**	**100**	**380**	**700**	**24**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

- **Important Note: Minimum Eight Experiment to perform based on the syllabus for the laboratory subject.**

Group A [Sem- IV] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE405 A	Microprocessor based systems
02	BTINPE405 B	Industrial Safety
03	BTINPE405 C	Signals and Systems

Semester III

BTBSC 301 Engineering Mathematics – III

Teaching Scheme:
Lectures: 03
Tutorial: 01

Course Credits : 04

Examination Scheme :
End semester exam (ESE): 60 marks
Internal Sessional Exams (ISE): 40 marks
Duration of ESE: 03 hours

Prerequisite course(s): 11^{th} & 12^{th} Mathematics, Mathematics-I and II		
Course objectives: **1.** To introduce the solution methodologies for Fourier transform, Z-Transform and Laplace transform with applications in engineering. **2.** To provide an overview of probability and statistics to engineers.		
Course outcomes: Upon completion of this course, students will be able to solve field problems in engineering involving ordinary differential equations using Laplace Transform. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.		
Course Syllabus		
Unit - I : Laplace Transform	**No. of Lectures:** 06 Hours	**Marks:** 12
Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.		
Unit - II : Inverse Laplace Transform	**No. of Lectures:** 06 Hours	**Marks:** 12
Inverse transforms of some elementary functions; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find solutions of linear differential equations.		
Unit - III : Fourier Transform and Z-transform	**No. of Lectures:** 09 Hours	**Marks:** 12
Fourier Transform: Fourier sine and cosine integrals, Fourier sine transform, Fourier cosine transform, Inverse Fourier transform. **Z-transform :** Definition, Region of convergence, Properties of Z-Transform (without proof), Inverse Z-Transform		
Unit - IV : Basic Statistics	**No. of Lectures:** 07 Hours	**Marks:** 12
Introduction to measures of central tendency, Moments, skewness and Kurtosis, Correlation and regression, Probability distributions: Binomial, Poisson and Normal distributions.		
Unit - V : Functions of Complex Variables	**No. of Lectures:** 08 Hours	**Marks:** 12
Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).		

Text Books:-

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010,2016.
2. H.K.DASS "Advance Engineering Mathematics" S. Chand publications. Fifteenth revised edition 2006.
3. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
4. S. C. Gupta "Fundamentals of Statistics", Himalaya Publishing House ,sixth revised edition 2008.
5. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.

Reference Books : -

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.
4. Wylie C.R. & Barrett , "Advanced Engineering Mathematics," Mc Graw Hill.
5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

BTINC 302. SENSORS AND TRANSDUCERS

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Basic electrical engineering	
Course Objective	To familiarize the students with Sensors and transducer	
Course Outcome	To expose the students to various sensors and transducers for measuring mechanicalquantities. To understand the specifications of sensors and transducers. To learn the basic conditioning circuits for various sensors and transducers. To introduce advances in sensor technology.	
Unit	Contents	Contact Hrs
1	**Introduction to Transducers** Transducer: Definition, classification, selection criteria, specifications. static and dynamic characteristics of a measurement system. Errors, loading effects, basic configuration of control system. Displacement, force and torque transducers. Force measuring transducers, electrical load cell, LVDT. Piezoelectric, vibrating type. Torque-strain gauge and other suitable transducers.	8
2	**Speed, Vibration and Temperature Transducers** Tachometers, toothed rotor tachometers, Photoelectric, stroboscopic principal Theory of acceleration pick- ups, their calibration, Type of accelerometer, Jerk meter. Temperature Transducers: fills system thermometers, semiconductor temperature detector(thermostat and p-n junction IC and PTAT type) resistance thermometer, thermometer ultrasonic, crystal, infrared thermometer.	8
3	**Level and Flow Measurement** Level transducers for liquid and solids- float type displacer, Air plug method, diaphragm box level gauge, DP cell, Load cell, bicolor direct reading, Vibrating, Ultrasonic, radioactive transducers, Reed switches, microwave sensors. Flow transducer: Basic measurement principle, Bernoulli's theorem, Differential pressure type (orifice, venturi, pitot type), Variable area type, target type, magnetic, Ultrasonic vortex shedding, cross co-relation, positive displacement type, Mass flow meter, anemometer, total flow meter.	6
4	**Pressure, Viscosity Transducers** Pressure transducer: Pressure scale and standards, manometer, elastic (Bellows, bourdon tube, diaphragm) type. Dead weight and vaccum gauge, testers, electrical pressure sensors (LVDT, strain gauge, load cell, piezo- electric, capacitive). Tuning fork type, differential sensors (capacitive, force balance and vibrating cylinder type).	6

	Vacuum pressure measurement: McLeod gauge, thermal conducting and ionization type, Viscosity and density sensing and measurement: capillary type, Shearle's rotating cylinder, cone and plate, falling and rolling ball type viscometers.	
5	**PH, Conductivity, Humidity Sensors and Transducers** PH and conductivity sensors: pH scale and standards, principle of pH measurement. Different type of reference and measuring electrodes, ion selective electrodes. Principle of conductivity measurement, conductivity cells and bridges-their application. Effect of temperature on pH and conductivity sensors. Humidity and misc. transducers: Pyrometer, Hygrometer (Hair, wire and Electrolysis type), Dew point meter, piezoelectric humidity meter, Infrared conductance and capacitive type probes for moisture measurement. Flow detectors, leak detectors, Acoustic transducers and sound level measurement. Introduction to Biosensors	8
	Reference Books: 1. Bentley J.P., "Principles of Measurement Systems", Third Edition, Pearson Education Asia pvt.ltd. 2. Doebelin, E.O., "Measurement Systems", McGraw Hill Book Co. 3. Patranabis D, "Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi. 4. Murthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi. 5. Neubert, H.K.P., "Instrument Transducers", Clarenden Press, Oxford. 6. R. K. Jain, "Mechanical and Industrial Measurement". 7. http://nptel.iitm.ac.in	

BTINC 303. NETWORK ANALYSIS AND SYNTHESIS.

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Basic electrical engineering	
Course Outcome	To review basic components of electric network. To design and develop network equations and their solutions. To apply Laplace theorem for electric network analyses To analyze AC circuit.	
Unit	Contents	Contact Hrs
1	Active & Passive Circuit Element:- Independent & dependent voltage & current sources, R, L, C, self and mutual inductance circuit parameters, Their mathematical models, Voltage- current- power relations, Independent voltage and current sources, dependent sources, Source transformation, star-delta conversion. Classification of element: Lumped and distributed, Linear and non-linear, Unilateral and Bilateral, Time invariant and variant,	6
2	Network theorems: - Kirchhoff‘s laws (KCL and KVL), Mesh analysis, nodal analysis, super node and super mesh analysis, Superposition theorem, Thevenin‘s theorem, Norton‘s theorem, Reciprocity theorem, Maximum power transfer theorem, Substitution theorem, Millman‘s Theorem, Tellegen's theorem for D.C and A.C. circuits. Graph Theory:- Network topology, graph, Tree, Branches, Chords, incidence, cut set and tie set matrix using network topology, Concept of duality & dual networks.	6
3	Two port network:- Terminals& terminal pairs, Driving points & transfer admittance, Transfer functions, Concept of poles & zeroes, Two port networks, Z, Y & the transmission parameters relationship between parameter sets.	6
4	Application of Laplace’s Transform:- Solution of differential equation using Laplace transform, Unit step, Impulse & ramp functions, Laplace transform of singular & shifted function, Convolution integral, Concept of complex frequency, Transform impedance & transform admittance, Series & parallel combination of these networks.	6
5	Sinusoidal Steady State A. C. Circuit:- R-L-C series circuits, Series resonance Variation of Z with frequency, maximum value of VC & VL, Magnification, Bandwidth, Q factor. Parallel Resonance: Resonance frequency for tank circuit frequency, Locus diagram of series R-L, R-C with variable R & X. Filter: Introduction classification, Low pass, High pass, Band pass & band reject filter, active & passive filters. Application of Fourier series, Expansion for periodic & non-sinusoidal waveforms.	6

	Referance Books:- 1. Mac.E Van Valkenburg, "Network Analysis", 2. Franklin Fa-Kun. Kuo, "Network Analysis & Synthesis", John Wiley & Sons. 3. M. L. Soni, J. C. Gupta, "A Course in Electrical Circuits and Analysis", 4. Mac.E Van Valkenburg, "Network Synthesiss", 5. Joseph A. Edminister, Mahmood Maqvi, "Theory and Problems of Electric Circuits", Schaum's Outline Series,	

BTINC 304. ANALOG ELECTRONICS.

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Basic electronics engineering	
Course Objective	To understand operational and performance characteristics of analog electronic devices To design and analyze transistor circuits	
Course Outcome	Analyze transistor circuit using h parameter model. Design and analyze different op-amp circuits for various applications. Describe characteristics of various power devices and power converters.	
Unit	Contents	Contact Hrs
1	**Diode Theory** Basic review of diode theory & Types of diode & their applications, Rectifiers, Filters, Clippers, clampers, Voltage Multipliers- Doublers, Trippler, quadrupler, Diode current equation.	7
2	**Basic Review of Transistor Configuration** Transistor biasing & Thermal stabilization, Bias compensation, Thermal runaway, Load line, Q –point, Transistor at low frequencies (h-parameter), Transistor at high frequencies (h-parameter), Darlington circuits, Frequency response of amplifier, Oscillators, Multivibrators.	7
3	**Basic Review Of Field Effect Transistor** Small signal FET analysis & FET applications, Single stage amplifier, Analog switches, Voltage variable resistance, UJT & its application, MOSFET & its application, IGBT & its application.	6
4	**Power amplifiers, Signal Generators and filters** Power amplifiers, audio power amplifier, classA/class-AB/class-B/classC; Push-pull class-AB power amplifier. Signal Generators and filters: Multi vibrators, triangular wave generator, saw tooth wave generator, square wave generator, sine wave generator, Bootstrap Sweep generator, basic low pass filters, low pass and high pass Butterworth filters, band pass, band reject filters, applications of filters	6
5	**Power Converters, Regulators** Power Converters: SMPS, working principles, performance parameters, DC-DC converters: different types, working principles and analysis, applications. Voltage regulators, stability of regulators.	5
	References : 1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education, Tenth ed., 2009. 2. RamakantGayakwad, "Op-Amp and Linear Integrated Circuits", PHI,4th ed.,2000 3. M.Rashid, "Power Electronics Circuit,Devices &Applications "Pearson Edu., Third ed.2004	

BTINL 305. SENSOR AND TRANSDUCER LAB

Teaching scheme:

Lab Work : 2 Hrs

Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/Oral: 40 Marks

Pre requisite	Basic electrical and electronics engineering
Course Objective	To understand operational and performance characteristics of sensors and transdducers
Course Outcome	Identify various elements required for characterization of given transducers/sensors. Designand conduct experiments for measurement, characterization, and ability to analyze and interpret data Communicate effectively in oral and written form while formulating experiments, reports and other related documents.
Expt. No	Title of Expt.
1	To determine the LVDT characteristics.
2	To determine the characteristics of capacitive displacement transducer.
3	Speed Measurement using Magnetic pickup.
4	To determine Strain gauge characteristics.
5	To determine Thermocouple characteristics.
6	To determine RTD and Thermistor characteristics.
7	To study and calibration of Dead weight Tester for pressure gauge.
8	To Study of flow transducer measurement.
9	To Study of level transducer measurement.
10	Study of DP Cell .

BTINL306. ANALOG ELECTRONICS LAB

Teaching scheme: **Examination Scheme:**

Lab work : 2 hrs **Continuous Assessment (T/W): 60 Marks**

Total credit: 1 Pr/oral: 40 Marks

Pre requisite	Basic electrical engineering
Course Objective	To understand and apply various network theorems for solution of engineering problems
Course Outcome	Understand and apply various network theorems for solution of engineering problems
Expt. No	Title of Expt.
1	To study characteristics of JFET
2	To study clipping circuits.
3	To study clamping circuits.
4	To study voltage multiplier circuits.
5	To study half wave rectifier.
6	To study full wave rectifier.
7	To study frequency response of two-stage RC coupled amplifier.
8	To study Hartley oscillator.
9	Design and implementation of Astable multivibrator and Monostable multivibrator
10	Design and implementation of Phase Shift Oscillator
11	Design inverting and non-inverting amplifier using OPAMP

Semester –IV

BTINC 401. DIGITAL ELECTRONICS.

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical technology,	
Course Objective	To familiarize the students with Digital Electronics.	
Course Outcome	To Work with a variety of number systems and numeric representations, including signed andunsigned binary, hexadecimal, 2's complement. To introduce basic postulates of Boolean algebra and show the correlation between Booleanexpression. To introduce the methods for simplifying Boolean expressions. To outline the formal procedures for the analysis and design of combinational circuits andsequential circuits.	
Unit	Contents	Contact Hrs
1	Number system and fundamental concepts of digital circuits: Number system –different types of number system like binary Octal, Decimal and hexadecimal, Signed binary numbers, Conversion methods of one type number system to another type, Fundamental concepts: Digital circuits.(AND,OR,NOT,NOR,NAND and Exclusive-OR operation), Different types of codes – binary code, Gray code, BCD code. f. Excess- 3 code, Hamming code, ASCII code, Comparison of digital logic families such as RTL, DCTL, DTL, HTL, TTL, PMOS and CMOS Causes, Boolean algebra laws.	8
2	Combinational logic design: Standard representation for logical function, SOP & POS form, Min-term & Max-term. Simplification of logical function specified in min-term & max-term or along with don't care condition using K- MAP, Design examples such as half and Full adder, half and full Subtractor, BCD to Seven segment decoder.	8
3	Combinational logic design using MSI circuits: Multiplexer and Demultiplexer operations, Adder and Digital comparator circuits. Parity generator /chekers, Code convertors BCD to binary , Binary to BCD, BCD to Excess-3 ,Binary to gray.	8
4	Sequential Logic Design: 1 Bit memory cell, clocked S-R flip-flop, master slave J-K flip flop, D and T types of flip flops, Excitation tables of flip flop, Conversion of one type of flip flop into another type, Registers, classifications, shift registers, counters, synchronous, asynchronous, Analysis of clocked sequential circuits, state table, state diagram, next state equation and state reduction.	8

5	Convertor circuits and digital storage devices: Digital to analog converter, weighted register D/A converter, R/2R ladder D/A converter, Analog to digital conveter, parallel comparator, A/D converter, successive approximation A/D converter, dual slope A/D converter, Digital storage devices such as ROM, RAM, EPROM, EEPROM, CAM (content addressable memory), CCD, ROM as PLD and PLA, PAL, field programmable gate arrays (FPGA), ERA (Electrically reconfigurable arrays)	8
	REFERENCES: Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003. Thomas L Floyd, Digital Fundamentals, Pearson Education, 8th edition, 2003. Donald P Leach, Albert Paul Malvino, Digital Principles and Applications, TMH, 2006.	

BTINC 402. FEEDBACK CONTROL SYSTEM

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Laplace Transform, Differential Equations	
Course Objective	• To understand the use of transfer function models for analysis physical systems and introduce the control system components. • To provide adequate knowledge in the time response of systems and steady state erroranalysis. • To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems. • To introduce stability analysis and design of compensators • To introduce state variable representation of physical systems and study the effect of state feedback.	
Course Outcome	Develop TF models of physical systems	
Unit	Contents	Contact Hrs
1	Introduction: Concept of open & closed loop control system, Servomechanism, Multivariable control system, Applications in non-engineering field	7
2	Physical Systems and Transfer Function: a) Concept of system: physical system, Physical model, Linear and nonlinear systems, Time variant and invariant system. b) Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series & parallel circuit) transfer function, Procedure of obtaining transfer function Control system components: Derivation of transfer functions of following components a)DC servomotors (Armature and field control) b) AC servomotors c) Amplidyne generators d),Synchros e) DC and AC tacho generators f) Potentiometer error detectors	9
3	Block diagrams and Signal flow graphs: a) Block diagram algebra, Diagram reduction, Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of negative and positive feedback, Sensitivity of the system to parameter variation, using negative and positive feedback	8
4	Time domain analysis: Typical test signals, Time domain specifications, Steady state response, Types of system, Steady state error constants and steady state error, (With different input), Numerical examples, transient response, Numericals, Concept of stability, Determination of stability by Routh - Hurwitz criterion	8
5	Frequency domain analysis: Introduction to frequency response, Advantages of frequency domain analysis, Polar plots, Numericals, Bode plots, Principle of argument, Nyquist criterion, Relative stability from Nyquist criterion, Numericals. Definition of Root Locus, Construction of root locus, Stability from root locus plots, Root counters, Effect of addition of poles & zeros on root locus plots.	8

	REFERENCES: 1. K. Ogata – Modern Control Engineering (Prentice Hall Of India). 2. Kuo B. C.– Automatic Control System.(Prentice Hall Of India). 3. I. J. Nagarath & M. Gopal – Control System(Willey Earstern) 4. Gopal .M.– Control System.(Prentice Hall Of India).	

BTHM403. Industrial Management and Economics

Teaching scheme:
Theory: 3 hrs

Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic Knowledge of Management	
Course Objective	To study concept of time value of money, demand To study Market concept	
Course Outcome	To understand Meaning of Production and factors of Production	
Unit	Contents	Contact Hrs
1	Principles of Management a. Basic Concepts: Definition, Nature, Importance, Management: Art and Science & as a Profession, Management Vs Administration, Evolution of Management: Introduction to Scientific Management by Taylor, Administrative, Management by Fayol, Contribution of Peter Drucker, Levels & Functions of Management, Forms of Business Organization. b. Approaches to Management: Decision Theory Approach, Contingency Approach, Systems Approach. c. Organization: Formal & Informal, Line & Staff relationship, Centralization vs. Decentralization, Span of Management, Departmentation, MBO.	8
2	Economics a. Introduction: Meaning & Scope of Economics, Basic Theories, Law of Demand & Supply, Elasticity of Demand & Supply. b. Consumer Theories: Meaning of Utility & Law of Diminishing Utility. c. Cost Concepts: Opportunity Costs, Sunk Costs, Marginal Cost, Total & Variable Costs, Fixed Costs, Contribution, Law of Diminishing Return.	6
3	Economic appraisal techniques a. Economic appraisal techniques: Long- Range and Short range Budgeting, b. Criteria for Project Appraisal, c. Social benefit-cost analysis, d. Depreciation: concepts and Techniques.	6
4	Marketing Management a. Introduction to Marketing: Concept of Market, b. Types of Market, Definition, Nature & Scope of Marketing, c. Marketing Approaches, Marketing Process, Functions of Marketing Management, d. 4 P's of Marketing. Advertising media of advertising market forecasting	8
5	Financial Management a. Introduction to Financial Management: Meaning, Nature & Scope of Financial Management, b. Capital Structure, Types & Sources of Finance. c. Money Market & Capital Market,	7
	Reference Books: 1. O P Khanna, "Industrial Engineering Managements" 2. L.M.Prasad, "Principles of Management", Himalaya Publications Ltd 3. D.N. Dwivedi, "Managerial Economics", Vikas Publications 4. Engineering Economics : Degramo.	

	5. A Text Book of Economic Theory : Sammuelson 6. Philip Kotler, “Marketing Management”, Tata McGraw Hill 7. Ravi M. Kishor, “Financial Management”, Taxmann Publication	

BTINBS 404 ELECTRICAL AND ELECTRONICS MEASUREMENT

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Objective	To familiarize with different measurement and instrumentation devices.	
Course Outcome	To understand philosophy of measurement. To understand different methods analog and digital measurement. To study principle of construction and operation of different transducer and dismay methods.	
Unit	Contents	Contact Hrs
1	Introduction: Static and Dynamic characteristics of instruments, dead zone, hysteresis, threshold, resolution, input & output impedance, loading effects, fundamentals of measurements, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors, calibration of instruments, Traceability, calibration report & certification.	8
2	Analog Indicating Instrumentation: DC galvanometer, PMMC and Moving Iron instruments, voltmeters, ammeters, ohmmeters, multimeters and extension of range of instruments, AC indicating instruments, Potential and current transformers, wattmeters, energy meters, DC Potentiometers, self-balancing potentiometers, standardization, application	8
3	Bridge Circuits: DC bridges: Wheatstone bridge and Kelvin bridge design, bridge sensitivity, errors in bridge circuits, null type and deflection type bridges, current sensitive and voltage sensitive bridges, applications of DC bridges AC bridges: General equations for bridge balance, Maxwell bridge, Hey bridge, Schering bridge, Wein bridge, phasor diagrams, storage and dissipation factor, applications of AC bridges	8
4	Oscilloscope: Introduction, Oscilloscope Block Diagram, Cathode Ray Tube, CRT Circuits, Vertical Deflection System, Delay Line, Multiple Trace, Horizontal Deflection System, front panel controls, deflection sensitivity, dual trace CRO, Oscilloscope Probes ,measurement of electrical parameters like voltage, current, frequency, phase, Z-modulation, Digital Storage Oscilloscope.	8
5	Digital Instruments: Block diagram, principle of operation, Accuracy of measurement Digital Multimeter, Kilo Watt Hour meter, Phase meter, Digital Tachometer, Ultrasonic Distance meter, Digital Thermometer, Recording Instruments and Waveform Generation: Principle and working of strip chart and X-Y recorders, single and multi-channel recorders, driving systems for pen and chart, chart speed and their applications, Waveform generation methods, Function generator.	8

	REFERENCES: 1. Electrical and Electronics Measurements and Instruments , Sahwaney A K 2. W. D. Cooper & A. D. Helfrick, 'Electronic Instrumentation And Measurement Techniques', PHI,4th e/d, 1987 3. David Bell, 'Electronic Instrumentation and Measurements', PHI, 2e/d, 4. Anand M. M. S., 'Electronic Instruments and Instrumentation Technology', PHI, 2004 5. Kalsi H. S., 'Electronic Instrumentation', TMH, 2nd e/d, 2004 6. R. Subburaj, 'The foundation for ISO 9000 and TQM', 7. Bouwens A. J., 'Digital Instrumentation'	

BTINPE405A. MICROPROCESSOR BASED SYSTEM

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Digital electronics	
Course Objective	To introduce architecture of microprocessor and its programming skill	
Course Outcome	Understands principles of architecture of microprocessor. Apply programming skill to different day to day applications.	
Unit	Contents	Contact Hrs
1	**Architecture of 8085 Microprocessor:** Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals, Machine cycles and timing diagrams	7
2	**Programming :**Instruction formats, Addressing modes, Instruction set, Need for Assembly language, Development of Assembly language programs	8
3	**Interfacing:** Memory Interfacing: Interface requirements, Address space partitioning,Buffering of Buses, timing constraints, Memory control signals, Read and write cycles, interfacing SRAM, EPROM and DRAM sections	8
4	**I/O Interfacing:** Memory mapped I/O Scheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports, Programmable peripheral interface (8255). Data transfer schemes: Programmable data transfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven data transfer schemes, Interfacing, Simple keyboards and LED displays	8
5	**Interrupts and DMA:** Interrupt feature, Need for interrupts, Characteristics of Interrupts, Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Development of Interrupt service subroutines, Multiple interrupt request and their handling, need for direct memory access, Devices for Handling DMA, Programmable DMA controller 8237. **Applications:** Interfacing of A/D converters (ADC 0800/ADC 0808/ADC 0809), Interfacing of D/A converters (DAC 0800), Waveform generators, Multiplexed seven segment LED display systems, Measurement of frequency, phase angle and power factor- Traffic light controller, Stepper motor control	9
	REFERENCES: 1. Goankar, R.S., “Microprocessor Architecture Programming and Applications withthe 8085/8080A‟, 3rd Edition, Penram International Publishing House, 1997. 2. Singh. I.P., “Microprocessor Systems”, Module 9 : Microcontrollers and their Applications”, IMPACT Learning Material Series IIT, New Delhi, 1997. 3. Douglas, V.Hall., “Microprocessor and Interfacing Programming and Hardware”,2ndEdition, McGraw Hill Inc., 1992. 4. Kenneth, L.Short., “Microprocessors and Programmed Logic”, Prentice Hall of India, 2nd Edition, 1987	

BTINPE405B. INDUSTRIAL SAFETY

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Course Objective	To understand various techniques and methods of analysis which occur in the variousregions of the spectrum. To study important methods of analysis of industrial gases. To understand the important radio chemical methods of analysis	
Course Outcome	Ability to understand and analyze Instrumentation systems and their applications to various industries.	
Unit	Contents	Contact Hrs
1	**Safety and Health Management : i.** Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety. ii. Ergonomics - Introduction, Definition, Objectives, Advantages. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders. iii. Importance of Industrial safety, role of safety department, Safety committee and National safety council Function Understanding basic safety Terms , Hazard definition , classification , What is Risk , Hazzard –Risk-Accident matrix. Personal Protective Equipments: Need, selection, supply, use, care and maintenance, Personal protective devices for head, ear, face, eye, foot, knee and body protection, Respiratory personal protective devices.	8
2	**Industrial Hazzards,** Risk and Prevention: Industrial noise: -Sources, and its control, Effects of noise on the auditory system and health, Measurement of noise , Different air pollutants in industries: Effect of different gases and particulate matter ,acid fumes ,smoke, fog on human health. Vibration : effects, measurement and control measures, Machine and Plant layouts , ii. Machine guards and its types, automation. High pressure hazards, emptying, inspecting, repairing, hydraulic and nondestructive testing, hazards and control in mines.	8
3	**Electrical Hazards :** i. Safe limits of amperages, voltages, distance from lines, etc., Joints and connections, Overload and Short circuit protection, Earthling standards and earth fault protection , Protection against voltage fluctuations, Effects of shock on human body , Hazards from Borrowed neutrals, Electrical equipment in hazardous atmosphere, Criteria in their selection, installation, maintenance and use, Control of hazards due to static electricity, Importance of Insulation ,Introduction to CEA Safety Regulation 2010 Static Electricity and associated hazards , Hazards in Electronics and Instrumentation manufacturing industry	8
4	**Fire Safety :** General causes and classification of fire, Detection of fire, extinguishing methods, fire-fighting installations with and without water., Type of Fire extinguishers, Use, hands on experience, Evacuation procedures, Mock drills introduction to Maharashtra Fire Prevention & Life Safety Measure Act, 2006 , Maharashtra Fire Prevention and Life Safety Measures Rules, 2009	8
5	**First aid and Emergency Procedures :** Body structure and Functions, Position of causality, the unconscious casualty, fracture and dislocation, Injuries in muscles and	8

	joints, Bleeding, Burns, Scalds and accidents caused by electricity, Respiratory problems, Rescue and Transport of Casualty. CPR, poisoning, wounds	
	REFERENCES: 1. NPTEL course material	

BTINPE405C. SIGNALS AND SYSTEMS

Teaching scheme:
Theory: 2 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Objective	To familiarize the students with elements of signals and systems.	
Course Outcome	Understand standard concepts and tools that will serve as building blocks towards signal and system analysis	
Unit		Contact Hrs
1	**Classification of signals:** Continuous time signals (CT signals), discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and periodic, random signals, representation of signals.	5
2	**Classification of systems:** CT systems and DT systems, Basic properties of systems - Linear Time invariant Systems and properties	5
3	**Analysis of continuous time signals:** Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in Signal Analysis	7
4	**Linear time invariant –continuous time systems** Differential equation, Block diagram representation, Impulse response, Convolution integral, frequency response , Fourier and Laplace transforms in analysis, State variable equations and matrix representation of system. **Linear time invariant - discrete time systems** Difference equations, Block diagram representation, Impulse response, Convolution sum, State variable equations and matrix representation of systems.	9
5	**Analysis of discrete time signals** Sampling of CT signals and aliasing, DTFT andproperties, Z-transform and properties of Z transform.	6
	REFERENCES: 1.Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, 2007. 2. Edward W Kamen& Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007 3. H P Hsu, RakeshRanjan" Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007 4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing, McGraw Hill International/TMH, 2007. 5. Simon Haykins and Barry Van Veen, Signals and Systems John Wiley & sons , Inc,2004. 6. Robert A. Gabel and Richard A.Roberts, Signals & Linear Systems, John Willy	

BTINL406. DIGITAL ELECTRONICS LAB

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Digital electronics theory	
Course Objective	Understands designing of various digital circuits	
Course Outcome	Design and verifies various digital circuits	
Expt. No	Title of Expt.	
1	Verification of truth table of various TTL logic gates.	
2	Verification of Boolean algebra laws.	
3	Verification of given logical expression using universal gates.	
4	To Design and test adder circuits (half and full adder) using K-map.	
5	To Design and test binary to gray code converter circuits and test using IC7486.	
6	To Design and test BCD to Exess-3 code converter circuit.	
7	To Design and test one bit comparator circuit using K-map.	
8	Verification of truth table of multiplexer using IC74153.	
9	Verification of truth table of De-multiplexer using IC74155.	
10	Verification of BCD to 7-segment display using IC7447.	
11	Verification of ring counter using IC7493.	

BTINL407. FEEDBACK CONTROL SYSTEM LAB

Teaching scheme:

Lab work : 2 hrs

Total credit: 1

Examination Scheme:

Continuous Assessment (T/W): 60Marks

Pr/oral: 40 Marks

Pre requisite	Basics of Feedback control System	
Course Objective	To understand characteristics of second order system, To understand behavior of different compensation networks	
Course Outcome	Design various compensation networks. Design feedback controller and observer	
Expt. No	Title of Expt.	
1	Study of Open loop and Closed loop.	
2	Time response Characteristic of a First order system	
3	Time response Characteristic of a second order system	
4	Frequency response Characteristic of a first order system	
5	Frequency response Characteristic of a second order system	
6	To draw Root Locus for a given transfer function.	
7	To draw Bode plot for a given transfer function.	
8	Design of lead compensation networks	
9	Design of lag compensation networks	
10	Design of compensation lead-lag networks	

BTINM 408. MINI PROJECT

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Objective	To provide platform to apply engineering knowledge
Outcome	1. Able to simulate hardware for verification of engineering principles 2. Demonstration of sensor circuits, extraction of signals and signal conditioning, measurement of various parametersincluding electrical, thermal, Mechanical communication parameters etc.

Dr. Babasaheb Ambedkar Technological University, Lonere

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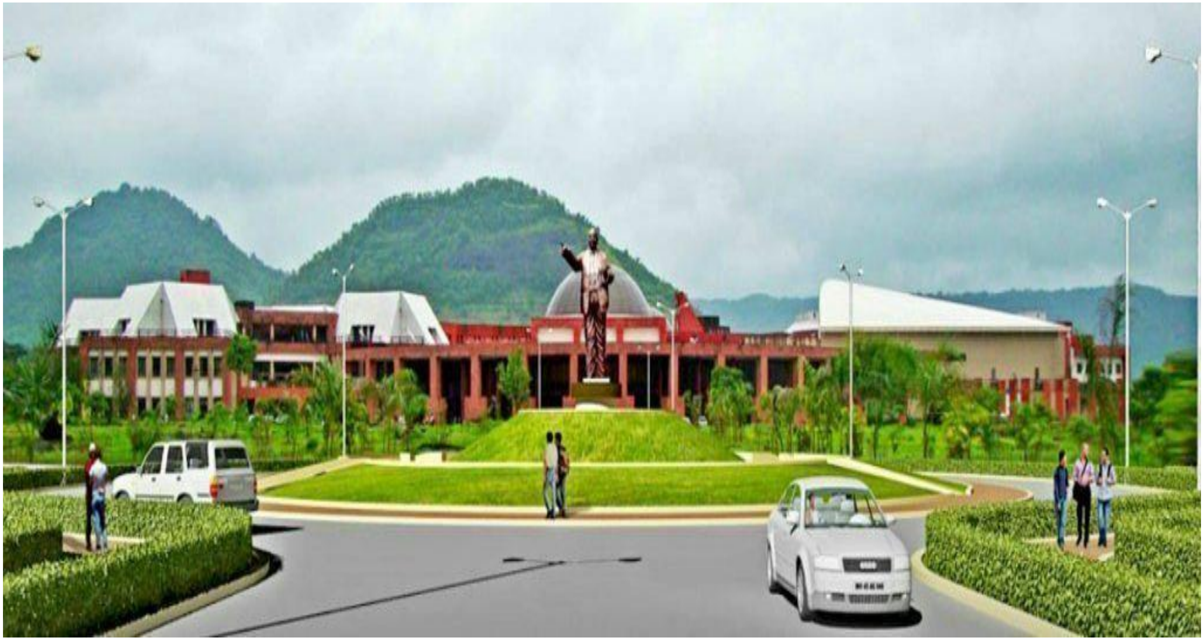
CURRICULUM

UNDERGRADUATEPROGRAMME

T. Y. B.Tech. (Instrumentation Engineering)

With effect from the Academic Year2022-2023



B. Tech in Instrumentation Engineering

Curriculum for Third Year

Semester V											
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC501	Process Loop Components	3	1	-	20	20	60	100	4
2	PCC 2	BTINC502	Microprocessor and Microcontroller	3	1	-	20	20	60	100	4
3	PCC 3	BTINC503	Digital Signal Processing	3	1	-	20	20	60	100	4
4	PEC 2	BTINPE504	Group B	3	-	-	20	20	60	100	3
5	OEC 1	BTINOE505	Group C	3	-	-	20	20	60	100	3
6	HSSMC	BTHM506	Human Rights	-	-	-	-	-	-	-	Audit
7	LC	BTINNL507	Process Loop Components Lab	-	-	2	60	-	40	100	1
8	LC	BTINNL508	Digital Signal Processing Lab	-	-	2	60	-	40	100	1
9	Project	BTINM509	Mini Project I	-	-	4	60	-	40	100	2
10	Internship	BTINP408	Internship – 2 Evaluation	-	-	-	-	-	50	50	1
Total				**15**	**3**	**8**	**220**	**100**	**430**	**850**	**23**

Semester VI											
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC601	Digital Control System	3	1	-	20	20	60	100	4
2	PCC 2	BTINC602	Industrial Automation and Control	3	1	-	20	20	60	100	4
3	PCC 3	BTINC603	Power Electronics and Drives	3	1	-	20	20	60	100	4
4	PEC 3	BTINPE604	Group D	3	-	-	20	20	60	100	3
5	OEC 2	BTINOE605	Group E	3	-	-	20	20	60	100	3
6	LC	BTINL606	Industrial Automation and Control Lab	-	-	2	60	-	40	100	1
7	LC	BTINL607	Power Electronics and Drives Lab	-	-	2	60	-	40	100	1
8	Project	BTINM608	Mini Project II	-	-	4	60	-	40	100	2
9	Internship	BTINP609	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in VII Sem.
Total				**15**	**3**	**8**	**220**	**100**	**380**	**800**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

- **Important Note: Minimum Eight Experiment to perform based on the syllabus for the laboratory subject.**

Group B [Sem - V] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE504 A	Multi-sensors and Data Fusion
02	BTINPE504 B	Linear Techniques
03	BTINPE504 C	Soft Computing

Group C [Sem - V] (Open Elective)

Sr. No.	Course Code	Course Title
01	BTINOE505 A	Control System
02	BTINOE505 B	Artificial neural network
03	BTINOE505 C	Biomedical Instrumentation

Group D [Sem - VI] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE604 A	Instrumentation Unit Operations
02	BTINPE604 B	Power Plant instrumentation
03	BTINPE604 C	Embedded Systems

Group E [Sem - VI] (Open Elective)

Sr. No.	Course Code	Course Title
01	BTINOE605 A	Industrial data communication
02	BTINOE605 B	Fiber Optics and Laser instrumentation
03	BTINOE605 C	Robotics and Control

SEMESTER V

BTINC501 Process Loop Components

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basics of Control System Components	
Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of control system components	
Course Outcome	1. Apply the knowledge of the control system components for controlling various Industrial parameters. 2. Able to identify, formulate and solve a problem using hydraulic, electrical & pneumatic system. 3. Analyse the process characteristics and apply suitable controller to that process. 4. Correctly select type and size of control valves for industrial use.	
Unit	Contents	Contact Hrs
1	Fundamentals of process control and Transmitters Elements of process control loop, Concept of Process variables, set point, controlled variable, manipulated variable, load variable. Representation of Process loop components using standard symbols (basics with reference to control loop), and Examples of process loops like temperature, flow, level, pressure etc. Need of transmitter (concept of field area & control room area), Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero.	8
2	Transmitters and Converters: Types of transmitters: Two and four wire transmitters, Electronic and Pneumatic transmitters Electronic Capacitive Differential Pressure Transmitter: Types, Mounting (Installation), Manifold, Calibration setup, DPT, Span & zero adjustment, Application of DPT for Flow and Level measurement, Zero elevation, suppression, Square root extractor. SMART: Comparison with conventional transmitter, Block schematic, Converters: Difference between converter & Transmitter, Pneumatic to current converter, Current to pneumatic converter.	8
3	Control Valves: Terminology, types and characteristics, Selection of control valves, Concept of Cv, calculation of Cv and trim size, Cavitation and flashing, Noise in control valves, testing of control valve, Valve positioners: necessity, types and effect on performance of control valves, Electrical, Pneumatic and Hydraulic Actuators, Electro-pneumatic and Electro-Hydraulic Actuators.	8

4	PID Controllers and PLC On-Off controller, Pneumatic, hydraulic and Electronic Proportional (offset), Integral (Reset windup), Derivative, Proportional- Integral, Proportional- Derivative, Proportional- Integral-derivative, reset windup, Rate before Reset, PID controllers and their tuning, Digital PID controllers: Velocity & Position algorithm. PLC Relay ladder diagrams, introduction to programmable logic controllers (PLC), Architecture and specifications of PLC, Ladder Programming, Development of ladder diagrams for various applications, Advance PLC programming.	8
5	Auxiliary components: Synchro transmitter and receiver, Servo motor, Stepper motor, Feeders and Dampers. Intrinsic safety and components. Gyroscope Indicators and Alarm Annunicator, Control Panel and their design.	8
	Reference books: 1. Process control and Instrument technology, C. D. Johnson, TMH 2. Introduction to Programmable Logic Controller, Gary Dunning 3. Process Control, Instrument Engineering Hand book, B.G. Liptak	

BTINC502 Microprocessor and Microcontroller

Teaching scheme:	**Examination Scheme:**
Theory: 3 hrs	Mid-term test: 20 Marks
Tutorial: 1 hr	Internal Assessment: 20 Marks
Total credit: 4	End semester exam: 60 Marks

Pre requisite	Digital electronics, electronics devices and circuits	
Course Objective	To know the architecture of 8085 and 8051. To understand interfacing and interrupt features of 8085 and 8051. To develop program for basic applications	
Course Outcome	1. Understand concept of microprocessors and microcontrollers. 2. Design and debug programming of microprocessors and microcontrollers. 3. Identify and select an appropriate microcontroller as well as development tools for given applications	
Unit	Contents	Contact Hrs
1	Architecture of 8085 Microprocessor and Programming: Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals, Machine cycles and timing diagrams. Instruction formats, Addressing modes, Instruction set, Need for Assembly language, Development of Assembly language programs	8
2	Interfacing: Memory Interfacing: Interface requirements, Address space partitioning, Buffering of Buses, timing constraints, Memory control signals, Read and write cycles, interfacing SRAM, EPROM and DRAM sections. I/O Interfacing: Memory mapped I/O Scheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports, Programmable peripheral interface (8255). Data transfer schemes: Programmable data transfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven data transfer schemes, Interfacing, Simple keyboards and LED displays.	8
3	Interrupts and DMA: Interrupt feature, Need for interrupts, Characteristics of Interrupts, Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Development of Interrupt service subroutines, Multiple interrupt request and their handling, need for direct memory access, Devices for Handling DMA, Programmable DMA controller 8237, Applications of microprocessors.	8
4	Intel 8051 Microcontroller : Architecture of 8051, Memory Organization, Addressing modes, Instruction set, Boolean processing, Simple programs	8
5	8051 Peripheral Functions : 8051 interrupt structures, Timer and serial functions, parallel port features : Modes of operation, Power control, features, Interfacing of 8051, Typical applications, MCS 51 family features	8
	Ref Books: 1. Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A", 3rd Edition, Penram International Publishing House, 1997. 2. Singh. I.P., "Microprocessor Systems", Module 9: Microcontrollers and	

	their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997. 3. Douglas, V. Hall. "Microprocessor and Interfacing Programming and Hardware", 2ndEdition, McGraw Hill Inc., 1992. 4. Kenneth, L. Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987.	

BTINC503 Digital Signal Processing

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Signals and systems network analysis and synthesis.	
Course Objective	To study different signals, systems, design procedure for filters. To understand time domain and frequency domain of systems. To analyses system signals and digital filter structure. To design digital filter for engineering application.	
Course Outcome	1. Ability to apply the various programming techniques on DSPs 2. Ability to design FIR and IIR filters using different techniques. 3. Ability to determine the frequency, steady state and transient response of LTI systems. 4. Ability to apply the DFT and FFT methods for various signals and determine their frequency response.	
Unit	Contents	Contact Hrs
1	Fourier series and Fourier transform & its properties. Discrete time Fourier series & its properties. Circular and Linear convolution, frequency response analysis of signal using DFT. Linear filtering based on DFT FFT algorithms. Use of FFT for spectral estimation, filtering & correlation.	8
2	Short Time Fourier Transform (STFT). Introduction to multi-resolution transform. Continuous wavelet transforms. Discrete Wavelet Transform (DWT). Simple application of DWT for noise filtering in one dimensional signal.	8
3	Introduction to Finite Impulse Response Filter, FIR filter design using different windowing techniques & frequency sampling method. Design of linear phase FIR filter. Introduction to computer-aided design of linear phase FIR filter. Basic structure of FIR system.	8
4	Introduction to Infinite Impulse Response Filter, impulse invariance and bilinear transformation, Design Specification of IIR Low pass filter and frequency transformation, Design of IIR filter using Butterworth, Chebyshev approximation. Introduction to computer-aided design of IIR filter. Realization methods for IIR filter.	8
5	Introduction to multirate DSP, Introduction to DSP hardware. TMS320C67XX processor, applications of TMS320C67XX e.g. square wave generator, matrix multiplication.	8

	Applications of DSP processor for biomedical, speech, image processing.	
	Reference Books: 1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007 2. Sanjit K. Mitra, "Applications DSP a Computer based approach", TMH, 2006 Oppenheium, Schaffer ,"Digital Signal Processing", PHI. 3. A. Nagoor Kani , "Digital Signal Processing", Mc. Graw Hill. 4. Rulph Chassaing ,"Digital Signal Processing, applications using C & TMS320CSX DSK", WILLEY publication.	

BTINPE 504 A. Multi-Sensor Data Fusion

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Objective	To learn the concepts and techniques used in sensor data fusion	
Course Outcome	To understand the concept of sensor fusion. To apply algorithms for multi-sensor data fusion. Interpret high performance data structures.	
Unit	Contents	Contact Hrs
1	Multi-sensor data fusion: Introduction, sensors and sensor data, Use of multiple sensors, Fusion applications. The interference hierarchy: output data. Data fusion model. Architectural concepts and issues.	8
2	Benefits of data fusion, mathematical tools used: Algorithms, Co-ordinate transformations, rigid body motion. Dependability and Markov chains. Meta – heuristics	8
3	Taxonomy of algorithms for multisensory data fusion. Data association. Identify declaration.	8
4	Estimation: Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters. Decision level identify fusion. Knowledge based approaches.	8
5	Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion. High performance data structures: Tessellated, trees, graphs and function. Representing ranges and uncertainly in data structures. Designing optimal sensor system with in dependability bounds. Implementing data fusion system	8
	Ref Books: 1. David L. hall, Mathematical techniques in multisensory data fusion, Artech House, Boston. 2. R. R. Brooks and S. S. Iyengar, Multi-sensor Fusion: Fundamentals and applications with Software, Prentice Hall Inc., New Jersey. 3. Arthur Gelb, Applied Optimal Estimation, M.I.T. press 4. James V. Candy, Signal Processing: The Model Based Approach, Mc Graw Hill	

BTINPE 504 B. Linear Techniques

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of Operational Amplifiers and its applications as well as signal sources and signal analysis.	
Course Outcome	1. Apply basic Knowledge of science and engineering subject to understand the concept, working and application of Operational Amplifier. 2. Understand concept of negative and positive feedback applications using Operational Amplifiers. 3. Understand the characteristics of operational amplifiers. 4. Understand fundamentals and design of different signal sources and voltage regulators	
Unit	Contents	Contact Hrs
1	Differential Amplifiers: dual input-balanced output ; single input-balanced output; their analysis, constant current bias, current mirror, level translators, Basic Operational amplifier; equivalent circuit, IC Operational amplifiers-characteristics, specification , parameter measurements, frequency response, types (741,308,356,OP07) and their properties.	8
2	Negative feedback applications: Voltage amplifier, current amplifier, Voltage to current and current to voltage converter, Op-amp as integrator and differentiator, Instrumentation amplifier. Positive feedback applications: Crystal oscillator and Function generator.	8
3	Comparator and Converter : basic comparator, zero-crossing detector, Schmitt trigger, precision AC/DC converters, logarithmic amplifier, sample-and –hold circuit, analog-todigital and digital-to –analog converters, clippers and clampers using op-amp.	8
4	Timer ICs.-Timer 555, its block diagram and applications- astable , monostable multivibrater, Timers- 7555 and XR2240, their block diagram and applications. Phase locked loop (PLL)- operating principle, IC 565 applications, Voltage controlled oscillator (VCO) and its applications.	8
5	Voltage regulators: 3 terminal positive and negative voltage regulators, variable voltage regulators (3085,723), tracking regulators. Active filters: Butterworth & Chebychev filter, design and evaluation of second order filterslow pass, high pass , band pass, band reject and all pass filter.	8
	References: 1. Ramakant A. Gayakwad, ‘Op-Amp and Linear Integrated Circuits’, Third edition, Prentice-Hall of India 2. Graeme,Tobey and Huelsman, ‘Operational Amplifiers: Design and	

	Application', McGraw-Hill International edition. 3. D.Roy Choudhury and Shail Jaon, 'Linear Integrated Circuits' New Age International 4. Albert Paul Malvino, 'Electronic Principles', 6th edition, Tata McGraw-Hill. 6. R. Subburaj, 'The foundation for ISO 9000 and TQM', 7. Bouwens A. J., 'Digital Instrumentation'	

BTINPE 504 C. Soft Computing

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Set Theory	
Course Outcome	Various Soft Computing Techniques in Industrial Engineering.	
Unit	Contents	Contact Hrs
1	Introduction of Soft Computing Introduction : Natural language processing , Machine Learning and Neural Networks, Fuzzy Systems, Pattern Recognition and Text Processing, Intelligent systems and their applications , Intelligent interfaces. Swarm Intelligence, Genetic Algorithm . Robotics and Kinematics. soft computing vs. hard computing; various types of soft computing techniques; applications of soft computing	8
2	Neural network model and algorithms Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture, single layer and multilayer feed forward networks, Mc Culloch Pitts neuron model, perceptron model, Adaline and Madaline, multilayer perception model, back propogation learning methods, effect of learning rule coefficient, back propagation algorithm, factors affecting back propagation training, applications.	8
3	Advances in Neural Networks Introduction of back propagation learning methods and algorithm, Counter propagation network architecture, functioning & characteristics of counter Propagation Network-Hopfield/ Recurrent network configuration, stability constraints associative memory and characteristics- limitations and applications, Hopfield v/s Boltzman machine, Adaptive Resonance Theory, Architecture- classifications Implementation and training, Associative Memory.	8
4	Fuzzy Logic Modeling and Control Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification inferencing and defuzzification-Fuzzy knowledge and rule Bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.	8
5	Genetic Algorithm Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant	8

	colony search techniques for solving optimization problems.	
	Text / Reference Books: 1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene V. Fausett, Pearson Education, 2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley India. 3.Genetic Algorithms in Search, Optimization, and Machine Learning, David E. Goldberg, Pearson Education, 2009. 4. Fuzzy set theory and its Applications, Zimmermann H.J, Springer international edition, 2011. 5. Neural Networks for Control, W. T. Miller, R.S.Sutton and P.J.Webrose, MIT Press,	

BTINOE 505 A. Control System

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basics of Control systems	
Course Outcome	1. Concept of control system in industry. 2. Design of Controllers. 3. Analysis of non-linear systems.	
Unit	Contents	Contact Hrs
1	Non-linear Control Systems: Peculiar behaviour of non-linear systems such as sub harmonics, jump resonance, limit cycle, Different types of non-linearities, Phase plane method, Singular Points, Methods of isoclines, Limit Lines & dividing lines on phase plane, Construction of phase plane, Obtaining time domain response from phase plane plots, merits & demerits. Describing function (DF) method, definition & assumptions, Derivation for describing function for different non- linearities, Stability analysis using DF method.	8
2	PID controllers: Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance, Numerical examples.	8
3	State Variable Technique: Concept of state & state variable, General form of state equations, formulation of state equations for the physical system, (RLC network, Armature controlled & Field controlled DC servo motor, mechanical systems).	8
4	State Variable Analysis: Different forms of state variable representations (Phase, physical & canonical form), Concept of diagonalization, Obtaining state equations from transfer function representation and vice versa, solution of state equations, State transition matrix (STM), Methods of finding STM, Power series method, Laplace transform method, Calay Hamilton method, Controllability & observability of linear system, Kalman's test.	8
5	Discrete Data Control System: Methods of representation, Z-transform, Inverse Z-transforms, Pulse transfer function of closed loop system, Response between sampling instants, Concept of stability of discrete time systems, Stability by Jury's test. Introduction to control system design, Compensation technique-Cascade & Feedback, Compensation network (lag, lead & lag-lead), Design by reshaping of Bode plots & Root locus technique.	8
	References: 1.Ogata K., 'Modem control Engineering', Prentice Hall 2.Kuo B. C., 'Automatic Control System' Prentice Hall 3. Nagarath I. J., Gopal M., 'Control System Engineering' Willey Eastern.	

BTINOE 505 B. Artificial Neural Network

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Concept of biological systems	
Course Objective	To study concept of neural network in engineering applications.	
Course Outcome	To review basic principles of neuron structure. To understand building blocks artificial neural network. To understand different networks of ANN To develop different algorithm for learning. To study and understand Fuzzy neural networks.	
Unit	Contents	Contact Hrs
1	Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures. Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.	8
2	Single layer perceptron: Structure and learning of perceptron. Pattern classifier introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptron.	8
3	Feed forward ANN: Structures of Multi-layer feedforward networks. Back propagation algorithm. Back propagation - training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.	8
4	Radial Basis Function Networks: Pattern reparability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF	8
5	Competitive Learning and Self organizing ANN: General clustering procedures. Learning Vector Quantization (LVQ). Competitive learning algorithms and architectures. Self -organizing feature maps. Properties of feature maps. Fuzzy Neural Networks: Neuro-fuzzy systems. Background of fuzzy sets and logic. Design of fuzzy stems. Design of fuzzy ANNs	8
	References NPTEL course	

BTINOE 505 C. Biomedical Instrumentation

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Human Anatomy and Physiology, Analytical Instrumentation, Electronic Instrumentation, Signal Processing, Sensors and Transducers, Human Diseases	
Course Objective	Study of various biomedical instruments.	
Course Outcome	1. Understands structure of human body 2. Understands use of Biomedical Instruments 3. Understands Transducers for biomedical instrumentation 4. To evolve an instrumentation system for diagnosis, supplementation, therapy of body functions. 5. Function in interdisciplinary team to solve engineering impact on human pathology . 6. Serve as engineer in medical field for safety of human being.	
Unit	Contents	Contact Hrs
1	Introduction to gross anatomy of human body, major physiological systems, their structure and function. Cell structure, basic cell functions, Origin of bio potentials, electrical activity of cells, Introduction to biomedical instruments, classification and justification.	8
2	Transducers for biomedical instrumentation and selection, biomedical electrodes Cardiological systems: Structure of heart, rhythamicity, cardiac cycle, heart sounds, cardiac output, blood pressure measurement, direct, indirect, Spygmomanometer, Digital B. P. Cardio vascular instrumentation: ECG electrodes, & leads, Cinthoven triangle, ECG quantification, PC based ECG analysis.	8
3	Pacemakers, Defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, Phonocardio graph, plentysmograph, Artificial Kidney, Blood cell counters,	8
4	Central Nervous system: The Brain, Receptors, sensory pathway and motor systems, Evoked potential, Electron rephalogram, EEG analysis, EMG. Mechanics of breathing O2/CO2 transport between lungs and tissue cells, Spirometer, Artificial respiration.	8
5	Imaging system: X-ray, CT Scan, Ultrasonography, MRI, Endoscopy. Electrical safety: Significance of electrical danger, Physiological effects of	8

	electrical current, Ground shock hazard, and methods of accident prevention.	
	Text / Reference Books: 1. Handbook of Biomedical Instrumentation , R S Khandpur, TMH, 2003 2. Cromwell, "Biomedical Instrumentation and Measurement, PHI 3. Introduction to Biomedical instrumentation, S G Kahalekar, 4. Handbook of Biomedical Instrumentation, Webster. http://nptel.iitm.ac.in	

BTHM 506 Human Rights/ Foreign Language **Audit Course**

Online NPTEL Course

BTINL507. Process Loop Components Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Basic electrical engineering	
Expt. No.	Title of Expt.	Contact Hrs
1	Study and calibration of D.P. Transmitter and its application for flow or level.	
2	Study and Calibration of 2 wire and 4 wire transmitter.	
3	Study of Square Root Extractor	
4	Study and Calibration of I/P and P/I converter	
5	Study & verification of different control actions (P, I, D, PI, PD, PID) for step Input	
6	Study of Control valve & plot the characteristics of Control valve	
7	Study of pneumatic components and simple pneumatic circuits.	
8	Study of PLC and PLC Programming.	
9	Study of hydraulic components and simple hydraulic circuits.	
10	Study of Alarm Annunicator	
11	Designing of intrinsic safety circuits	

BTINL508. Digital Signal Processing Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Pre requisite	Digital Signal Processing Operations	
Expt. No.	Title of Expt.	Contact Hrs
1	Shifting and folding of digital signal.	
2	Linear convolution.	
3	Discrete Fourier transforms.	
4	Fast Fourier transforms.	
5	Design and implement FIR filter using windowing method.	
6	Design and implement IIR filter using Butterwoth approximation.	
7	Design and implement IIR filter using Chebeshev approximation.	
8	Sine/square wave generation using TMS32OC67XX.	
9	FIR filter implementation using TMS32OC67XX.	
10	IIR filter implementation using TMS32OC67XX.	
11	Filtering Using Discrete Wavelet transforms.	

SEMESTER VI

BTINC601 Digital Control System

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Knowledge of Control systems at SE level & Control system	
Course Objective	Study and Analysis of Digital Control Systems	
Course Outcome	1. Use and handle various blocks and instructions in control system toolbox of Matlab. 2. Plot response and stability analysis of the Discrete Time Control System for different standard signals. 3. Design and investigate State Space Analysis of Control Systems. 4. Find controllability and observability of a system.	
Unit	Contents	Contact Hrs
1	Introduction to Discrete-Time Control Systems: Introduction of DCS, Basic building blocks of Discrete time Control system, Quantization and Quantization Error, Sampling process and theorem, Z transform applications for solving differential equations	8
2	Z plane Analysis of Discrete-time Control Systems: Introduction, Impulse Sampling and Data Hold, Transfer function of Zero Order Hold and First Order Hold, Pulse Transfer Function	8
3	Design of Discrete Time Control System by conventional methods: Introduction, Mapping between the S plane and Z plane, Stability analysis in Z-plane, Jury stability criterion, Bilinear transformations, Digital Controller Design using Analytical Design Method	8
4	State Space Analysis of Discrete Time Control System, State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Discretization of continuous time state space equations, Similarity transformations.	8
5	Pole Placement and Observer Design, Concept of Controllability and Observability, Useful transformations in state space analysis and design Stability improvement by state feedback, Design via pole placement, State observers, Quadratic Optimal Control, Steady-State Quadratic Optimal Control	8
	References: 1. K. Ogata, Discrete Control System 2. M. Gopal, Digital Control and state variable methods, Tata McGraw Hill	

BTINC602 Industrial Automation and Control

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Control system I, industrial automation	
Course Outcome	To understand construction and working principle of different industrial measurement systems. To understand new trends in industrial process control.	
Unit	Contents	Contact Hrs
1	Control Systems and Automation Strategy: Control Systems and Automation Strategy, Evolution of instrumentation and control, Types of industries, Types of automation, Role of automation in industries, Benefits of automation, Automation strategy evolution.	8
2	**Instrumentation Standard Protocols** Instrumentation Standard Protocols: Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Foundation Fieldbus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.	8
3	**Programmable logic controllers (PLC)** Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, high speed counter, PTO, PWM and PID blocks in PLC, PLC design, study of at least one industrial PLC. PLC programming methods as per IEC 61131, PLC applications for batch process using SFC, PLC interface to SCADA/DCS using communication links (RS232, RS485).	8
4	**Supervisory Control and Data Acquisition (SCADA)** Introduction to (SCADA), Evolution of SCADA, Types of SCADA, Hardware and Software architecture of SCADA System, Objectives of SCADA, Functions of SCADA, SCADA in Process Control, SCADA applications.	8
5	**Distributed Control Systems** Introduction to DCS. Evolution of DCS, DCS flow sheet symbols, architecture of DCS. Controller, Input and output modules, Communication module, data highway, local I/O bus, Workstations, Specifications of DCS.	8

	Introduction to database management. Supervisory computer tasks DCS configuration. Supervisory computer functions, Control techniques, DCS & Supervisory computer displays.	
	Reference Books: 1. John Webb & Ronald, “PLC Principles and Application”, Prentice Hall India. 2. S. K. Sigh, “Computer Aided Process Control”, Prentice Hall India. 3. John Hackworth & Frederick D Hackworth, “PLC: Programming Methods and Applications”, Pearson Education. 4. Krushna kant, “Computer Based Process Control” Prentice Hall India. 5. Prof. Rajesh Mehra and Er. Vikram Vij, “PLC and SCADA”, Laxmi Publication, 6. Distributed Computer Control for Industrial Automation, Poppovik Bhatkar, Dekkar Publications 7. http://nptel.iitm.ac.in	

BTINC603 Power Electronics

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Knowledge of basic components of electronics and electrical circuits and networks	
Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of power electronics circuits and their classifications. The course aimed at acquiring an understanding of basic principles, operation, performance and applications of power electronics circuits. The subject is helpful in the study of technological aspects such as utilization semiconductor devices and technology in power systems, industrial drives, automation and control.	
Course Outcome	1.To review principle of construction, operation and characteristics of basic semiconductor devices. 2. To understand and analyze performance of controlled and uncontrolled converters. 3. To understand and analyze performance of DC to DC converters. DC to AC converters. 4. To understand and analyze performance of AC voltage controllers.	
Unit	Contents	Contact Hrs
1	Power Family Components Characteristics constructional details and working of Thyristor/SCR, Triac, Diac, SCS, SUS, LASCR. Methods of turning on an SCR, turn-on, turn-off mechanism and characteristic, device specifications, rating and nomenclature of SCR. SCR triggering circuits, R, RC, pulse and UJT triggering circuits, Protection circuits for SCR. Multiple connection of SCR: series operation, parallel operation, string efficiency. Commutation of SCR: Natural and Forced commutation techniques.	8
2	Rectifier and Inverter Controlled rectifier: Single phase and three-phase controlled rectifier circuits, with R, RL Load, with FWD, Dual converters. Inverters: Principle of operation of series inverter, parallel inverter and bridge inverter, designing of commutating component. Design and operation of UPS & SMPS.	8
3	AC Voltage Controllers and Cycloconverters AC Voltage controllers: single-phase & three-phase with R and RL load Cycloconverter: Single-phase and Three-phase Cycloconverter. Induction heating and dielectric heating, Resistance welding.	8
4	Chopper and Speed Control of Motor	8

	Choppers: Classification of choppers, step-up, step-down chopper, Jones chopper, Morgan chopper, and principle of operation for each method. Chopper control techniques. Speed control of single- phase induction motor-using SCR and Triac: various methods their circuit diagrams and working.	
5	Industrial Applications Thyristor control Applications: AC and DC Static circuit breaker, Over Voltage protection circuit. Zero voltage switch, Integral-cycle triggering, Time delay circuit, Soft start circuit. Temperature regulator, SCR-controlled dimmer circuit, Emergency light using SCR, Automatic water level indicator, automatic battery charger using SCR.	8
	References: 1.RashidM. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education). 2.Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford). 3. Bimbhra.P. S- Power Electronics.(Khanna Publication). 4. Dr. P.S. Bimbhra, 'Power Electronics', Khanna Publisher. 5. M. Ramamoorty, 'An introduction to Thyristors and their applications', second edition, East-West Press. 6. M.D. Singh and K.B. Khanchandani, 'Power Electronics', Tata McGraw Hall. 7. S.K.Bhattacharya, S.Chatterjee, 'Industrial Electronics and Control' , Tata McGraw-Hill. 8. P.C.Sen, 'Power Electronics', Tata McGraw-Hill.	

BTINPE 604 A. Instrumentation in Unit Operations

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Chemical Processes, Laws of Thermodynamics, Control Systems, Controllers etc.	
Course Objective	Study concept of various unit operations in industry	
Course Outcome	1. List chemical processes, units, and the corresponding equipments. 2. Make material balances and energy balance on unit operations and processes. 3. Understanding of the degrees of freedom analysis and its significance. 4. Get knowledge of basic principles of fluid mechanics 5. Analyze fluid flow problems with the application of the momentum and energy equations	
Unit	Contents	Contact Hrs
1	Introduction: - Concept of unit operations & unit processes, material balance and energy balance. Evaporation: - Liquid characteristics, types of evaporators, Methods of Feeding, operation of single effect and multi effect evaporator, capacity & economy of multiple effect evaporation, Vapour recompression, Operation of mechanical and thermal Recompression, Instrumentation and control for this process. Drying: - Classification of dryers, Principle & operations, Drying equipments, Instrumentation for this process.	8
2	Distillation:- Equipment set up, Operation of flash Distillation, Batch Distillation, Continuous Distillation, Fractionating Column; slue plate arrangement, Rectification and stripping, Instrumentation and control for this process. Leaching and Extraction: - Principles, Various types of equipments for this process.	8
3	Material Handling Equipments: - Transport Equipments, Positioning Equipments, Unit load formation Equipment, Storage equipment, Identification & control equipment. Size Reduction:-Principle of commutation Equipments, Classification and operation of crushers & grinders.	8
4	Crystallization: - Definition, Magma, Super-saturation, formation of Crystal, Equipment classification& operation. Instrumentation & control for this process. Mechanical separation: Screening, Filtration – Mechanisms of filtration, Types of Industrial filters- Rotary filter, filter press, Centrifuges, cyclones, Bag filter, electrostatic precipitators and Centrifuge separator.	8
5	Heat Exchangers:-Theory, Types of heat exchanger, temperature pattern in heat exchanger, condensers, Boilers. Application of above Unit operations in Paper, Cement, Fertilizer, Petrochemical and sugar industry.	8
	Reference Books: -	

	1.McCabe Smith, ‘Unit Operation of Chemical Engineering’, 5thEdition, McGraw Hill. 2.Perry, ‘Chemical Engineers Handbook’, 6thEdition, McGraw Hill int. Student ed. 1984. 3.Felder, Rotsseau, Herriot, ‘Elementary principles of Chemical Processes’, Wiley 1978 4.W.F. Stoeker, ‘Design of Thermal System’, 3rdEdition McGraw Hill int. ed. 1989. 5.M. Gopalrao& M. Sitting , ‘Outline of Chemical Technology’, 2ndedition east west 973. 6.http://nptel.iitm.ac.in	

BTINPE605 B. Power Plant Instrumentation

Teaching scheme:
Theory: 3 hrs
Tutorial:
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic Knowledge of Power Plants	
Course Objective	To create awareness of energy resources and its scenario in India. To study the concept of power generation using various resources. To study the role of Instrumentation in power plants. To study and compare various power plants for optimal performance	
Course Outcome	1. Understand the over view of different power plants and its operation. 2. Understand the application of instrumentation for measurement, monitoring and safety of human being and assent of power plants. 3. Discharge the technical duties in field of power generation as maintenance and automation engineer. 4. Understand the safety awareness through latest through latest safety equipments. 5. Use latest software and tools of instrumentation for power plant.	
Unit	Contents	Contact Hrs
1	Power generation from conventional sources Thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems; Economic considerations in power systems. Alternate sources of power generation - solar, wind, geo-thermal, ocean-thermal, tidal, wave and MHD.	7 Hours
2	Hydro-electric power plants Selection of site, elements of power plant, classification, water turbines, governor action, hydro- electric generator, plant layout, pumped storage plants Thermal steam power plants: Selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.	7 Hours
3	Nuclear power plants Selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.	7 Hours
4	Renewable power plants Solar power generation, Photo-voltaic and solar thermal generation, solar concentrators, Wind power generation, types of wind mills, wind generators, tidal, biomass, geothermal and magneto- hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants	7 Hours

5	Combined operation of power plants Plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.	7 Hours
	Text/References Books 1. Wadhwa, C.L., _Generation Distribution and Utilisation of Electrical Energy', New Age International Publishers, 3rd Edition, 2010. 2. J.B.Gupta, _A Course in Power Systems‘, S.K.Kataria and Sons, Reprint 2010-2011. 3. M. M. El-Wakil, Power Plant Technology, Mcgraw Hill, Digitized on Dec 2000 4. B. G. A. Skrotzki & W. A. Vopat, Power Station Engineering & Economy, McGraw Hill, Digitized on Dec 2007. 5. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A Text Book on Power Systems Engg', Dhanpat Rai and Sons, New Delhi, 2nd Revised Edition, 2010.	

BTINPE 604 C. Embedded Systems

Teaching scheme:
Theory: 3 hrs
Tutorial:
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Knowledge of Microcontrollers	
Course Objective	To learn about the Embedded Processors with Real World applications. To introduce the concept of control applications in embedded systems. To enhance the knowledge in interfacing processes with embedded controllers.	
Course Outcome	Write programs in an IDE and download it to the Processor. Design and program Embedded circuits. Design control algorithms in an embedded processor.	
Unit	Contents	Contact Hrs
1	Introduction to Embedded systems, the build process for embedded systems, Structural units in Embedded processor, selection of processor & memory devices, DMA, Memory management methods, timer and counting devices, watchdog timer, real time clock, in circuit emulator, target hardware debugging.	8
2	Embedded networking: Introduction, I/O Device ports and buses, serial bus communication protocols, RS 232 standard, RS 422, RS 485, CAN Bus, Serial Peripheral Interface (SPI), Inter Integrated Circuits (I2C), need for device drivers.	8
3	Embedded Product Development Life Cycle: objectives, different phases of ELDC, Modelling of ELDC, issues I Hardware- software co-design Data flow graph, state machine model, sequential program model, concurrent Model, object oriented model.	8
4	OS Concepts and types, tasks & task states, process, threads, inter process communication, task synchronization, semaphores, and role of OS in real time systems, scheduling resource allocation, interrupt handling.	8
5	Introduction to basic concept of RTOS, multiprocessing and multitasking, preemptive and non- preemptive scheduling, task communication shared memory, message passing, inter process communication- synchronization between processes semaphores, mailbox, pipes, priority inversion, priority inheritance, comparisons of real time operating systems: Vx Works, uc/OS-II, RT Linux. Case study of washing machine- automotive application- smart card system application.	8
	Text/Reference Books: 1. Rajkamal, Embedded system- architecture, programming, design, Mc Graw Hill 2. Peckol, Embedded system design, John Wiley & Sons. 3. Lyla B Das, Embedded Systems-an integrated approach, Pearson.	

BTINOE605 A. Industrial Data Communication

Teaching scheme:
Theory: 3 hrs
Tutorial:
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basics of Communication Techniques	
Course Objective	Study concepts of communications techniques in industry at various levels.	
Course Outcome	Upon completing the course, the student should have understand the concepts required for building industrial systems.	
Unit	Contents	Contact Hrs
1	Interface: Introduction, Principle of interface, serial interface and its standards. Parallel interfaces and buses.	8
2	Fieldbus: Use of fieldbuses in industrial plants, functions, international standards, Performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation	8
3	Instrumentation network design and upgrade: Instrumentation design goals, cost optimal and accurate sensor networks.	8
4	Global system architectures, advantages and limitations of open networks, HART network and Foundation fieldbus network.	8
5	PROFIBUS-PA: Basics, architecture, model, network design and system configuration, Designing PROFIBUS-PA and foundation Fieldbus segments: general considerations, network design.	8
	Text/Reference Books: 1. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann 2. B. G. Liptak, Process software and digital networks, CRC press.	

BTINOE605 B. Fiber Optics and Laser Instrumentation

Teaching scheme:
Theory: 3 hrs
Tutorial:
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic Knowledge of Fiber Optics and Laser	
Course Outcome	Identify various sensors, Fiber optic and its specifications. Understand principle of working of Fiber Optic used to measure Temperature, Displacement, Level, and various miscellaneous other sensors Understand applications of Fiber Optics in industry.	
Unit	Contents	Contact Hrs
1	Optical Fiber and Their properties: Ray theory, wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, optical fiber mode, single mode fiber, special fiber, fiber materials, fiber fabrication, transmission characteristics of fiber, absorption losses, scattering losses, dispersion, polarization, non-linear phenomena.	8
2	Optical Sources and Detectors, Power Launching and Coupling: Laser theory, Laser diodes, LED, PN diode, Pin diode, avalanche diode, solid, liquid, gas and semiconductor laser their characteristics modulation circuits, optical detection principles, quantum efficiency and detector noise, Source to fiber power launching, fiber alignment and fiber to fiber joints, splices, connectors, coupling losses, lensing schemes for coupling improvement, LED coupling to single mode fiber.	8
3	Optical Fiber Measurements: Measurement of attenuation, dispersion, refractive index profile of fiber and cut off wavelength, numerical aperture, OTDR, Measurement of flow, pressure, Temperature, displacement, acceleration and fluid level vibration measurement.	8
4	Fiber Optic Sensing Principles and Techniques: Classification and principle of fiber optic sensors, fiber grating and fiber Bragg grating technology and distributed optical fiber sensing.	8
5	Optical Amplification and Integrated Optics: Beam splitter, directional coupler, opto isolators, multimode interference coupler(MMIC) optical modulators, fiber modulator optical amplifiers, optical switches, frequency translators, optoelectronic integration, Holography and Laser instruments in medical application and Remote Sensing: Basic principle, methods, Holographic interferometry. Application of laser in medical application, laser in industrial application.	8
	Text/Reference Books: 1. “Fiber optics – communication”, Gerd Keiser. 2. “Integrated circuits and semiconductor devices theory and application” Deboo Burrous, McGraw Hill Second Edition.	

BTINOE 605 C. Robotics Control

Teaching scheme:
Theory: 3 hrs
Tutorial:
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic Knowledge of Robots and its elements	
Course Outcome	After studying the subject students will be able to design various controls in robotics.	
Unit	Contents	Contact Hrs
1	Introduction Introduction to robots, Robot manipulators, Mobile robots, Robot anatomy, Coordinate systems, Work envelope, Types and classification, Specifications, Sensors, Actuators and drives.	6 Hours
2	Forward and Inverse Kinematics Introduction Representation of position and orientation of a rigid body, Homogeneous transformations Forward and inverse kinematics problems, Denavit - Hartenberg (D-H) notations and parameters Representation of joints, link representation using D-H parameters, Closed-form solutions, Geometric and Numerical methods	8 Hours
3	Velocity and Statics analysis Linear and angular velocity of links Velocity propagation, Jacobians for robotic manipulators, Statics and force transformation of robotic manipulators, Singularity analysis.	8 Hours
4	Robot Dynamic analysis Introduction, Forward and inverse dynamics, Mass and inertia of links, Lagrangian formulation for equations of motion for robotic manipulators, Newton- uler formulation method, Dynamic modelling, State space representation of dynamic equations of robotic manipulators.	8 Hours
5	Trajectory Planning and Control 7 Hours Joint and Cartesian space trajectory planning and generation – Classical control concepts using the example of control of a single link – Independent joint PID control – Control of a multi-link manipulator – Nonlinear model-based control schemes. Simulation and experimental case studies on robotic manipulators.	8 Hours
	Text/Reference Books 1. William B. Riddens, ―Understanding Automotive Electronics‖, 5th Edition, (Butterworth Heinemann Woburn), (1998). 2. Tom Weather Jr and Cland C. Hunter, ―Automotive Computers and Control System‖,Prentice Hall Inc. ,New Jeresy. 3. Jiri Marek, Hans Peter trah, ―Sensers Applications, Sensers for Automotive Technology‖ 1st Edition , Wiley 4. T. Mellard, Automotive Electronic Systems‖1987 by Heinenmann Professional.	

BTINL606. Industrial automation and Control Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

	List of Experiments
Expt. No.	Title of Expt.
1	Study of different PLC and their specification.
2	Study of installations and troubleshooting of PLC.
3	Solving example by LD and ST programming in PLC.
4	Solving example by timer and counter in PLC.
5	Solving example using SFC programming in PLC.
6	Study of Interfacing between PLC and Process loop.
7	Study of SCADA system.
8	Study different type of DCS and their latest trends.
9	Selection steps of DCS for industrial automation.
10	Study of specification list for DCS.

BTINL607. Power Electronics and Drives Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

	List of Experiments
Expt. No.	Title of Expt.
1	To plot the characteristics of SCR.
2	To plot the characteristics of Diac.
3	To plot the characteristics of Triac.
4	To Plot voltage vs firing angle for AC phase control using Triac.
5	Study of Forced commutation circuits.
6	To study and plot the line vs Load regulation for SMPS
7	To study Single phase half wave controlled converter
8	To study Single phase full wave controlled converter
9	Study and implement series inverter.
10	Study and implement parallel inverter.

BTINM608. Mini Project II

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Students in group of three or four are expected to develop minor project on the concept learned in Semester V and VI subjects.

Dr. Babasaheb Ambedkar Technological University, Lonere.

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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech. Instrumentation Engineering

With effect from the Academic Year 2020-2021(Final Year)

PROGRAM EDUCATIONAL OBJECTIVES. (PEOs)

The Board of Studies in Instrumentation Engineering of Dr. Babasaheb Ambedkar Technological University, Lonere has defined set of program educational objectives. The Program Educational Objectives of Instrumentation Engineering are designed to provide graduates with:

PEO1: Professional Knowledge: Graduates shall acquire the fundamental and advanced knowledge in Instrumentation Engineering subjects along with additional knowledge on other subjects such as Mathematics, Inter-disciplinary, Engineering, Management and Economics to solve basic and complex engineering problems. Graduates will be able to design system within realistic constraints for sustainable developments.

PEO2: Professional Employment: Graduates will have a successful career in Instrumentation Engineering. Graduates will succeed in getting the entry-level engineering positions as trainee engineer, project engineer, erection and commissioning engineer, automation engineer in process industries, Government Organizations at regional and national levels and as an Entrepreneur.

PEO3: Higher Studies & Life Long Learning: Graduates may pursue their professional development through self-learning, advanced degree and continue life-long learning. Graduates will be able to use software and modern engineering tools.

PEO4: Social Engineering: Graduates will aware of social responsibility, ethical values, safety standard, economical and environmental issues so that they serve the society better.

PROGRAM OUTCOMES (POs)

a. An ability to apply knowledge of mathematics, science, and engineering.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. An ability to function on multidisciplinary teams.

e. An ability to identify, formulates, and solves engineering problems.

f. An understanding of professional and ethical responsibility.

g. An ability to communicate effectively.

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

i. Recognition of the need for, and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

l. An ability to work professionally in both software and hardware system areas including the design and realization of such systems.

B. Tech (Instrumentation Engineering)
Proposed Curriculum for Semester VII [Final Year]

Sr No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
01.	BTIEC701	PCC1	Process Instrumentation and Control	3	-	0	20	20	60	100	3
02.	BTIEC702	PCC2	Instrumentation System Design	3	-	0	20	20	60	100	3
03.	BTIEC703	PCC3	Industrial Project Planning and Estimation	3	-	-	20	20	60	100	3
04.	BTIEPE704A	PEC1 (Elective - IX)	Image Processing	3	-	0	20	20	60	100	3
	BTIEPE704B		Internet of things								
	BTIEPE704C		Clinical Instrumentation								
05.	BTIEOE705A	OEC1 Open (Elective - X)	Analytical Instrumentation	3	0	0	20	20	60	100	3
	BTIEOE705B		Adaptive Control System								
	BTIEOE705C		Automobile Instrumentation								
06.	BTIEL706	Lab	Process Instrumentation and Control Lab	0	0	2	-	30	20	50	1
07.	BTIEL707	Lab	Instrumentation System Design Lab	0	0	2	-	30	20	50	1
08.	BTIEL708	Lab	PEC1 Elective - IX Lab	0	0	2	-	30	20	50	1
09.	BTIES709	Seminar	Seminar	0	0	2	-	30	20	50	1
10.	BTIEP710	Project	Project Part-I	0	0	12	-	30	20	50	3
11.	BTIEF711	-	Industrial Training	-	-	-	-	-	50	50	1
			Total	15	0	20	100	250	450	800	23

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B.Tech (Instrumentation Engineering)
Proposed Curriculum for Semester VIII [Final Year]

Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
1. Control Engineering 2. The Joy of Computing using Python			3	-	-	20*	20*	60*	100	3
3. Biomedical Signal Processing 4. Industrial Automation and Control 5. Sensors and Actuators 6. Fuzzy Sets, Logic, Systems & Applications 7. Optical Engineering # Student to opt any two subjects from above list			3	-	-	20*	20*	60*	100	3
BTIEP803	Project	Project Part-II	-	-	30	-	100	150	250	15
		Total	06	-	30	40	140	270	450	21

- *Six months of Internship in the industry*
- *Students doing project at institute will have to appear for CA/MSE/ESE*
- *Student doing project at Industry will give NPTEL examination / Examination conducted by university i.e. CA/MSE/ESE*
- *These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source*
- *Teacher who works as a facilitator for the course should be allotted 3 hrs/week load.*
- *Project Load: 2hrs/week/project*

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

Sr. No.	Course Name	Duration (Weeks)	Institute offering course	Name of Professor
1.	Control Engineering	12 Week	IIT Madras	Prof. Ramkrishna Pasumarthy
2.	The Joy of Computing using Python	12 Week	IIT Ropar	Prof. Sudarshan Iyengar Prof. Yayati Gupta
3.	Biomedical Signal Processing	12 Week	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4.	Industrial Automation and Control	12 Week	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay
5.	Sensors and Actuators	12 Week	IISc Bangalore	Pro. Hardik Jeetendra Pandya
6.	Fuzzy Sets, Logic, Systems & Applications	12 Week	IIT Kanpur	Prof. Nischal K. Verma
7.	Optical Engineering	12 Week	IIT Madras	Prof. Shanti Bhattacharya

Semester VII

BTIEC701	Process Instrumentation and Control	3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. To understand principles of elements in the control loop
2. To appreciate the properties of different control loops and suggest suitable control for it
3. To develop problem-solving skills applicable to real-world problems in the process industries.

Course Outcomes (COs):

1. Summarize and classify characteristics of various control loops
2. Design and apply appropriate control for different control loops.
3. Familiarize with the advances in process instrumentation..

Unit: 1 **7 Hours**

Process characteristics: Types of Processes (Dead time, single and multi capacity, Self and non-self regulating, interacting and non-interacting, linear and nonlinear processes).

Process gains, process reaction curve, process time constant and constant step analysis method for finding time constant, Dead time.

Dynamic elements in control loops. PID control of processes. Process simulators.

Unit: 2 **7 Hours**

Analysis and properties of some common loops: Flow, pressure level, temperature, composition, pH etc.

Linear and non linear controllers, review of PID with limitations(offset, saturation in D, & reset windup) rate before reset, PID variations, and tuning,

Digital controller (position and velocity algorithms, effect of sampling g time)hardware structures, features and specification.

Single loop and multiloop controllers and the application programs, Non-linear controller-two state, three state, proportional time, dual mode, optimal switching.

Unit: 3 **7 Hours**

Multi-loop and multivariable process control systems: Feedback, Feed forward Control, cascade control, ratio control, auto selective control, spit range control.

Predictive control systems and Adaptive control systems.

Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.

Unit: 4 **7 Hours**

Boiler instrumentation and Optimization, boiler equipment safety interlocks,

Boiler efficiency and dynamics, boiler controls, combustion control, air to fuel ratio control.

3 element drum level control, steam pressure control, steam temperature control.

Burner management and control boiler optimization.

Furnace control of heat exchangers, steam and fired heaters control.

Reboilers, vaporization, heat exchanger and condensers.

Unit: 5 **8 Hours**

Instrumentation design for Pumps and compressor controls,

Instrumentation design for multi effect evaporators, distillation, dryer, chemical reactor and cooling tower.

Instrumentation design for size reduction, extruder, crystallizer, chiller.

Recommended Books:

1. Process Control Systems by F. G. Shinskey (TMH).
2. Process Control by B. G. LIptak (Chilton).
3. Computer Based Industrial Control by Krishna Kant (PHI).
4. Distributed Computer Control for Industrial Automation by Popovic and Bhatkar (Dekker).
5. Chemical Process Control by G. Stephanopoulos (PHI).
6. Distillation Column Control by F. G. Shinskey (TMH).
7. Process control Instrumentation – C.D. Johnson(8)Process control designing processes and control system for dynamic processes Thomes E. narlin
8. Analog and Digital control – Ramakant Gaikwad
9. Distributed computer control for industrial automation, Ppovik Bhatkar, Dekkar Pub

BTIEC702 Instrumentation System Design 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. Control Valve Sizing concepts and its usual terms for applications like liquid, gas, vapour and flashing fluids.
2. Control room and Control Panel details
3. The process of Electronic product design

Course Outcomes (COs):

1. Design and Analyse CV Sizing
2. Identify various Control panels and Control Room details
3. Design of Electronic product.
4. Understand Signal Conditioning for Transducers.

Unit 1. **07 Hours**

Basic concepts of transducer design: General transducer design consideration, testing of transducer, and selection criteria of transducer.

Design of temperature measurement system based on RTD, Thermocouple and thermisters, Design of Displacement measurement system based using LVDT, Potentiometer,

Ultrasonic transducer, Complete signal conditioning circuits for above temperature and Displacement transducers.

Unit 2 **07 Hours**

Design of orifice, rotameter, venture based flow system and signal conditioning circuits for above system. Design of level sensors and its signal conditioning circuits, design of pressure gauge, diaphragm based pressure gauge, strain gauge cell and its signal conditioning, study of P/I and I/P converters, Design of smart transmitters

Unit3. **07 Hours**

Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, Importance of documentation in system design.

Unit4. **07 Hours**

Guidelines for enclosure: components and accessories, Grounding and shielding techniques noise in electronic circuits, EMI/ EMC protection against EMI, ESD selection of cables, connectors, types of knobs,; mechanical fixture PCB holders, clamps, control panel layout and control room design. Safe and Hazardous area.

Unit 5. **07 Hours**

Printed circuit board design guidelines: general components layout scheme, grid system, PCB size mechanical stress, design rules for analog and digital circuit PCB, single, multi layer and SMD boards, Artwork CAD packages, soldering techniques.

Reference Books :

1. Electrostatic Discharge and Electronic Equipment, “Warren Boxleitner” IEEE presses.
2. Printed Circuit Boards, “Walter C. Bosshart”, CEDT series, TMH.
3. Noise Reduction Techniques, “Ott”.
4. Reliability Engineering, “E. Balguruswamy”, PHI.
5. Applications of Analog Intergrated Circuit, “S. Soclof”, PHI.
6. Process Control, “B.G.Liptak”, Chilton.
7. National Instruments Catalog.
8. Measurement Systems, “E.O.Doebline”.
9. Process control and Instrumentation technology, “C. D, Johnson”, PHI

BTIEC703 Industrial Project Planning and Estimation 3 Credits

Course Education Objectives (CEOs)
Upon completion of this course, student should be able to:

The objective of the course is to provide students with a firm grasp of the essential principles of project, planning, controlling, estimation and economics.

Course Outcomes (COs):

1. Apply the knowledge of the documentation for project execution.
2. Able to do the documentation for procurement of instruments/equipment.
3. Apply the knowledge for project, planning, controlling, estimation and economics.
4. Do higher studies in field of project, planning, controlling, estimation and economic developments.

Unit: 1 Introduction: 7 Hours

Definition of Project : Purpose, scope, time Quantity, and organization structure Degree of Automation, Manpower considerations, Inter-department and inter organization interactions, Process flow sheets, P & I diagrams, Interlock diagrams, Instrument Index Sheets, Instrumentation standards and practices, Legends and Symbols Instrumentation symbols and Identifications (ANSI/ISA-5.1), Plant layout General arrangement drawing (Plans and Elevations).

Unit: 2 Instrumentation & Control Documentation & Cable Engineering: 7 Hours

Instrument specification sheets, Loop diagrams, wiring diagrams isometrics, installation detail drawing bill of material (BOM), control panel drawing, instrument data sheet, document control as per ISA standards, check lists, legend sheets, instrument catalogues test and process reports different classes of conductors and their routines and NEMA Standards Types and specifications of cables, Cable schedule, Routing of cables, Types of glands, Ferruling and terminations

Unit: 3 Procurement Activities and Construction Activities: 7 Hours

Vendor registration, Tendering and bidding process, Bid evaluation, Purchase order Vendor documents, Drawing and reports as necessary at above activities, Site conditions and planning, Front availability, Installation and commissioning, Activities and documents, On-site inspection and testing (SAT), Installation sketches Contracting, Cold commissioning and hot commissioning CAT (Customer Acceptance Test Perform trials and final handover Control console, centers, panels and indicators: Types, Design, Inspection, and specification Intelligent operator interface (IOI). Field bus Wiring: Terminator, Power Conditioners, Spurs, Segments, and repeaters Networking: Hubs, routers, LAN cards, and Cat cables.

Unit: 4 Project Management: 7 Hours

Process planning and scheduling Management: importance, characteristics, principles and levels of management Controlling, Directing, project authority, responsibility, Accountability Interpersonal influences Standard communication format, project reviews, The statement of work (SOW) Project specifications, milestone schedules, work breakdown structures, cost breakdown structure and the planning cycle Overview planning and execution mode (conceptual focus, design) Implementation, operation and support transition.

Unit: 5 Cost Management, PERT and CPM: 7 Hours

Cost and Estimation: Types of Estimates, Pricing process Salary overheads Labour hours, Material and support costs Network fundamentals Slack time network planning Estimating activity time and total program time Total PERT and CPM planning, crash times Software used in project management Software features and classification Evaluation and implementation

Reference Books :

1. Andrew and Williams, "Applied Instrumentation in Process Industries", Gulf Publishing.
2. Liptak , "Process Control Instruments Engineer's Handbook", Chilton.
3. Hardlod Kerzner, "Project Management System Approach To Planning Scheduling and Controlling, 5th edition, Van Nostrand Reinhold Publishing.
4. John Bacon, " Management systems," (ISA).
5. T.G. Fisher, "Batch Control Systems", (ISA).
6. John Bacon, "Instrument installation project management", (ISA).

BTIEPE704A Image Processing 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

The fundamentals of digital image processing and algorithms that are used. Useful skill base that would allow them to carry out further study should they be interested and to work in the field. The students are expected to develop a foundation that can be used as the basis for further study and research in this field. The syllabus gives great emphasis on basic principles as well as more advanced techniques for image enhancement, segmentation, morphological operations etc.

Course Outcomes (COs):

Upon the completion of course the students will be able to:

1. Acquire the fundamental concepts of a digital image processing system
2. Identify and exploit analogies between the mathematical tools used for 1D and 2D signal analysis and processing
3. Analyze 2D signals in the frequency domain through the Fourier transform
4. Design and implement with Mat lab algorithms for digital image processing operations such as histogram equalization, enhancement, restoration, filtering, and denoising.

Unit 1. 7 Hours

Digital Image representation, steps in Image processing, Elements of IP system, Frame Grabber, Digital camera, Elements of visual perception, Image model, Sample and Quantization, Basic relationship between pixels, Image Geometry.

Unit 2. 7 Hours

Image Transforms, Introduction to Fourier Transform, DFT, Properties of 2-D fourier transform, FET, Walsh transform, Hazard Transform, Discrete Cosine transform, Harr transform, Wavelet transform.

Unit 3. 7 Hours

Image Enhancement methods by Spatial and Frequency domain methods, point processing, Spatial filtering, Color Image processing, Image Restoration, Degradation model, Digitalization of circulant and block circulant matrices, Algebraic approach, inverse filtering, Least Mean Square filter, constrained Least square restoration, Restoration in spatial domain, geometric Transformation.

Unit 4. **7 Hours**

Image Compression by Redundancies, Image compression models, Elements of Information theory, Error-Free compression, Lossy compression, compression standards: JPEG & MPEG. Image Segmentation Detection of Discontinuities, Edge linking and Boundary detection, Thresholding, Region oriented segmentation, use of motion in segmentation.

Unit 5. **7 Hours**

Representation and Description Representation schemes, Boundary descriptors, Regional descriptors, Morphology, Applications of Image Processing in Instrumentation and Control

Reference Books:

1. Digital Image Processing, "R.C.Gonzalez and R.E.Woods", Addison-Wesley Longman,Inc, 1999

2. Digital Image Processing, , "A.K.Jain", PHI

3. Image processing, Analysis and Machine vision, "M.Sonka, V.Hlavac, and R.Boyle", Thomson Asia pvt. Ltd, 1999.

BTIEPE704B	Internet of Things	3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. Students will be explored to the interconnection and integration of the physical world and the cyber space.
2. To provide ability to design and develop IOT devices.

Course Outcomes (COs):

1. Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help of various protocols.
3. Learner will be able to understand IOT concept at data link layer.
4. Learner will be able to apply the concept of mobile networking to the internet connected devices.
5. Learner will be able to measure and schedule the performance of networked devices in IOT.
6. Learner will be able to analyze the challenges involve in developing IOT architecture.

Unit: 1 Introduction to Internet of Things : 7 Hours

Definition & Characteristics, Physical Design of IOT,Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates Domain specific IOTs – Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle IoT and M2M, IoT System Management with NETCONF-YANG

Unit: 2 IOT Platform Design Methodology: 7 Hours

Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information model Specification, Service specification, IOT level Specifications, Functional

View Specifications, Operational View Specification, device and component integration, application development, case study on IOT system for weather monitoring

Unit: 3 Embedded suite for IoT: 7 Hours

Physical device – Arduino / Raspberry Pi Interfaces, Hardware requirement of Arduino / Pi, Connecting remotely to the Arduino /Raspberry Pi , GPIO Basics, Controlling GPIO Outputs Using a Web Interface,– Programming , APIs / Packages, Arduino Interfaces, Integration of Sensors and Actuators with Arduino, Introduction to Python programming – Python data types & data structure, Control flow (if, for, while, range, break/continue, pass), Functions, Modules, packages, file handling, date/time operations, classes, Python packages of interest for IOT

Unit: 4 Connectivity Technologies & Communication Protocols in IOT RFID: 7 Hours

Introduction, Principle of RFID, Components of an RFID system, Wireless Sensor Networks: WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications.

Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4, Zigbee, 6LoWPAN, Bluetooth, WirelessHART

Unit: 5 IOT Physical Server and Cloud Offerings: 7 Hours

Cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, Fog Computing, SDN Cloud Storage Models & Communication APIs, Web Application Messaging Protocol (WAMP), Python web application framework – Django, Developing Application with Django, Developing REST web services, SkyNet IoT Messaging Platform, Case Studies Illustrating IOT Design – Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection,Smart Irrigation, IoT Printer

Reference Books:

1. Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, CRC Press Taylor & Francis Group, International Standard Book Number-13: 978-14987-6128-4
2. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things –Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9 Hakima Chaouchi, ― The Internet of Things Connecting Objects to the Web‖ ISBN : 978-1- 84821140-7, Willy Publications
3. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
4. Daniel Kellmereit, Daniel Obodovski, ―The Silent Intelligence: The Internet of Things‖,. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
5. Fang Zhaho, Leonidas Guibas, ―Wireless Sensor Network: An information processing approach‖, Elsevier, ISBN: 978-81-8147-642-5.
6. Daniel Minoli, ―Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications‖, ISBN: 978-1-118-47347-4, Willy Publications
7. Bernd Scholz-Reiter, Florian Michahelles, ―Architecting the Internet of Things‖, ISBN 78-3

BTIEPE704C	Clinical Instrumentation	3 Credits

Course Education Objectives (CEOs):

Upon completion of this course, student should be able to:

1. the study of different types of electrodes used in bio-potential recording.
2. To understand how to measure various biochemical and nonelectrical parameters of human system

Course Outcomes (COs):

Upon completion of this course, student should be able to

1. Understands structure of human body
2. Understands use of Biomedical Instruments
3. Understands Transducers for biomedical instrumentation
4. To evolve an instrumentation system for diagnosis, therapy, supplementation of body functions.
5. Function in interdisciplinary team to solve engineering impact on human pathology .
6. Serve as engineer in medical field for safety of human being.

Unit: 1 **7 Hours**

Introduction to gross anatomy of human body, major physiological systems, their structure and function. Cell structure, basic cell functions, Origin of bio potentials, electrical activity of cells, Introduction to biomedical instruments, classification and justification.

Unit: 2 **7 Hours**

Transducers for biomedical instrumentation and selection, biomedical electrodes Cardiological systems: Structure of heart, rhythamicity, cardiac cycle, heart sounds, cardiac output, blood pressure measurement, direct, indirect, Spygmomanometer, Digital B.P. Cardio vascular instrumentation: ECG electrodes, & leads, Cinthoven triangle, ECG quantification, PC based ECG analysis.

Unit: 3 **7 Hours**

Pacemakers, Defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, Phonocardio graph, plentysmograph, Artificial Kidney, Blood cell counters.

Unit: 4 **7 Hours**

Central Nervous system: The Brain, Receptors, sensory pathway and motor systems, Evoked potential, Electron rephalogram, EEG analysis, EMG. Mechanics of breathing

O_2/CO_2 transport between lungs and tissue cells, Spirometer, Artificial respiration.

Unit: 5 **7 Hours**

Imaging system: X-ray, CT Scan, Ultrasonography, MRI, Endoscopy.

Electrical safety: Significance of electrical danger, Physiological effects of electrical current, Ground shock hazard, and methods of accident prevention.

Reference Books:

1. Handbook of Biomedical instrumentation, "R S Khandpur", TMH

2. Biomedical instrumentation and measurement, "Cromwell", PHI

3. Introduction to Biomedical instrumentation, "S G Khalekar".

4. Handbook of Biomedical instrumentation, "Webster".

BTIEOE705A	Analytical Instrumentation	3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. To understand principles of instrumental analysis
2. To study the theory and design of analytical instruments
3. To develop problem-solving skills applicable to real-world problems

Course Outcomes (COs):

Students should be able to

1. Summarize and classify capabilities and limitations of analytical instruments.
2. Ability to select and use an analytical instrument in the physical, chemical and biological world and appreciate the role of instrumentation.
3. Familiarize with the advances in analytical instrumentation. Explain Energy management systems

Unit: 1 **7 Hours**

Introduction to classical and instrumental methods for chemical analysis: comparison of these methods, classification of Instrumental methods (spectral, electroanalytical and separative methods) U.V. Visible and spectroscopy: laws of photometry, Beer and Lambert's law, monochromator design and monochromator performance. Colorimeters, single beam and double beam spectrophotometers, dual wavelength and double monochromatic systems, direct reading multichannel spectrophotometers, diode array rapid scanning spectrophotometers, reverse optics technique.

Unit: 2 Security System: **7 Hours**

IR spectroscopy: Instrumentation, sources, detectors, FTIR. Raman Spectrometry; Raman effect, Raman spectrometer components, LASER Raman spectrophotometer.

Flame photometry: Principle, Instrumentation constructional details, fuel gases, atomizer, burner, optical system, Recording system. Interferences in Flame photometry, Applications

Atomic Absorption Spectroscopy(AAS): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems. Interferences in AAS, Applications

Unit: 3 Introduction: **7 Hours**

Nuclear Magnetic Resonance (NMR) spectrometry: Principle ,nuclear spin, nuclear energy levels, resonance condition, NMR absorption spectra, chemical shift, constructional details of NMR spectrometer, sensitivity enhancement techniques, spin decoupler ;Fourier transform NMR Spectroscopy; Electron spin resonance (ESR) spectrometry – principle, constructional details.

Fluorimeters and phosphorimeters; principle, single and double beam filter fluorimeter, ratio fluorimeter, spectrofluorimeter, microprocessor-based instruments, phosphorescence spectrometer.

Unit: 4 Processes: **7 Hours**

Mass spectrometr: basic mass spectrometer components, types, magnetic deflection type, time of flight, radio frequency, double focusing, quadrupole type ,Gas chromatograph mass spectro-meter, y GCMS Sy stems; resolution of mass spectrometer, applications.

Electron and ion spectroscopy: surface spectroscopic techniques, electron spectroscopy for chemical analysis (ESCA), Auger spectroscopy (AES), Secondary ion mass spectrometry (SIMS) and ion scattering Spectroscopy (ISS), densitometer.

Radio chemical instrumentation: Radio chemical methods, radiation detectors – ionization chamber, Geiger Muller counter, proportional counter, Scintillation counter, Semiconductor detectors, pulse height analyzer. X-ray spectrometry: Xray spectrum, instrumentation for X-ray spectrometry, X-ray diffract meters, X-ray absorption meter.

Unit: 5 Control Panel: **7 Hours**

Gas and liquid chromatography: Classification; basic parts of gas chromatograph – carrier gas, sample injection system, chromatographic column, thermal compartment, temperature programming, dual column system, detectors-thermal conductivity, flame ionization, electron capture, Argon ionization detector, recording instruments; introduction to liquid chromatography and its classification, HPLC , Introduction to optical densitometer, Refractometry.

Different types of gas analyzers: oxygen, carbon monoxide, carbon dioxide, Nitrogen analyzer, gas density analyzers. Environment monitoring system.

Reference books:

1. 'Handbook of Analytical instruments', R.S. Khandpur, Tata McGraw-Hill.
2. 'Instrumental methods of Analysis', Willard, Merrit, Eean,CBS Publishers & distributor, New Delhi.
3. 'Instrumental Methods of Chemical Analysis', E.W.Ewing , McGraw-Hill, fifth edition
4. 'Introduction to Instrumental Analysis' Robert D. Braun, McGraw-Hill.
5. 'Instrumental Methods of Chemical Analysis', B.K.Sharma, goyal publications
6. 'Principles of Instrumental Analysis', S.G.Skoog, Thomson.

BTIEOE705B Adaptive Control System 3 Credits

Course Education Objectives (CEOs)
Upon completion of this course, student should be able to:

Applications of adaptive controls are growing in practical and industrial control systems. The objective of this course is to present an overview of theoretical and practical aspects of adaptive control. The theory of adaptive control techniques and related issues are covered in detail.

Course Outcomes (COs):

After completion of subject students will be able to:
1. Design and implement system identification experiments.
2. Use input-output experimental data for identification of mathematical dynamical models.
3. Use system identification methods to design adaptive controllers.
4. Explain the advantages and disadvantages of adaptive control relative to other control approaches.

Unit: 1 Introduction: 7 Hours

Definitions, History of adaptive Control, Essential aspects of adaptive control, Classification of adaptive control system: Feedback adaptive controllers, Feed forward adaptive controllers, Why adaptive control?

Unit: 2 Model Reference Adaptive System: 7 Hours

Different configuration of model reference adaptive systems; classification of MRAS, Mathematical description, and Equivalent representation as a nonlinear time-varying system, direct and indirect MRAS

Unit: 3 Analysis and Design of Model Reference Adaptive Systems: 7 Hours

Model reference control with local parametric optimization (Gradient method), MIT rule, MRAS for a first order system, MRAS based on Lyapunov stability theory, Design of a first order MRAS based on stability theory, Hyper stability approach, Monopoli's augmented error approach

Unit: 4 Self-Tuning Regulators: 7 Hours

Introduction: The basic idea; process models, disturbance models, General linear difference equation models, model simplification, Different approaches to self-tuning, Recursive Parameter Estimation Methods: The RLS method, extended Least squares, Recursive instrumental variable method; U-D factorization, Covariance resulting, variable data forgetting. Estimation accuracy, Direct and Indirect Self-tuning regulators, Clarke and Gawthrop's Self tuning Controller, Pole Placement approach to self-tuning control; Connection between MRAS and STR.

Unit: 5 Gain Scheduling: 7 Hours

Introduction, The Principal, Design of Gain Scheduling Regulators, Nonlinear transformations, Applications of gain scheduling. Alternatives to Adaptive Control, Why not Adaptive Control? Robust High gain feedback control, Variable Structure schemes.

Recommended Books:

1. I. B Landau, Adaptive Control - The Model Reference Approach, New York; Marcel Dekker, 1979
2. K. J. Astrom and B. Wittenmark, Adaptive Control, Addison Wesley Publication Company, 1989.
3. B. Roffel, P. J. Vermeer, P. A. Chin, Simulation and Implementation of self-Tuning Controllers, Prentice-Hall, Englewood cliffs, NJ, 1989.
4. R. Isermann, K. Lashmann and D. Marko, Adaptive Control Systems, Printice-Hall International (UK) Ltd. 1992.
5. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems

BTIEOE705C Automobile Instrumentation 3 Credits

Course Education Objectives (CEOs):

Upon completion of this course, student should be able to:

1. Know the fundamentals of automotive electronics
2. Understand automotive control systems
3. Know basics of safety factors in automobile.

Course Outcomes (COs):

1. Ability to understand electronic control unit.
2. Acquire knowledge of various automotive standards and Protocols.
3. Design aspects of measurement and control strategies in automotive application

Unit: 1 Fundamentals of Automotive Electronics: 7 Hours

Open loop and closed loop systems, Components for electronic engine management, vehicle motion control, Current trends in modern Automobiles

Unit: 2 Electronic Fuel Injection and ignition systems: 7 Hours

Introduction, throttle body ignition and multi-port or point fuel injection, Advantages of electronic ignition system, Types of solid state ignition systems and their principle of operation, electronic spark timing control system,

Unit: 3 Engine control system: 7 Hours

Engine cranking and warm up control, Acceleration enrichment –Deceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, Engine performance testing

Unit: 4 Automobile chassis electronic control system: 7 Hours

Principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, ABS, ASR, ESP, and other electronic control method

Unit: 5 Auto Body Electronic Control Technology: 7 Hours

Automotive central locking and anti-theft system control technology, electronically controlled windows and doors and airbag technology, principle of control circuit components and characteristics, Ergonomics and safety: Driver information system, lighting system components, battery monitoring and control, Air conditioning, steering control techniques, Automatic gear control systems, Emission standards.

Recommended books:

1. William B. Riddens, ―Understanding Automotive Electronics‖, 5th Edition, (Butterworth Heinemann Woburn), (1998).
2. Tom Weather Jr and Cland C. Hunter, ―Automotive Computers and Control System‖,Prentice Hall Inc. ,New Jeresy.
3. Jiri Marek, Hans Peter trah, ―Sensers Applications, Sensers for Automotive Technology‖ 1st Edition , Wiley
4. T. Mellard, Automotive Electronic Systems‖1987 by Heinenmann Professional

BTIEL706 Process Instrumentation and Control Lab 1 Credit

List of Experiments:

1 Study of the time constant of single capacity / Multi-capacity process by graphical methods.

2 Study of interacting and non-interacting process.

3 Study the analysis of flow controller control loop.

4 Study the analysis of Pressure control system

5 Study of Temperature control using PID

6 Study of Level control using PID

7 Study of Cascade control system

8 Study of ratio control loop.

9 Study of Split range control

BTIEL707 Instrumentation System Design Lab 1 Credit

List of Experiments:

1. Design of signal conditioning for displacement measurement transducer..

2. Design of signal conditioning RTD (Pt-100)

3. Design of signal conditioning for thermocouple

4. Study and Calibration of I/P & P/I converter

5. Study of D.P. Transmitter and its application for flow

6. Study of D.P. Transmitter and its application for level

7. Study of smart transmitter

8. Design of signal conditioning for strain gauge.

9. Study of Enclosure design for circuit and instrument.

BTIEL708A Image Processing Lab 1 Credit

List of Experiments:

1. Study of IP Toolbox in Matlab
2. Perform Arithmetic & Logical operations on Image
3. To study application of Histogram Equalization for image contrast improvement
4. To study application of Edge detection in IP for image identification
5. Application of FFT to perform operations on image like Convolution, Translation.
6. Application of FFT to perform operations on image like Rotation.
7. To Study application of Transform, Filtering by applying LPF & Mask for smooth imaging.
8. To Study application of Transform, Filtering by applying HPF & Mask for Image shaping

BTIEL708B Internet of Things Lab 1 Credit

List of Experiments:

1. Study of Raspberry-Pi, Beagle board, Arduino and other micro controller.
2. Study of different operating systems for Raspberry-Pi. Understanding the process of OS installation on Raspberry-Pi.
3. Study of Connectivity and configuration of Raspberry-Pi circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.
4. Understanding the connectivity of Raspberry-Pi circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs.
5. Understanding the connectivity of Raspberry-Pi circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
6. Understanding and connectivity of Raspberry-Pi with camera. Write an application to capture and store the image.
7. Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi.
8. Write an application using Raspberry-Pi to control the operation of a hardware simulated traffic signal.
9. Write an application using Raspberry-Pi to control the operation of a hardware simulated lift elevator.

BTIEL708C Clinical Instrumentation Lab 1 Credit

List of Experiments:

1. Study of different biomedical transducers.
2. Study of cardiovascular systems
3. Study of ECG machine
4. Study of EEG simulator.
5. Study of EMG simulator.
6. Study of blood sugar meter.
7. Measurement of heartbeats using heart beat monitor.
8. Measurement of lung capacity using spirometer.
9. Demonstration of defibrillator.
10. Measurement of blood pressure by indirect method.
11. Electrical safety measures in hospitals.

BTIES709 Seminar 1 Credit

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Instrumentation Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTIEP710 Project Stage I 3 Credits

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarize the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project may be industry-based.

BTIEF711 Industrial Training / Internship 1 Credit

Students are expected to undergo industrial training for at least four weeks at factory / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / industry expert. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of industrial training shall be submitted. Evaluation shall be based on report and power point presentation.

BTIEPE801A Control Engineering 3 Credits

Prof. Ramkrishna Pasumarthy **Department of Electrical Engineering** **IIT Madras**

Course Duration: 12 week

Course Outline:

This course shall introduce the fundamentals of modeling and control of linear time invariant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems. The 11th module of the course will cover a detailed application of filter design in the field of navigation and human movement (gait). Students will be able to design their very own basic navigational system using inertial sensors and microcontrollers.

Course Plan:

Week 1: Mathematical Modelling of Systems
Week 2: Laplace Transforms, transfer functions, block diagram representation.
Week 3: Block diagram reduction, Time response characteristics.
Week 4: Introduction to stability, Routh Hurwitz stability criterion.
Week 5: Root locus plots, stability margins.
Week 6: Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain.
Week 7: Basics of control design, the proportional, derivative and integral actions.
Week 8: Design using Root Locus
Week 9: Design using Bode plots
Week 10: Effects of zeros, minimum and non-minimum phase systems.
Week 11: State space analysis
Week 12: Design using State space

BTIEPE801B The Joy of Computing using Python 3 Credits

Prof. Sudarshan Iyengar and Prof. Yayati Gupta IIT Ropar

Course Duration: 12 week

Course Outline:
A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

Course Plan:
- Motivation for Computing
- Welcome to Programming
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTIEPE801C Biomedical Signal Processing 3 Credits

Prof. Sudipta Mukhopadhyay Department of Electronics & Comm. Engg IIT Kharagpur

Course Duration: 12 week

Course Outline:

This course is prepared for the engineering students in their final year of undergraduate studies or in their graduate studies. Electrical Engineering students with a good background in Signals and Systems are prepared to take this course. Students in other engineering disciplines, or in computer science, mathematics, geo physics or physics should also be able to follow this course. While a course in Digital Signal Processing would be useful, it is not necessary for a capable student. The course has followed problem solving approach as engineers are known as problem solvers. The entire course is presented in the form of series of problems and solutions.

Course Plan:

Week 1: Preliminaries; Biomedical signal origin & dynamics (ECG)
Week 2: Biomedical signal origin & dynamics (EEG, EMG etc.)
Week 3: Filtering for Removal of artifacts Statistical Preliminaries; Time domain Filtering (Synchronized Averaging, Moving Average)
Week 4: Filtering for Removal of artifacts contd. Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter)
Week 5: Filtering for Removal of artifacts contd. Optimal Filtering: The Weiner Filter
Week 6: Filtering for Removal of artifacts contd. Adaptive Filtering Selecting Appropriate Filter
Week 7: Event Detection Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection
Week 8: Event Detection contd. Dicrotic Notch Detection Correlation Analysis of EEG Signal
Week 9: Waveform Analysis Illustrations of problem with case studies Morphological Analysis of ECG Correlation coefficient The Minimum phase correspondent and Signal Length
Week 10: Waveform Analysis contd. Envelop Extraction Amplitude demodulation The Envelogram Analysis of activity Root Mean Square value Zero-crossing rate Turns Count, Form factor
Week 11: Frequency-domain Analysis Periodogram
Week 12: Frequency-domain Analysis Averaged Periodogram Blackman-Tukey Spectral Estimator Daniellâ€™s Spectral Estimator Measures derived from PSD.

BTIEPE802A **Industrial Automation and Control** **3 Credits**

Prof. Siddhartha Mukhopadhyay **Electrical Engineering** **IIT Kharagpur**

Course Duration: 12 week

Course Outline:

This course provides an overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course, in 40 lectures, discusses a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC Machines. A student of IIT Kharagpur once commented - ? because of the course I can identify and relate to much of the equipment that I see in a factory?.

Course Plan:

I. Introduction
Architecture of Industrial Automation Systems

II. Measurement Systems Characteristics
Data Acquisition Systems

III. Introduction to Automatic Control
P-I-D Control
PID Control Tuning
Feed forward Control Ratio Control
Time Delay Systems and Inverse Response Systems
Special Control Structures
Concluding Lesson on Process Control (Self-study)
Introduction to Sequence Control, PLC, RLL
Sequence Control. Scan Cycle, Simple RLL Programs
Sequence Control. More RLL Elements, RLL Syntax
A Structured Design Approach to Sequence Control
PLC Hardware Environment

IV. Flow Control Valves
Hydraulic Control Systems - I
Hydraulic Control Systems - II
Industrial Hydraulic Circuit
Pneumatic Control Systems - I
Pneumatic Systems – II
Energy Savings with Variable Speed Drives
Introduction To CNC Machines

V. The Field bus Network - I
Higher Level Automation Systems
Course Review and Conclusion (Self-study)

BTIEPE802B	Sensors and Actuators	3 Credits

Prof. Hardik Jeetendra Pandya **Electronics Systems Engineering** **IISc Bangalore**

Course Duration: 12 week

Course Outline:
This course is designed with an aim of educating students in microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also able to understand how to fabricate some of those sensors. Students will have an exposure towards how to fabricate the sensors and its application in real world. The students will provide an understanding on modern day microsensors and micro actuators. The students will have an idea about how to simulate some of those sensors and characterise before fabricating it. Below are some of the course objectives. The first objective of this course is to understand basics of sensors, actuators and their operating principle. The second objective is to educate the students on different types of microfabrication techniques for designing and developing sensors (Several applications from Electronics to Biomedical will be covered). The third objective is to explain working of various types of electrochemical sensors and actuators. Fourth objective is to provide information about interfacing of sensors and signal conditioning circuits to establish any control system or monitoring system. Fifth objective is to provide knowledge about simulation and characterization of different sensors. The final objective is to provide an understanding on characteristic parameters to evaluate sensor performance

Course Plan:

Week 1: Basics of Energy Transformation: Transducers, Sensors and Actuators
Week 2: Understanding of thin film physics: Application in MOSFET and its variants
Week 3: Thin Film Deposition Techniques: Chemical Vapor Deposition (APCVD, LPCVD, UHVCVD, PECVD, ALCVD, HPCVD, MOCVD)
Week 4: Thin Film Deposition Techniques: Physical Vapor Deposition (Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition)
Week 5: Basic understanding of Photolithography for pattering layer. Detailed overview of Etching methods.
Week 6: Understanding various gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured ba sed gas sensors
Week 7: Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications
Week 8: Explain working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications
Week 9: Understanding basics of microfluidics to assist Photomask design using Clewin Software, pattern transfer techniques, PDMS moulding and degassing, device bonding techniques.
Week 10: Simulation, Optimization and characterization of various sensors using COMSOL Multiphysics
Week 11: Understanding of Sensor Interfacing with Microprocessor to build electronic system
Week 12: Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor based electronics systems.

BTIEPE802C	Fuzzy Sets, Logic, Systems & Applications	3 Credits

Prof. Nischal K. Verma **Electrical Engineering** **IIT Kanpur**

Course Duration: 12 week

Course Outline:
The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Plan:

Week 1: Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10: Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning

BTIEPE802D	Optical Engineering	3 Credits

Prof. Shanti Bhattacharya **Electrical and Electronics Engineering** **IIT Madras**

Course Duration: 12 week

Course Outline:

Optics is used in many applications today. In fact, the field of optics has quietly gone from the research table to being used in numerous applications ranging from devices to metrology. Opto-electronics and metrology are already well-developed fields merging the areas of optics and a variety of other engineering areas (such as electronics, mechanical engineering, etc) in many advanced and commonly used devices. For an engineering student to be able to understand and design optics for such applications, it is important to understand some basic optics. This course will introduce these concepts at a level relevant for an engineer. The course will also study specific engineering examples with a detailed look at the optics of these.

Course Plan:

Week 1: Introduction to Optical Engineering Postulates of Geometric Optics, Geometric Optics and Imaging, Refraction at a single surface

Week 2: Thin lens, Lens imaging conditions, Aperture stop, pupils, important rays

Week 3: Ray tracing using matrix method, Thick lenses, principal planes

Week 4: Monochromatic Aberrations, means of quantifying aberrations

Week 5: Chromatic Aberrations, correcting aberrations

Week 6: Gaussian beams, transmittance of an optical element

Week 7: Gaussian beam transformation through a lens

Week 8: Basics of Interference

Week 9: Applications of Interference, holography

Week 10: Basics of diffraction

Week 11: Applications - Barcode readers, Finger print sensors, Pick-up heads used in DVD/CD players, Biomedical instrumentation, Interferometers for metrology (Optical coherence tomography), Sensors

Week 12: Applications contd.

BTIEP803 Project Stage II 15 Credit

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Mechanical Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate

the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO 1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO 2	Graduates should excel in best post-graduate engineering institutes, acquiring advanced degrees in engineering and related disciplines.
PEO 3	Alumni should establish a successful career in an engineering-related field and adapt to changing technologies.
PEO 4	Graduates are expected to continue personal development through professional study and self-learning.
PEO 5	Graduates should be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

At the end of the program the student will be able to:

PO 1	Apply the knowledge of mathematics, basic sciences, and mechanical engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex mechanical engineering problems reaching substantiated conclusions.
PO 3	Design solutions for complex engineering problems and design mechanical system components that meet the specified needs.
PO 4	Use mechanical engineering research-based knowledge related to interpretation of data and provide valid conclusions.
PO 5	Create, select, and apply modern mechanical engineering and IT tools to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning acquired by the mechanical engineering knowledge to assess societal and safety issues.
PO 7	Understand the impact of engineering solutions on the environment, and demonstrate the knowledge for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO 11	Understand the engineering and management principles and apply these to the multidisciplinary environments.
PO 12	Recognize the need for life-long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

PSO 1	Make the students employable in engineering industries.
PSO 2	Motivate the students for higher studies and research.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam

B. Tech. Mechanical Engineering

Course Structure for Semester VII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTMEC701	PCC 29	Mechatronics	2	1	--	20	20	60	100	3
BTMEC702	PCC 30	CAD/CAM	2	1	--	20	20	60	100	3
BTMEC703	PCC 31	Manufacturing Processes - III	2	1	--	20	20	60	100	3
BTMEC704A	PEC 2	Fluid Machinery	2	1	--	20	20	60	100	3
BTMEC704B		Industrial Engineering and Management								
BTMEC704C		Finite Element Method								
BTMEC704D		Surface Engineering								
BTMEC704E		Refrigeration and Air Conditioning								
BTAMC704C		Automobile Design (Product Design, PLM, CAE, Catia)								
BTMEC705A	OEC 5	Engineering Economics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTMEC705B		Intellectual Property Rights								
BTMEC705C		Wind Energy								
BTMEC705D		Knowledge Management								
BTMEL706	PCC 32	Manufacturing Processes Lab - II	--	--	2	30	--	20	50	1
BTMEL707	PCC 33	Mechatronics Lab	--	--	2	30	--	20	50	1
BTMEL708	PCC 34	CAD/CAM Lab	--	--	2	30	--	20	50	1
BTMES709	Project 4	Seminar	--	--	2	30	--	20	50	1
BTMEF710	Project 5	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1
BTMEP711	Project 6	Project Stage-I**	--	--	6	30	--	20	50	3
		Total	11	4	14	230	80	390	700	20

***In case of students opting for Internship in the eighth semester, the Project must be industry-based.*

B. Tech. Mechanical Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
Choose any two subjects from ANNEXURE-A#			-	-	--	20	20	60	100	3
			-	-	--	20	20	60	100	3
BTMEP803	Project 7	Project Stage-II or Internship and Project*	--	--	30	50	--	100	150	15
		Total	--	--	30	90	40	220	350	21

** Six months of Internship in the industry*

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

 # Students doing project in the Institute will have to appear for CA/MSE/ESE

ANNEXURE-A#

Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	BTMEC801A	Fundamentals of Automotive Systems	12 Weeks	IITM	Prof. C. S. Shankar Ram
2	BTMEC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTMEC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTMEC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S
5	BTMEC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan

6	BTMEC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

Semester - VII

Mechatronics

BTMEC701	PCC 29	Mechatronics	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define sensor, transducer and understand the applications of different sensors and transducers
CO2	Explain the signal conditioning and data representation techniques
CO3	Design pneumatic and hydraulic circuits for a given application
CO4	Write a PLC program using Ladder logic for a given application
CO5	Understand applications of microprocessor and micro controller
CO6	Analyse PI, PD and PID controllers for a given application

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1
CO2	3	2			3	3	2				1	3
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			
CO5	3			1	3	2	3					2
CO6		3	3		3	3	1	1	3			2

Course Contents:

Unit 1: Introduction

Introduction to Mechatronic systems, elements, advantages; practical examples of Mechatronic systems.

Sensors and Transducers: Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2: Signal Conditioning and Data Representation
Types of electronic signals, Need for signal processing, Operational amplifiers: Types, classification and applications, Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electro-magnetic Relays.
Data representation systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3: Drives
Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.
Pneumatics and Hydraulics: Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods.
Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4: Microprocessor and Microcontroller
8085 microprocessor: architecture, various types of registers and their functions in 8085µP, Instruction sets, interfacing, applications. 8081 microcontroller: architecture, Instruction sets, various pins and their functions interfacing, applications.
Programmable Logic Controller: Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection of PLCs, Programming: Ladder logic and FBD

Unit 5: Control Systems
Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using Spring, Dashpot and Mass equivalence.

Unit 6: Stability of Systems
On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts:

1. HMT Limited, “Mechatronics”, Tata McGraw Hill Publications, 1998.
2. W. Bolton, “Mechatronics; Electronic Control System in Mechanical Engineering”, Pearson Education Asia, 1999.
3. Raven, “Automatic Control Engineering”, Tata McGraw Hill Publications, New York, 1986.

References:

1. R. K. Rajput, “A textbook of Mechatronics”, S. Chand and Co., 2007.
2. Michael B. Histand, David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, Tata McGraw Hill International Editions, 2000.
3. D. A. Bradley, D. Dawson, N. C. Buru, A. J. Loader, “Mechatronics”, Chapman and Hall, 1993

CAD/CAM

BTMEC702	PCC 30	CAD/CAM	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	List and describe the various input and output devices for a CAD work station
CO2	Carry out/calculate the 2-D and 3-D transformation positions (Solve problems on 2-Dand 3-D transformations)
CO3	Describe various CAD modeling techniques with their relative advantages and limitations
CO4	Describe various CAD modeling techniques with their relative advantages and limitations
CO5	Develop NC part program for the given component, and robotic tasks
CO6	Describe the basic Finite Element procedure
CO7	Explain various components of a typical FMS system, Robotics, and CIM
CO8	Classify parts in part families for GT
CO9	Describe and differentiate the CAPP systems

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											1
CO2	3	2	1		2							1
CO3	1		1									1
CO4	3											1
CO5	1	3	3		1							1
CO6	3	1	1		1							1
CO7	3											1
CO8	3	1	2	3	1							1
CO9	2	1										1

Course Contents:

Unit 1: Computer Aided Design (CAD)

Hardware required for CAD: Interactive input output devices, Graphics software: general requirements and ground rules, 2-D curves like Line, Circle, etc. and their algorithms, 2-D and 3-D transformations such as Translation, Scaling, Rotation and Mirror

Unit 2: Bezier and B-splines Curves

Equations and Applications, window and view port clipping algorithms, 3-D geometries, CSG, B-rep, wireframe, surface and solid modeling and their relative advantages, limitations and applications.

Unit 3: Computer Aided Manufacturing (CAM)
Numerical Control, Elements of a NC system, Steps in NC based manufacturing, Point to point, straight line and contouring control, Manual and Computer Assisted Part Programming, NC and APT programming, Adaptive control, Distributed Numerical Control.

Unit 4: Finite Element Methods
Introduction, Types of elements, Degrees of freedom, Field variable, Shape function, Boundary conditions, Meshing, Nodal displacements, Plain stress and plain strain problems, 1-D, 2-D and 3-D problems, Static, dynamic and thermal analysis, Preprocessors – solvers – postprocessor.

Unit 5: Flexible Manufacturing System
Introduction, Components of FMS, Group Technology, Part classification and families, Composite part, Types of FMS layouts, Advantages of FMS
Robotics: Robot configurations, Drives for robots, Sensors used in robotics, Programming technique, Programming languages, Applications, Latest development in robotics

Unit 6: Computer Aided Process Planning
Introduction, Retrieval and Generative CAPP systems, generation of Machining Data.
Computer Integrated Manufacturing: Introduction, Types of data, Types of interfaces, Computer network structures, Computerized production management systems, Inventory management, MRP, Operation scheduling, Process monitoring, Computer aided quality control, Testing/Inspection methods.

Texts:

1. Ibrahim Zeid, “CAD/CAM Theory and Practice”, Tata McGraw Hill Publication,
2. M. P. Grover, Zimmer, “CAD/CAM/CIM”, Prentice Hall India.

Manufacturing Processes - III

BTMEC703	PCC 31	Manufacturing Processes - III	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Differentiate clearly between NC and CNC machines
CO2	Prepare and execute a part program for producing a given product
CO3	Select appropriate non-traditional machining process for a given application
CO4	Compare different surface coating techniques
CO5	Explain different rapid prototyping techniques
CO6	Illustrate the working principle of various micro-manufacturing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1									
CO2	1	1			1							
CO3	2	2	2									
CO4	2	2	1			1	1					1
CO5	1	1	1			1	1					
CO6	1	1	1			1						

Course Contents:

Unit 1: Introduction to CNC System
Numerical Control, CNC, Classification of NC/CNC systems, Basic components of CNC system: Design considerations, structure, Antifriction LM guideways, spindles, ballscrews; CNC Drives and controls: DC motors, AC motors, Stepper motors, Feedback devices: Encoders, tachometers; Servo motors, Linear motors

Unit 2: CNC Tooling and Programming
CNC Tooling, Tool and work holding devices, Automatic Tool Changers, Automatic Pallet Changers. Part programming: Introduction, Part Program and its elements, Methods of Programming: Manual and Computer Assisted Part programming, APT language.

Unit 3: Advanced Machining Processes
Introduction; Chemical Machining; Electrochemical Machining: Pulsed, Electrochemical Machining; Electrochemical Grinding; Electrical-discharge Machining: Wire EDM, Electrical-discharge Grinding; Laser-beam Machining; Electron-beam Machining; Water-jet Machining; Abrasive-jet Machining; Hybrid Machining Systems

Unit 4: Surface Treatments and Coatings

Introduction; Mechanical Surface Treatments; Mechanical Plating and Cladding; Thermal Spraying, Vapour Deposition: Physical Vapor Deposition, Chemical Vapor Deposition; Ion Implantation and Diffusion Coating; Laser Treatments; Electroplating, Electroless Plating, and Electroforming; Conversion Coatings, Hot Dipping, Porcelain Enamelling: Ceramic and organic coatings; Diamond Coating and Diamond like Carbon; Surface Texturing

Unit 5: Rapid Prototyping

Introduction; subtractive processes; additive processes: Fused-deposition Modeling, Stereolithography, Multijet/Polyjet Modeling, Selective Laser Sintering, Electron-beam Melting, Three-dimensional Printing, Laminated-object Manufacturing, Solid-ground Curing, Laser-engineered Net Shaping; virtual prototyping; direct manufacturing and rapid tooling

Unit 6: Micromanufacturing Technology

Introduction to fabrication of MEMS, micromachining of MEMS devices: Bulk Micromachining, Surface Micromachining; LIGA microfabrication process; Solid free-form fabrication of devices; Nanoscale manufacturing.

Texts:

1. HMT Ltd, “Mechatronics”, Tata McGraw Hill Publications, New Delhi, 1998.
2. Serope Kalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology”, Addison Wesley Longman (Singapore) Pte. India Ltd., 6thedition, 2009

References:

1. James Madison, “CNC Machining Handbook”, Industrial Press Inc., 1996.
2. Gibbs and Crandell, CNC Machining and Programming: An Introduction, Industrial Press Inc, 2003.
3. Gary F. Benedict, “Non Traditional Manufacturing Processes”, Marcel Dekker, 1987.

Fluid Machinery

BTMEC704A	PEC 2	Fluid Machinery	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand and apply momentum equation
CO2	Understand and explain Hydrodynamic Machines
CO3	Explain difference between impulse and reaction turbines
CO4	Find efficiencies, draw velocity triangles
CO5	Explain governing mechanisms for hydraulic turbines
CO6	Explain working of various types of pumps, draw velocity diagrams, do simple calculations
CO7	Design simple pumping systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3		3				2					1
CO3	3	2										1
CO4	3	3	2									1
CO5			3									1
CO6	3	3	3	1	1							1
CO7	3	3		3								1

Course Contents:

Unit 1: Momentum Equation and its Applications
Impulse momentum, Principle, Fixed and moving flat inclined plates, Curved vanes, Series of plates and vanes, Velocity triangle and their analysis, Water wheels. Hydrodynamic Machines: Classification, General theory, Centrifugal head, Fundamental equations, and Euler's equation, Degree of reaction, Head on machine, various efficiencies, Condition for maximum hydraulic efficiency.

Unit 2: Impulse Turbines
Impulse principle, Construction of Pelton wheel, Velocity diagrams and its analysis, Number of buckets, Jets, Speed ratio, Jet ratio.
Reaction Turbines: Constructional details of Francis, Kaplan and Propeller turbine, Deciaz turbine, and Draft tube types, Efficiencies, Cavitation.

Unit 3: Governing of Turbines
Methods of governing, Performance characteristics, Safety devices, Selection of turbines, Unit quantities, Specific speed, Principles of similarity and model testing.

Unit 4: Centrifugal Pump
Construction, Classification, Terminology related to pumps, Velocity triangle and their analysis, Cavitation, NPSH, Thoma’s cavitation factor, Priming, Methods of priming, Specific speed, Performance characteristics, Actual thrust and its compensation, Troubleshooting.
Multistage Pumps: Pump H-Q characteristics and system H-Q Characteristics, Series and parallel operation of pumps, Systems in series and parallel, Principle of model testing and similarity.

Unit 5: Special Purpose Pumps
Chemical pumps, nuclear pumps, Sewage pumps, Submersible deep well pumps, Pump installation, Energy efficient pumps.
Failure of Pumping System: Pump failures, Remedies, Source failure, Causes and remedies, Trouble shooting.

Unit 6: Design of Pumping System
Principles of line layout, Estimation of pressure drops across pipes, Fittings, etc.
Miscellaneous Pumps: Reciprocating pump, Gear pump, Vane pump, Lobe pump, etc., Application field (no mathematical treatment).

Texts:

1. P. N. Modi, S. M. Seth, “Hydraulics and Fluid Mechanics including Hydraulic Machines”, Standard Book House, Rajsons Publications Pvt. Ltd., 20th edition.
2. R. K. Bansal, “A Text Book of Fluid Mechanics and Hydraulic Machines”, Lakshmi Publications Pvt. Ltd., 9th edition.

References:

1. Yunus A. Çengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications”, McGraw Hill, 3rd edition, 2014.

Industrial Engineering and Management

BTMEC704B	PEC 2	Industrial Engineering and Management	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering
CO2	Produce ability to adopt a system approach to design, develop, implement and innovate integrated systems that include people, materials, information, equipment and energy.
CO3	Understand the interactions between engineering, businesses, technological and environmental spheres in the modern society.
CO4	Understand their role as engineers and their impact to society at the national and global context.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											2	1
CO2									2	2	2	
CO3								2				
CO4								2				2

Course Contents:

Unit 1: Introduction
Managing and managers, management- science, theory and practice, functions of management, evolution of management theory, contributions of Taylor, Fayol and others.
Planning: The nature and purpose of planning, objectives, strategies, policies and planning premises, decision making.
Organizing: The nature and purpose of organizing, departmentation, Line/ staff authority and decentralization, effective organizing and organizational culture.

Unit 2: Human Resource Management
Staffing: Human resource management and selection, orientation, apprentice training and Apprentice Act (1961), performance appraisal and career strategy, job evolution and merit rating, incentive schemes.

Leading: Managing and human factor, motivation, leadership, morale, team building, and communication.
Controlling: The system and process of controlling control techniques, overall and preventive control.

Unit 3: Production/Operations Management
Operations management in corporate profitability and competitiveness, types and characteristics of manufacturing systems, types and characteristics of services systems.
Operations planning and Control: Forecasting for operations, materials requirement planning, operations scheduling.

Unit 4: Design of Operational Systems
Product/process design and technological choice, capacity planning, plant location, facilities layout, assembly line balancing, and perspectives on operations systems of the future.

Unit 5: Introduction to Industrial Engineering
Scope and functions, history, contributions of Taylor, Gibreth, Gantt and others.
Work Study and Method Study: Charting techniques, workplace design, motion economy principles.
Work Measurement: Stopwatch time study, micro motion study, predetermined time system (PTS), work sampling.

Unit 6: Ergonomics
Basic principles of ergonomics
Concurrent Engineering: Producibility, manufacturability, productivity improvement.
Total Quality Management: Just in time (JIT), total quality control, quality circles, six sigma.

Texts:

1. H. Koontz, H. Weirich, "Essentials of Management", Tata McGraw Hill book Co., Singapore, International Edition, 5th edition, 1990.
2. E. S. Buffa, R. K. Sarin, "Modern Production/Operations Management", John Wiley and Sons, New York, International Edition, 8th edition, 1987.
3. P. E. Hicks, "Industrial Engineering and Management: A New Perspective", Tata McGraw Hill Book Co., Singapore, International Edition, 2nd edition, 1994.

References:

1. J. L. Riggs, "Production Systems: Planning, Analysis and Control", John Wiley & Sons, New York, International Edition, 4th edition, 1987.
2. H. T. Amrine, J. A. Ritchey, C. L. Moodie, J. F. Kmec, "Manufacturing Organization and Management", Pearson Education, 6th edition, 2004.
3. International Labour Organization (ILO), "Introduction to Work Study", International Labour Office, Geneva, 3rd edition, 1987.

Finite Element Method

BTMEC704C	PEC 2	Finite Element Method	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural , thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two and three dimensional problems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				1		1	1
CO2	2	3	2	1	2	1		1			2	1
CO3	3	2	2	1	1				1		2	1
CO4	3	3	2	1	2		1		1		2	1
CO5	3	1	1		1		1				2	1
CO6	1	1	1						1		1	1

Course Contents:

Unit 1: Introduction
Finite element analysis and its need, Advantages and limitations of finite element analysis (FEA), FEA procedure.

Unit 2: Elements of Elasticity
Stress at a point, Stress equation of equilibrium, 2-D state of stress, Strains and displacements, Stress-strain relationship for 2-D state of stress, Plane stress and plane strain approach.

Unit 3: Relevant Matrix Algebra
Addition, subtraction and multiplication of matrices, Differentiation and integration of matrices, Inverse of a matrix, Eigen values and eigen vectors, Positive definite matrix, Gauss elimination.

Unit 4: One-Dimensional Problems
Introduction, FE modeling, Bar element, Shape functions, Potential energy approach, Global

stiffness matrix, Boundary conditions and their treatments, Examples.

Unit 5: Trusses and Frames
Introduction, Plane trusses, Element stiffness matrix, Stress calculations, Plane frames, examples.

Unit 6: Two-dimensional Problems
Introduction and scope of 2-D FEA, FE modeling of 2-D problem, Constant strain triangle, other finite elements (no mathematical treatment included), Boundary conditions.

Texts:

1. T. R. Chandrupatla, A.D. Belegundu, " Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.
2. P. Seshu, "A Textbook of Finite Element Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc.

References:

1. K. J. Bathe, "Finite Element Procedures", Prentice Hall of India Pvt. Ltd., 2006.

Surface Engineering

BTMEC704D	PEC 2	Surface Engineering	2-1-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Learn the importance and need of surface engineering
CO2	Describe various surface cleaning and modification techniques
CO3	Understand the concepts of surface integrity
CO4	Compare various surface coating technologies
CO5	Select appropriate method of coating for a given application
CO6	Apply measurement techniques and carry out characterization of coated surfaces.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1							1		1
CO2	2				2							
CO3	2	2	1	2						1		
CO4	2				1	1		1		1		
CO5	2	2	1		1		1	1	1	1	1	
CO6	2	2	1	2	2			1	1	1		

Course Contents:

Unit 1: Introduction
Definition, Significance, Role of surface Engineering in creating high performance product, Functional characteristics of a surface, Nature of surfaces: Deformed layer, Beilby layer, chemically reacted layer, Physisorbed layer, Chemisorbed layer; Classification of Surface Engineering Techniques.

Unit 2: Surface Preparation Techniques
Factors affecting selection of cleaning process, Significance of surface preparation, Classification of cleaning processes, Chemical cleaning processes; Mechanical Processes; Substrate considerations, Surface contaminants or soils, Tests for cleanliness.

Unit 3: Surface Integrity
Definition, Importance, Surface alterations, Factors in Surface Integrity: Visual, Dimensional, Residual stress, Tribological, Metallurgical; Measuring Surface Integrity effects: Minimum and Standard data set, Macroscopic and microscopic examination.

Unit 4: Surface Modification Techniques
Classification, Thermal treatments: Laser and electron beam hardening, Mechanical treatments: Short peening: Peening action, surface coverage and peening intensity, Types and sizes of media, Control of process variables, equipment;
Ion Implantation: Basic Principle, Advantages and disadvantages, equipment.

Unit 5: Surface Coating Techniques
Thermal Spraying: Types and applications; Chemical Vapour Deposition: Principles, Reactions, Types and applications; Physical Vapour Deposition: Basic principle, Evaporation, Sputtering, Ion Plating, Applications; Electroplating: Principle of working and applications; Types of Coatings: Hard, Soft, Single layer, Multi-layer.

Unit 6: Characterization of Coatings
Physical characteristics and their measurements: Coating thickness, Surface Morphology and Microstructure. Mechanical properties and their Measurements: Hardness, Adhesion, Friction and Wear.

References:

1. ASM Handbook, "Volume 5: Surface Engineering", ASM International.
2. K. G. Budinski, "Surface Engineering for Wear Resistance", Prentice Hall.
3. T. Burakowski, T. Wierschon, "Surface Engineering of Metals: Principles, Equipment, Technologies", CRC Press.
4. B. Bhushan, B. K. Gupta, "Handbook of Tribology: Materials, Coatings, and Surface Treatments", Tata McGraw Hill Publications.
5. ASM Handbook, "Volume 16: Machining", ASM International.

Refrigeration and Air Conditioning

BTMEC704E	PEC 2	Refrigeration and Air Conditioning	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Unit 1: Introduction
History, Fundamentals of refrigeration, Unit, Applications, Methods of producing cooling, Refrigeration systems, Thermodynamics of refrigeration, Primary and secondary refrigeration, Heat Pump

Unit 2: Vapour Compression System

Thermodynamics analysis, theoretical and actual cycle, Use of P-h and T-s diagram for problem solving, COP, Effect of evaporator and condenser temperature on cycle performance, Effects of suction superheating
Liquid sub-cooling, liquid-vapour heat exchanger, estimation of compressor displacement, COP and power requirement, waste heat recover opportunities

Unit 3:
Compound Vapour Compression System: Multi-evaporator, multi-compressor systems, cascade system (no mathematical treatment)
Vapour Absorption System: Aqua-ammonia system, lithium bromide-water system, Electrolux refrigerator, comparison with vapour compression cycle (descriptive treatment only), P-T-ξ chart, thermodynamic analysis, and capacity control, solar refrigeration system

Unit 4:
Refrigerant for Vapour Compression System: Desirable Properties, Selection, Zeotrops and Azeotropes, Necessity for replacement of CFC refrigerants, natural refrigerants
Air Conditioning: Psychrometry, properties of moist air, psychrometric charts.
Thermal comfort: Heat transfer from human body by sensible and latent heat transfer, metabolic heat generation, steady state model for heat transfer, effect of clothing and definition of effective temperatures, comfort conditions, human comfort, comfort chart.

Unit 5: Air Conditioning Process Calculation
Sensible and latent heat loads, SHF, GSHF, RSHF, outside conditions, indoor conditions, estimation of coil capacity required, bypass factor, evaporative cooling

Unit 6: Distribution of Air
Principle of air distribution, duct design methods, friction chart, duct materials, methods of noise control
All air system, all water system, unitary systems; window air-conditioner, split air-conditioners, refrigeration and air-conditioning controls.

Texts:

1. Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw Hills, New Delhi, Second Edition, 2000.
2. Stoeker, W.F. and Jones, J.P., Principles of Refrigeration and Air Conditioning,

McGraw Hill, New York, Second Edition, 1982.

References:

1. ASHRAE Handbook – Fundamentals and Equipment, 1993.
2. ASHRAE Handbook – Applications, 1961.
3. ISHRAE Handbook
4. NPTEL Lectures by Prof. RamGopal, IIT Kharagpur
5. Carriern Handbook
6. Jord R.C., and Priester, G.B., Refrigeration and Air Conditioning, Prentice - Hall of India Ltd., New Delhi, 1969.
7. Threlkeld, J.L., Thermal Environmental Engineering, Prentice Hall, New York, 1970.

Automobile Design (Product Design, PLM, CAE, Catia)

BTAMC704C	PEC 2	Automobile Design (Product Design, PLM, CAE, Catia)	2-1-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Domain related training (Approx. 20 Hrs)

Unit 1:

Introduction to Styling, Basic of Design - Introduction to Design, Good Design & it's Examples of All Time, Industrial Design & its use. Design Process - Typical Product Life Cycle, Automotive Design Process (for production release), Design Studio (Automotive studio) Process or Product Conceptualization Process, Case Study. CAS Surfaces or Digital Clay Models, Class A Surfaces - Role of Class A surface Engineer, Requirements for a Surface to fulfill " Class A Surface" Standards, Case Studies for Class A Surfaces, Class A Surface Creation for Bonnet

Unit 2:

Introduction to Body In White: Introduction & familiarization to Body In White (BIW), various type of BIW, Types of BIW sub system, various aggregates of BIW. Bonnet Design Case Study: Function of Bonnet, Defined Input to Bonnet, Intended Input to Bonnet Design. Steps in Bonnet design, Study of Class A Surfaces, Hood Package Layout , Typical Sections, Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D, Hood Structural Members, CAE 1(Durability, Crash), Panel Detail Design, Body Assembly Process, CAE 2(Durability, crash, individual panel level), Design Updating & Detailing Prototypes, Design Updating & Production Release

Unit 3:

Introduction to CAE & its importance in the PLM, Introduction to FEA & its applications (NVH, Durability & Vehicle Crashworthiness). Introduction of Pre-Processor, Post-Processor & Solvers. Importance of discretization & Stiffness Matrix (for automobile components). Importance of oil canning on an automobile hood with Case study related to Durability Domain. Modal analysis on the hood (Case Study related to NVH Domain). Introduction of vehicle crashworthiness & Bio-mechanics (Newtonian laws, energy management, emphasis of impulse in car crashes). Head impact analysis as a Case study on the hood of an automobile (EuroNCAP test regulation). Importance of Head performance criteria (HPC). Introduction to failure criteria (By explaining the analogy of using uni-axial test results for predicting tri-axial results in reality), Mohr's Circle, Von-Mises stress criteria, application of various failure criteria on brittle or ductile materials

Unit 4:

Introduction to CAD,CAM & CAE, FEA - Definition, Various Domains – NVH, Dura, Crash, Occupant Safety, CFD. Implicit vs. Explicit Solvers, Degree of Freedom, Stiffness Matrix, Pre-Post & Solver; Types of solvers, Animation. Durability - Oil Canning, Oil Canning on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. NVH – Constrained Modal Analysis, Constrained Modal Analysis on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. Crash – Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria, Von-Mises Stress

Unit 5:

Sheet metal design & Manufacturing Cycle, Simultaneous Engineering (SE) feasibility study, Auto Body & its parts, Important constituents of an automobile, sheet metal, sheet metal processes. Type of draw dies, Draw Model development & its considerations. Forming Simulations, Material Properties, Forming Limit Curve (FLD), Pre Processing, Post-Processing, Sheet metal formability- Simulation

Unit 6:

Die Design – Sheet metal parts, Sheet metal operations (Cutting, Non-Cutting etc.), Presses, Various elements used in die design, Function of each elements with pictures, Types of dies, Animation describing the working of dies, Real life examples of die design. **Fixture Design -** Welding (Spot/Arc Welding), Body Coordinates, 3-2-1 principle, Need for fixture, Design considerations, Use of product GD&T in the fixture design, fixture elements. Typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Typical unit design for sheet metal parts (Rest/Clamp/Location/Slide/Dump units/Base), Types of fixture (Spot welding/ Arc welding/ Inspection fixture/Gauges)

Tools related training (Approx. 20 Hrs):

Depending on the tools available in the college, the relevant tool related training modules shall be enabled to the students.

AutoCAD, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD P&ID, Autodesk 3ds Max, Autodesk Alias, Autodesk SketchBook, Automotive, CATIA V5, CATIA V6, FEA, Autodesk Fusion 360, Autodesk Inventor, Autodesk Navisworks, Autodesk Ravit,

Autodesk Showcase, Autodesk Simulation, PTC Creo, PTC ProENGINEER, Solid Edge, SOLIDWORKS.

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.
4. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.

References:

1. IbrahimZeid,"CAD/CAM TheoryandPractice", TataMcGrawHillPublication,
2. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
3. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
4. Onwubiko, C., "Foundation of Computer Aided Design", West Publishing Company. 1989
5. R.W.Heine, C. R.Loper and P.C.Rosenthal, *Principles of Metal Casting*, McGraw Hill, Newyork, 1976.
6. J. H.Dubois And W. I.Pribble, *Plastics Mold Engineering Handbook*, Van NostrandReihnhold, New York, 1987.
7. N. K. Mehta, Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
8. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
9. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
10. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
11. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, SpringerVerlag, 2004. ISBN 1852338105

Engineering Economics

BTMEC705A	OEC 5	Engineering Economics	3-0-0	Audit

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, Benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Compute the depreciation of an asset using standard Depreciation techniques to assess its impact on present or future value.
CO5	Apply all mathematical approach models covered in solving engineering economics problems: mathematical formulas, interest factors from tables, Excel functions and graphs. Estimate reasonableness of the results.
CO6	Examine and evaluate probabilistic risk assessment methods.
CO7	Compare the differences in economic analysis between the private and public sectors. Recognize the limits of mathematical models for factors hard to quantify.
CO8	Develop and demonstrate teamwork, project management, and professional communications skills

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											3	
CO2											3	
CO3											3	
CO4											3	
CO5					3						3	
CO6											3	
CO7											3	
CO8									2		3	

Course Contents:

Unit 1: Introduction to Economics

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Engineering Economics: Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis: V ratio, Elementary economic Analysis: Material selection for product Design selection for a product, Process planning.

Unit 2: Value Engineering
Make or buy decision, Value engineering: Function, aims, and Value engineering procedure. Interest formulae and their applications: Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor: equal payment series capital recovery factor:
Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

Unit 3: Cash Flow
Methods of comparison of alternatives: present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

Unit 4: Replacement and Maintenance Analysis
Replacement and Maintenance analysis: Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset: capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit 5: Depreciation
Depreciation: Introduction, Straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, service output method of depreciation-

Unit 6: Evaluation of Public Alternatives
Introduction, Examples, Inflation adjusted decisions: procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Texts:

1. PanneerSelvam R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.

References:

1. Chan S. Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, “Engineering Economics and analysis”, Engineering Press, Texas, 2010.
3. E. P. Degarmo, W. G. Sullivan and J. R. Canada, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A. Khan, "Engineering Economy", Dorling Kindersley, 2012.

Intellectual Property Rights

BTMEC705B	OEC 5	Intellectual Property Rights	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic fundamental terms such as copyrights, Patents, Trademarks etc.,
CO2	Interpret Laws of copy-rights, Patents, Trademarks and various IP registration Processes.
CO3	Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms commercial strategies.
CO4	Create awareness at all levels (research and innovation) to develop patentable technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2								1				
CO3		1						1				
CO4										1		
CO5	1							1				
CO6								2				

Course Contents:

Unit 1: Introduction to Intellectual Property
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit 2: Trade Marks
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 3: Law of Copy Rights
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Unit 4: Law of Patents
Foundation of patent law, patent searching process, ownership rights and transfer.

Unit 5: Trade Secrets
Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

Unit 6: New Development of Intellectual Property
New developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international trade mark law, copy right law, international patent law, and international development in trade secrets law.

Texts:

1. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage learning.
2. Prabuddha Ganguli, "Intellectual property right: Unleashing the knowledge economy", Tata McGraw Hill Publishing Company Ltd.

References:

1. Ajit Parulekar, Sarita D'Souza, "Indian Patents Law-Legal and Business implications", Macmillan India Ltd., 2006.
2. B. L. Wadhera, "Law related to patents, Trademarks, Copyrights, Designs and Geographical indications", Universal law Publishing Pvt. Ltd., India, 2000.
3. P. Narayanan, "Law of copyright and Industrial Designs", Eastern Law house, Delhi, 2010.

Wind Energy

BTMEC705C	OEC 5	Wind Energy	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand historical applications of wind energy
CO2	Understand and explain wind measurements and wind data
CO3	Determine Wind Turbine Power, Energy and Torque
CO4	Understand and explain Wind Turbine Connected to the Electrical Network AC and DC
CO5	Understand economics of wind energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2	2	2	1		1
CO2		3	2	1	3	2	2	2	2			1
CO3	3	3	1	1	2	2	1					1
CO4	3	3		1								1
CO5	3	2	1									1

Course Contents:

Unit 1: Introduction
Historical uses of wind, History of wind electric generations

Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull statistics, Weibull parameters, Rayleigh and normal distribution

Unit 2: Wind Measurements
Biological indicators, Rotational anemometers, other anemometers, Wind direction

Unit 3: Wind Turbine Power, Energy and Torque
Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.

Unit 4: Wind Turbine Connected to the Electrical Network
Methods of generating synchronous power, AC circuits, The synchronous generator, Per unit calculations, The induction machine, Motor starting, Capacity credit features of electrical network

Unit 5: Wind Turbines with Asynchronous Electric Generators
Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self excitation of the induction generators, Single phase operation the induction generator, Field modulated generators, Roesel generator.
Asynchronous Load: Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.

Unit 6: Economics of Wind Systems
Capital costs, Economic concepts, Revenues requirements, Value of wind generated electricity

Texts:
1. S. Ahmad, "Wind Energy: Theory and Practice", Prentice Hall of India Pvt. Ltd.

References:
1. Garg L. Johnson, "Wind Energy Systems" Prentice Hall Inc., New Jersey, 1985.
2. Desire Le Gouriers, "Wind Power Plants: Theory and Design" Pergamon Press, 1982.

Knowledge Management

BTMEC705D	OEC 5	Knowledge Management	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
CO2	Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.
CO3	Identify and select tools and techniques of KM for the stages of creation, acquisition, transfer and management of knowledge.
CO4	Analyze and evaluate tangible and intangible knowledge assets and understand current KM issues and initiatives.
CO5	Evaluate the impact of technology including telecommunications, networks, and internet/intranet role in managing knowledge.
CO6	Identify KM in specific environments: managerial and decision making communities; finance and economic sectors; legal information systems; health information systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1						3
CO2												3
CO3												3
CO4								2				3
CO5					3				2			3
CO6												3

Course Contents:

Unit 1: Introduction
Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge.

Unit 2: Learning Organization
Five components of learning organization, knowledge sources and documentation.

Unit 3: Essentials of Knowledge Management

Knowledge creation process, knowledge management techniques, systems and tools.

Unit 4: Organizational Knowledge Management
Architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization.

Unit 5: Knowledge Management System
Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies.
Unit 6: Futuristic KM
Knowledge engineering, Theory of computation, data structure.

Texts:
1. Thohothathri Raman, “Knowledge Management: A resource book”, Excel, 2004.
2. M. Elias, Awad Hasan, M. Ghazri, “Knowledge Management”, Pearson Education.

References:

1. Amrit Tiwana, “Strategy &Knowledge Platforms”, The KM Toolkit–Orchestrating IT, Pearson, PHI, 2ndedition.
2. Peter Senge et al., “The Fifth Discipline Field Book–Strategies and Tools for Building A learning Organization”, Nicholas Brealey, 1994.
3. Sudhir Warier, “Knowledge Management”, Vikas Publications.
4. Madanmohan Rao, “Leading with Knowledge”, Tata McGraw Hill Publications.

Manufacturing Processes Lab - II

BTMEL706	PCC 32	Manufacturing Processes Lab - II	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: Manufacturing Processes - II

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

- **Any 8 out of the following should be conducted**

1. Study of types of chips
2. Study of the effect of process parameters on cutting ratio and shear angle in oblique turning process
3. Study of the effect of process parameters on the surface roughness during oblique turning process
4. Study of the effect of cutting fluid on surface roughness during oblique turning process
5. Study of the effect of process parameters on tool wear during oblique turning process
6. Study of the effect of process parameters on cutting forces in oblique turning process
7. Study of the effect of process parameters on cutting forces in end milling process
8. To develop a manual part program of a given component on CNC Lathe using G and M codes.

9. To develop a manual part program of a given component on CNC Lathe using stockremoval cycle.

10. To develop a manual part program of a given component on CNC Lathe using canned cycle.

11. To develop a manual part program of a given component on CNC Milling machine using
G and M code.

12. To develop a manual part program of a given component on CNC Milling machine using
pocket milling cycle.

13. To develop a manual part program of a given component on CNC Milling machine using
canned cycle.

14. To examine the effect of parameters on MRR and TWR in Electro Discharge Machining (EDM).
15. To evaluate machining accuracy in EDM.
16. Demonstration on Wire-EDM
17. Industrial visit to study manufacturing practices.

Mechatronics Lab

BTMEL707	PCC 33	Mechatronics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: Mechatronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the various types of sensors and their applications
CO2	Design a pneumatic circuit for a given application
CO3	Design a hydraulic circuit for a given application
CO4	Write a PLC program using Ladder logic
CO5	Experiment PID controller for controlling temperature
CO6	Demonstrate the capacitance sensor for measuring level

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2							3			1
CO2	1	1	3	3	3		3		3			1
CO3	1	1	3	3	3		3		3			1
CO4	2		3	1	3		1		3			1
CO5	1	1	3	3	3	3	2		3			1
CO6	1	1	3	3	2		2		3			1

List of Practicals/Experiments/Assignments

1. Study and demonstration of various types of sensors
2. Speed control of various types of Electrical Motors
3. Minimum two circuits on Pneumatics to be developed on Pneumatic trainer kit
4. Minimum two circuits on Electro-Pneumatics to be developed on Electro- Pneumatic trainer kit
5. Minimum two circuits on Hydraulics and Electro-hydraulics to be developed on Hydraulic trainer kit
6. Programming of Microprocessor and Microcontroller
7. Programming on PLC
8. Demonstration of Process control such as temperature, level, flow, etc. control using PID controller

CAD/CAM Lab

BTMEL708	PCC 34	CAD/CAM Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Construct CAD part models, assembly model and drafting of machine elements using CAD software.
CO2	Evaluate stresses in components subjected to simple structural loading using FE software
CO3	Write NC programs for turning and milling
CO4	Describe case study of industrial robots

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	1	1	3				3	3		2
CO2		3	3	3	3				3	2		2
CO3		1	2	1	3				3	2		2
CO4	1		1		3		3	3	3	3	3	2

List of Practicals/Experiments/Assignments

1. Part modeling of machine elements using any one of the CAD software out of ProE, CATIA, Unigraphics or Autodesk Inventor Professional.
2. Assembly modeling of assembly or sub-assembly of engineering products using any one of the CAD software out of ProE, CATIA, Unigraphics or Autodesk Inventor Professional.
3. Drafting of Parts and Assembly of engineering assembly using any one of the CAD software out of ProE, CATIA, Unigraphics, or Autodesk Inventor Professional.
4. Minimum 4 structural analysis problems to be solved using a CAE software like Ansys, Hyperworks, etc.
5. Minimum 2 Jobs (Programs) on CNC Turning operations
6. Minimum 2 Jobs (programs) on CNC Milling Foperation
7. Case Study of an Industrial Robot

Seminar

BTMES709	Project 4	Seminar	0-0-2	1 Credit

Examination Scheme:
Continuous Assessment: 30 Marks
End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the seminar
CO2	Explain the motivation for selecting the seminar topic and its scope
CO3	Search pertinent literature and information on the topic
CO4	Critically review the literature and information collected
CO5	Demonstrate effective written and verbal communication

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					2	2	2	2	1		1
CO2								2		2		1
CO3	2					1	1	1	3	3		3
CO4	2		1			2	1	2	2	2		2
CO5												

Course Contents:

Before the end of Semester VII, each student will have to deliver a seminar on a subject mutually decided by candidate and his/her guide. The student should select the topic for his/her seminar which is latest and relevant. The student, as a part of the term work, should submit the write-up of the seminar topic in duplicate, typed on A4size sheets in a prescribed format and bound at the end of semester.

The performance of the student will be evaluated on the basis of the contents, the presentation and discussion during the delivery of seminar before the evaluation committee appointed by the Department.

Field Training/Internship/Industrial Training - III

BTMEF710	Project 5	Field Training/Internship/Industrial Training - III	---	1 Credit

Examination Scheme: End Semester Exam: 50 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	To make the students aware of industrial culture and organizational setup
CO2	To create awareness about technical report writing among the student.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1			2		1			3	3
CO2		1	1			2		1			3	2

Students will have to undergo 6 weeks training programme in the Industry during the summer vacation after VIth semester examination. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.

Also, students should take up a small case study and propose the possible solution(s).

They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in final year B.Tech. Programme. They will have to give a power point presentation in front of the group of examiners.

Project Stage - I

BTMEP711	Project 6	Project Stage - I	0-0-6	3 Credits

Examination Scheme: Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the project and problem definition
CO2	Explain the motivation, objectives and scope of the project
CO3	Review the literature related to the selected topic of the project
CO4	Design the mechanism, components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1								1		
CO2									1	2	2	
CO3		1				1						
CO4			3	2	2		1		1	1	1	1
CO5	1		1					1			2	1

Course Contents:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
5. Software development for particular applications.
6. A combination of the above.

It is expected that the students should complete at least 40% of the total project work in VII Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry.

The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format, before the end of VII semester. The report shall be comprehensive and presented typed on A_4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Semester - VIII

Project Stage – II/Internship and Project

BTMEP803	Project 7	Project Stage – II or Internship and Project*	0-0-30	15 Credits

Examination Scheme:

Continuous Assessment: 50 Marks

End Semester Exam: 100 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the aim and objectives for this stage of the project
CO2	Construct and conduct the tests on the system/product
CO3	Analyze the results of the tests.
CO4	Discuss the findings, draw conclusions, and modify the system/product, if necessary.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2			2	2	2	1	1					
CO3		1			1	2		1		1		
CO4			2	1	2	1	2			3		1

Course Contents:

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

List of all UG courses with their equivalent SWAYAM courses:

Sr.No.	Name of Subject as per Curriculum	Equivalent SWAYAM/ NPTEL Courses	Relevance %
1	Mechatronics	Mechatronics and manufacturing automation	70%
2	CAD/CAM	No	-
3	Manufacturing Processes-III	Manufacturing Processes- I and II	10%
4	Fluid Machinery	Fluid Machinery	80%
5	Industrial Engineering and Management	Industrial Engineering	60%
6	Finite Element Method	Finite Element Method	50%
7	Surface Engineering	Fundamentals of Surface Engineering	20%
8	Refrigeration and Air conditioning	Refrigeration and Air conditioning	90%
9	Automobile Design	No	-
10	Engineering Economics	No	-
11	Intellectual Property Rights	No	-
12	Wind Energy	Wind Energy Technology	90%
13	Knowledge Management	No	
14	Biomechanics	Mechanics of human movement	20%
15	Power Plant Engineering	Power Plant Engineering	50%
16	Mechanical Vibrations	Mechanical Vibrations	100%
17	Robotics	Robotics	50%
18	Steam and Gas Turbines	Steam and Gas Power system	70 %
19	Non-conventional Machining	Non-Traditional abrasive machining processes	20%
20	Cryogenic Systems	Cryogenic Engineering	70%
21	Advanced IC Engines	Engine Combustion	60%
22	Sheet Metal Engineering	Metal forming	70%

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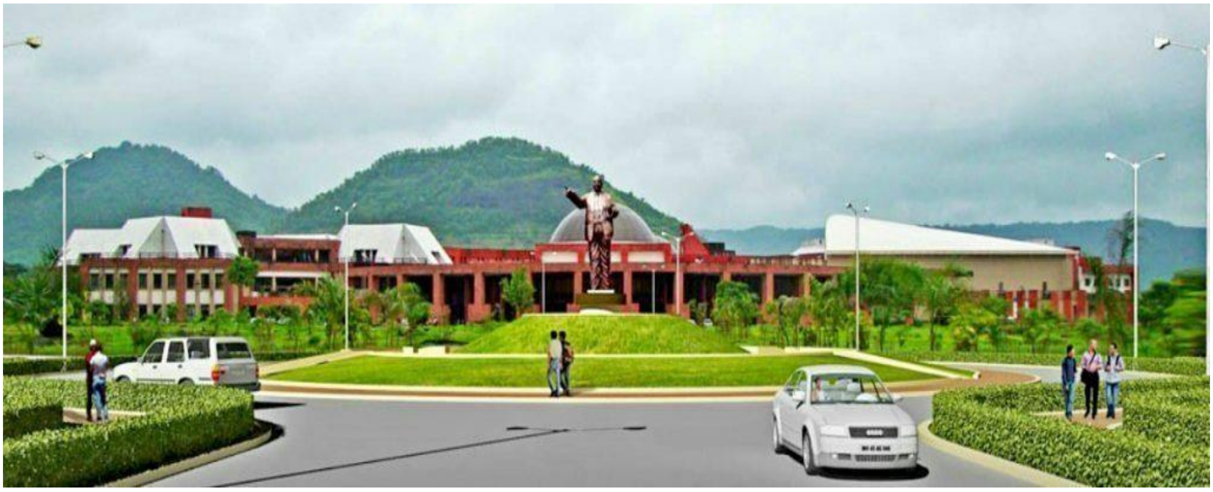
CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH.

2nd and 3rd Year MECHANICAL ENGINEERING/MECHANICAL ENGINEERING(SANDWICH)

ACADEMIC YEAR 2022-2023



Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Course Structure for Semester III
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
BSC7	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC1	BTMC302	Fluid Mechanics	3	1	-	20	20	60	100	4
PCC2	BTMC303	Thermodynamics	3	1	-	20	20	60	100	4
ESC10	BTMES304	Materials Science and Metallurgy	3	1	-	20	20	60	100	4
PCC3	BTMCL305	Machine Drawing and CAD Lab	-	-	4	60	-	40	100	2
PCC4	BTMCL306	Mechanical Engineering Lab – I	-	-	4	60	-	40	100	2
PROJ-2	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
		Total	**12**	**4**	**8**	**200**	**80**	**420**	**700**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Course Structure for Semester IV
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 5	BTMC401	Manufacturing Processes – I	3	1	-	20	20	60	100	4
PCC 6	BTMC402	Theory of Machines-I	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
ESC11	BTMES404	Strength of Materials	3	1	-	20	20	60	100	4
PEC 1	BTMPE405A-C	Elective-I	3	-	-	20	20	60	100	3
PCC7	BTMCL406	Mechanical Engineering Lab-II	-	-	4	60	-	40	100	2
PROJ-3	BTMI407	Field Training /Industrial Training (minimum of 4 weeks which can be completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be evaluated in Sem V
		Total	**15**	**4**	**4**	**160**	**100**	**340**	**600**	**20**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr. No	Course code	Course Name
1	BTMPE405A	Numerical Methods in Engineering
2	BTMPE405B	Sheet Metal Engineering
3	BTMPE405C	Fluid Machinery

Course Structure for Semester V
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester V										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 8	BTMC 501	Heat Transfer	3	1	-	20	20	60	100	4
PCC 9	BTMC 502	Machine Design – I	3	1	-	20	20	60	100	4
PCC 10	BTMC 503	Theory of Machines- II	3	1	-	20	20	60	100	4
PEC 2	BTMPE 504A-C BTAPE504A,D	Elective-II	3	-	-	20	20	60	100	3
OEC 1	BTMOE 505A-D	Open Elective-I	3	-	-	20	20	60	100	3
PCC 11	BTMC 506	Applied Thermodynamics	3		-	20	20	60	100	3
PCC12	BTMCL 507	Mechanical Engineering Lab – III	-	-	6	60	-	40	100	3
PROJ-3	BTMI 408	IT – 2 Evaluation	-	-	-	-	-	100	100	1
		Total	**18**	**3**	**6**	**180**	**120**	**500**	**800**	**25**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective II

Sr. No	Course code	Course Name
1	BTMPE504A	Refrigeration and Air conditioning
2	BTMPE504B	Steam and Gas Turbines
3	BTMPE504C	Engineering Tribology
4	BTAPE504A	Fundamentals of Automobile Design
5	BTAPE504D	Automobile Engineering

Open Elective I

Sr.No.	Course code	Course Name
1	BTMOE505A	Solar Energy
2	BTMOE505B	Renewable Energy Sources
3	BTMOE505C	Human Resource Management
4	BTMOE505D	Product Design Engineering

Course Structure for Semester VI
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester VI											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC12	BTMC 601	Manufacturing Processes-II	3	1	-	20	20	60	100	4
PCC13	BTMC 602	Machine Design-II	3	1	-	20	20	60	100	4
PEC3	BTMPE 603A-C BTAPE 603C,E	Elective-III	3		-	20	20	60	100	3
PEC4	BTMPE 604A-D BTAPE 604B	Elective-IV	3		-	20	20	60	100	3
OEC2	BTMOE 605A-E	Open Elective-II	3	-	-	20	20	60	100	3
PCC14	BTMCL 606	Mechanical Engineering Lab – IV	-	-	6	60	-	40	100	3
PROJ-4	BTMS607	B Tech Seminar	-	-	2	60		40	100	1
PROJ-5	BTMP 608	Mini Project (TPCS)	-	-	2	60	-	40	100	1
PROJ-6	BTMI 609 (IT-3)	Field Training / Industrial Training (minimum of 4 weeks which can be completed partially in fifth semester and sixth semester or in one semester itself).	-	-	-	-	-	-	-	Credits to be evaluated in Sem VII
		Total	**15**	**2**	**10**	**280**	**100**	**420**	**800**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective III:

Sr.No	Course code	Course Name
1	BTMPE603A	IC Engines
2	BTMPE603B	Mechanical Vibrations
3	BTMPE603C	Machine Tool Design
4	BTMPE603D	Engineering Metrology and Quality Control
5	BTAPE603C	Advance Automobile Design
6	BTAPE603E	E – Vehicles

Elective IV:

SrNo	Course code	Course Name
1	BTMPE604A	Process Equipment Design
2	BTMPE604B	Product Life Cycle Management
3	BTMPE604C	Finite Element Method
4	BTMPE604D	Robotics
5	BTAPE604B	Computational Fluid Dynamics

Open Elective II:

Sr.No	Course code	Course Name
1	BTMOE605A	Quantitative Techniques and Project Management
2	BTMOE605B	Nanotechnology
3	BTMOE605C	Energy Conservation and Management
4	BTMOE605D	Wind Energy
5	BTMOE605E	Introduction to Probability Theory and Statistics

Semester III

Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC 7	3L-1T-0P	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Course Contents:

Unit 1: Laplace Transform [09 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform [09 Hours]

Introductory remarks ; Inverse transforms of some elementary functions; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients

Unit 3: Fourier Transform [09 Hours]

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications [09 Hours]

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and one-dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables [09 Hours]

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Fluid Mechanics

BTMC302	PCC 1	Fluid Mechanics	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define fluid, define and calculate various properties of fluid
CO2	Calculate hydrostatic forces on the plane and curved surfaces and explain stability of floating bodies
CO3	Explain various types of flow. Calculate acceleration of fluid particles
CO4	Apply Bernoulli's equation to simple problems in fluid mechanics
CO5	Explain laminar and turbulent flows on flat plates and through pipes
CO6	Explain and use dimensional analysis to simple problems in fluid mechanics
CO7	Understand centrifugal pump.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1							1
CO2	3	3	1	1	1							1
CO3	3	3	1	1	1							1
CO4	3	3										1
CO5	3	3										1
CO6	2	3										1
CO7	2	3										1

Course Contents:

Unit 1: Fluid properties & Hydrostatic [07 Hours]

Fluid properties & its definitions, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapor pressure, Surface tension, Capillarity, Manometers (No numerical on manometers), Pascal's law, Hydrostatic law its derivation, Total pressure & Centre of pressure on vertical, horizontal, inclined, curved surface its derivation, Concept Of buoyancy & flotation Meta center, metacentric height its derivation. Stability, unitability, equilibrium of floating & submerged body

Unit 2: Fluid Kinematics and Dynamics [07 Hours]

Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Uniform, non-uniform, Compressible incompressible,2D Euler's equation, Bernoulli's equation along a stream line for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.

Unit 3: Viscous Flow and Turbulent Flow [07 Hours]

Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

Turbulent Flow**:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses.

Unit 4: Dimensional Analysis and Flow through Pipes [07 Hours]

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment), Loss of energy in pipes, loss of energy due to friction, minor energy losses, concept of HGL and TEL, flow through syphon, flow trough pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Water hammer phenomenon (No numerical on water hammer)

Unit 5: Centrifugal Pump [07Hours]

Introduction to main parts of centrifugal pump, working & construction of centrifugal pump, types of impellers, types of casings, priming, Work done on centrifugal pump, various heads and efficiencies of centrifugal pump, minimum starting speed of a centrifugal pump, multistage centrifugal pump, principles of similarity applied to centrifugal pump.

Texts:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10^{th} edition,1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5^{th}edition.
3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005

References:

1. V. L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9^{th}edition, 1998.

2. S. K. Som, G.Biswas, " Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2^{nd}edition, 2003.

Thermodynamics

BTMC303	PCC2	Thermodynamics	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define the terms like system, boundary, properties, equilibrium, work, heat, ideal gas, entropy etc. used in thermodynamics.
CO2	Studied different laws of thermodynamics and apply these to simple thermal systems to study energy balance .
CO3	Studied Entropy, application and disorder.
CO4	Studied various types of processes like isothermal, adiabatic, etc. considering system with ideal gas and represent them on p-v and T-s planes.
CO5	Represent phase diagram of pure substance (steam) on different thermodynamic planes like p-v, T-s, h-s, etc. Show various constant property lines on them.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	1	2	1									
CO3		1	1									
CO4	2											
CO5	1	1										

Course Contents:

Unit 1: Fundamental Concepts and Definitions [07 Hours]

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process.

Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, specific heat and latent heat, relationship between C_P and $C_{V.}$

Unit 2: First Law of Thermodynamics [07 Hours]

First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume.

Application of first law of steady flow processes (nozzle, turbine, compressor, pump, boiler,throttle valve etc.)

Unit 3: Second Law of Thermodynamics [07 Hours]

Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

Entropy: Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder.

Unit 4: Ideal gas [07 Hours]

Boyle's law, Charl's law, Avogadro's law, universal gas constant, ideal processes with question, other equation of states.

Unit 5:Properties of Pure Substance [07Hours]

Phase change phenomenon of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, critical point parameters, triple point, property table, representation of processes of steam on p-v, T-s, and other diagrams, Dryness fraction and its measurement.

Texts:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 3rd edition,2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 5th edition, 2006.

References:

1. G. J. Van Wylen, R. E. Sonntag, "Fundamental of Thermodynamics", John Wiley and Sons, 5th edition, 1998.
2. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

Material Science and Metallurgy

BTMES304	ESC10	Materials Science and Metallurgy	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Study various crystal structures of materials
CO2	Understand mechanical properties of materials and calculations of same using appropriate equations
CO3	Evaluate phase diagrams of various materials
CO4	Suggest appropriate heat treatment process for a given application
CO5	Prepare samples of different materials for metallography
CO6	Recommend appropriate NDT technique for a given application

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1									
CO2	3	2	2	3	2							
CO3	2	1	2	1	1							
CO4	1	2	2	1	2	1	2	1	1	1		
CO5	1	1	1	3	2		1		1			
CO6	1	1	2	2	2	1	2		1	1		

Course Contents:

Unit 1: Fundamentals

a) Structure of Materials **[07 Hours]**

Crystal structures, indexing of lattice planes, Imperfections in crystals-point defects, line defects, Mechanism of plastic deformation, plastic deformation of polycrystalline materials.

b) Mechanical Properties and their Testing

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, formability, hardness testing, and different hardness tests-Vickers, Rockwell, Brinnel, Impact test.

Unit 2: Equilibrium Diagrams **[07 Hours]**

Definitions of terms, rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, classification and application of steels, specification of steels, TTT diagram, critical cooling rate, CCT diagram.

Unit 3: Heat Treatment **[07 Hours]**

Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbo-nitriding, flame hardening, induction hardening.

Unit 4: Metallography **[07 Hours]**

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, Sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 5: Strengthening Mechanisms and Non-destructive Testing **[07 Hours]**

Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye Penetrant inspection, ultrasonic inspection, radiography, eddy current testing.

Texts:

1. V. D. Kodgire, S.V. Kodgire, "Material Science and Metallurgy for Engineers", EverestPublishing House, Pune, 24thedition, 2008.
2. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley andSons, 5thedition,2001.
3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.

References:

1. V. B. John, "Introduction to Engineering Materials", ELBS, 6thedition, 2001.
2. G. F. Carter, D. E. Paul, " Materials Science and Engineering", ASM International, 3rdedition, 2000.
3. T. E. Reed-Hill, R. Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition

Machine Drawing and CAD Lab

BTMCL305	PCC3	Machine Drawing and CAD	0-0-4	2 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs/week	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump , machine tool part etc.
CO5	Represent tolerances and level of surface finish on production drawings
CO6	Understand various creating and editing commands in Auto Cad

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1	2								3	2		1
CO2	2	1							2	1		1
CO3	2								2	1		
CO4	2	2			1				2	1		1
CO5	1	1			1				2	1		1
CO6	1	1			1				2	2		1

List of Practical's/ Experiments/ Assignments (minimum six assignments should be completed)

1. One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.
2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignments of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model at least one simple machine component.

Texts:

1. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House, Anand, India.
2. N. D. Bhatt, “Machine Drawing”, Charotar Publishing House, Anand, India.
3. Ajeet Sing, “Working with AutoCAD 2000”, Tata McGraw Hill, New Delhi.
4. George Omura, “ABC of AutoLISP”, BPB Publications, New Delhi.

References:

1. Narayana, Kannaiah, Reddy, “Machine Drawing”, New Age International Publishers.
2. AutoCAD and Auto LISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Mechanical Engineering Lab - I

BTMCL306	PCC4	Fluid Mechanics + Material Science and Metallurgy	0-0-4	2 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Fluid Mechanics)

List of Practicals/Experiments/Assignments (Any Five from Group A)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli's theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determination of pressure drop in pipes of various cross-sections
5. Determination of pressure drops in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer(at least one type)
7. Verification of momentum equation using impact of jet apparatus
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Gauge and differential pressure measurements using various types of manometers, Bourdon type pressure gauge.
11. Demonstration of measurement using these instruments Lab.
12. Experiment to study hydraulic jump.

Group B (Material Science and Metallurgy)

List of Practical's/Experiments/Assignments (Any Four from Group B

1. Brinell Hardness Test
2. Rockwell Hardness test
3. Erichson Cupping Test
4. Magnaflux Test
5. Dye Penetrant Test
6. Specimen Preparation for Microscopy
7. Sulphur Print Test
8. Spark Test
9. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
10. Study and drawing of microstructures of heat treated steels
11. Jominy End Quench Test
12. Study and drawing of microstructures of cast irons

13. Study and drawing of microstructures of non-ferrous alloys
14. Hardening of steels of varying carbon percentage

IT – 1 Evaluation

BTES209P (Internship – 1)	Internship – 1 Evaluation	PROJ-2	0L-0T-0P	1 Credits

Teaching Scheme:	Examination Scheme:
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester IV

Manufacturing Processes-I

BTMC401	PCC 5	Manufacturing Processes-I	3-1-0	4 Credits

Pre-Requisites: None

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Understand the various metal forming processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand milling machines and operations, cutters and indexing for gear cutting.
CO6	Study shaping, planning and drilling, their types and related tooling's

Mapping of course outcomes with program outcomes

Course	Program Outcomes

Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1	1				1		1
CO2	2	2	1		1	1				1		1
CO3	2	1	1		1	1				1		1
CO4	1		1		1	1				1		1
CO5	2		1		1	1				1		1
CO6	1				1	1				1		1

Course Contents:

Unit 1: Introduction and Casting Processes [07 Hours]

What is manufacturing? Selection of manufacturing processes, Introduction to casting; solidification of metals: Pure metals, Alloys; fluid flow; fluidity of molten metal; heat transfer: Solidification time, Shrinkage; defects: Porosity; Metal casting processes: Introduction; sand casting, shell molding, investment casting; Permanent-mold casting, vacuum casting, die casting, centrifugal casting.

Unit 2: Metal Forming

a) Rolling and Forging Processes [07Hours]

Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Geometric Considerations; Flat-rolling Practice: Defects in Rolled Plates and Sheets; Rolling Mills; Various Rolling Processes and Mills.

Introduction to forging, Open-die forging; Impression-die and Closed-die forging; various forging Operations; Forging Defects; Forging Machines.

b) Extrusion and Drawing

Introduction; Extrusion Process; Hot Extrusion; Cold Extrusion: Impact extrusion, Hydrostatic Extrusion; Extrusion Defects; Extrusion Equipment; Drawing Process; Drawing Practice; Drawing Defects and Residual Stresses; Drawing Equipment.

Unit 3: Joining Processes [07Hours]

Oxy-fuel-gas Welding; Arc-Welding Processes: Non consumable Electrode; Arc-welding Processes: Consumable Electrode, Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; The Weld joint, Quality, and Testing: Weld Quality, Weldability, Testing of Welds.

Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection Welding. Introduction to brazing and soldering.

Unit 4: Machining Processes: Turning and Hole Making [07 Hours]

Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes. Types of chips, Boring andBoring Machines; Drilling Machines: Drills, Drill Materials and Sizes, Drilling Practice, DrillingMachines, Reaming operation and Reamers; Tapping and Taps.

Unit 5: Machining Processes: Milling, Broaching and Gear Manufacturing [07 Hours]

Introduction, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Tool holders, Milling Process Capabilities, Milling Machines; Planning and Shaping; Broaching and Broaching Machines; Gear Manufacturing by Machining: Form Cutting, Gear Generating, Cutting Bevel Gears, Gear-finishing Processes.

Text:

1. Serope Kalpak Jain and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6thedition, 2009.

References:

1. Milkell P. Groover, " Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.

Theory of Machines- I

BTMC402	PCC 6	Theory of Machines-I	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define basic terminology of kinematics of mechanisms
CO2	Classify planar mechanisms and calculate its degree of freedom
CO3	Perform kinematic analysis of a given mechanism using ICR and RV methods
CO4	Introduction of different types of lubrication system.
CO5	Perform kinematic analysis of slider crank mechanism using Klein's construction and analytical approach
CO6	Perform balancing of unbalance forces in rotating masses, different types of single/multi cylinder reciprocating engines in different positions.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1								3
CO2				1								3
CO3	1	1		2								3

CO4	1											
CO5	1	1		3								2
CO6	1	1										2

Course Contents:

Unit 1: Velocity Acceleration Analysis [07 Hours]

Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom.
Study of various mechanisms such as straight line mechanisms, pantograph, Geneva mechanism, steering gear mechanisms. Instantaneous centre of rotation, body and space centrodes, Kennedy's theorem.

Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method, Corioli's component of acceleration.

Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 2: Friction and Lubrication [07 Hours]

Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Frication at pivot and collars, Friction in turning pair, Friction circle and friction axis, Friction in mechanisms.

Lubrication, Viscosity, Viscous flow, Boundary lubrication, Thick film lubrication, Hydrostatic and hydrodynamic lubrications.

Unit 3: Clutch, Brakes and Dynamometers [07 Hours]

Friction Clutches: Single plate and multi-plate clutch, Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanism.

Brakes: Shoe brake, Internal and external shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torque.

Dynamometers: Different types of absorption and transmission type dynamometers, Construction and working of eddy current dynamometer, Torque measurement.

Unit 4: Cams and Followers [07 Hours]

Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion, Circular arc cam, Tangent cam, Cycloidal cam.

Unit 5: Balancing [07 Hours]

Balancing of rotating masses in one and several planes, balancing of reciprocating, masses in single and multi-cylinder engine viz., inclined, radial and v-type engines, Primary and secondary balancing analysis, Concept of direct and reverse cranks, Balancing of locomotive engines, Effect of partial balancing, Static and dynamic balancing.

Texts:

1. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

References:

1. Thomas Beven, “Theory of Machines”, CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, “Theory of Machines and Mechanisms”, Tata McGraw Hill Publications, New York, International Student Edition, 1995.

Basic Human Rights

BTHM403	HSSMC3	Basic Human Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1						2						
CO2												
CO3												
CO4									3			
CO5								2		2		

CO6												1

Course Contents:

Unit 1: The Basic Concepts, Fundamental Rights and Economic Program [07 Hours]
Individual, group, civil society, state, equality, justice. Human Values, Human rights and HumanDuties. Declaration of independence, Rights of citizen, Rights of working and exploited people Society, religion, culture, and their inter-relationship. Impact of social structure on humanbehavior.
Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

Unit 2: Workers and Human Rights [07 Hours]
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 3: NGOs and Human Rights in India [07 Hours]
Land, Water, Forest issues.

Unit 4: Human Rights in Indian Constitution and Law [07 Hours]
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 5: UDHR and Indian Constitution [07 Hours]
Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References:
1. Shastry, T. S. N., “India and Human Rights: Reflections”, Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford

Strength of Materials

BTMES404	ESC11	Strength of Materials	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: Engineering Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principle stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Design a beam based on bending and shafts based on torsion
CO5	Analyze given beam for calculations of SF and BM
CO6	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		1				1				2
CO2	1	1	2	2								2
CO3	1	1	2	2		1						3
CO4	1	3	2	1								2
CO5	1	1	2	3								2

Course Contents:

Unit 1: Simple Stresses and Strains **[07 Hours]**

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.

Principal Stresses and Strains

Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain energy, resilience and Combined Stresses **[10 Hours]**

Strain energy, resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load.

Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Unit 3: Stresses in Beams **[10 Hours]**

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear.

Torsion

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram **[10 Hours]**

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and **load** diagram from SFD, Construction of load diagram and SFD from BMD.

Unit 5. Deflection of beams **[08 Hours]**

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of areamoment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Texts:

S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.

Numerical Methods in Mechanical Engineering

BTMPE405A	PEC 1	Numerical Methods in Engineering	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe the concept of error
CO2	Illustrate the concept of various Numerical Techniques
CO3	Evaluate the given Engineering problem using the suitable Numerical Technique
CO4	Develop the computer programming based on the Numerical Techniques

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		1	3							
CO2	3	3		1	3							
CO3	3	3		1	3							
CO4	3	3		1	3							

Course Contents:

Unit1: Error Analysis **[07 Hours]**

Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of error sin computer programming.

Unit2: Roots of Equations **[07 Hours]**

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit3: Numerical Solution of Algebraic Equations **[07 Hours]**

Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation **[07 Hours]**

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

Unit5: Curve, Fitting and Interpolation and Computer Programming **[07 Hours]**

Motivation, Least Square Regression: Linear Regression, Polynomial regression. **Interpolation:** Newton's Divide Difference interpolation, engineering applications. **Solution to Ordinary Differentiation Equations:** Motivation**,** Euler' sand Modified Euler's Method, Hen's method, Runge–Kutta Method, engineering applications.

Computer Programming

Overview of programming language, Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Reymond P. Canale,
   "Numerical Methods for Engineers", Tata Mc Graw HillPublications,2010.
2. E. Balagurusamy, "Numerical Methods" Tata McGraw HillPublications,1999.

References:

1. V. Rajaraman, "Fundamental of Computers " Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi,3rd edition,2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Sheet Metal Engineering

BTMPE405B	PEC 1	Sheet Metal Engineering	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Recognize common manufacturing processes of Sheet Metal Fabrication
CO2	Understand the principles of design and fabricate of sheet metal products and recognize common material used in the industry
CO3	Distinguish Shearing, Drawing and Pressing etc. processes.
CO4	Know types of dies and formability.
CO5	Select mechanical or hydraulic presses for the given process

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1
CO2	3			1	3	2	3					2
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			

CO5	3	2			3	3	2				1	3

Course Contents:

Unit1: Introduction [07 Hours]
Importance of sheet metal engineering, materials used, desirable properties of materials in sheet metal products

Unit2: Basic Applications [07 Hours]
Shearing processes like blanking, piercing, and punching.

Unit3: Drawing Processes [07 Hours]
Shallow and deep drawing of cylindrical and rectangular bodies, forming and bending including spring-back.

Unit4: Types of Dies and Mechanical Presses [07Hours]
Dies: Compound dies, progressive dies, and combination dies
Mechanical Presses
Mechanical and hydraulic presses, modern development sin press tools, formability.

Unit 5: Case Studies [07 Hours]
Case studies for manufacturing of sheet metal products in various engineering applications
Texts:
1. Donaldson al., “Tool Design”, Tata McGraw-Hill Publications, New Delhi, 1998.

References:
1. P.N.Rao,“ManufacturingTechnology,Foundry,FormingandWelding”,Vol.I,TataMcGrawHill PublishingCo.Ltd,NewDelhi,3rdedition, 2004.
2. ASMH and book, “Metal Forming”, Vol. XV, ASM Publication, Metals Park, Ohio,10thedition,1989.
3. A. S. Deshpande, “Die Design Hand book”, ASTME.
4. Sheet Metal Engineering Notes, IITBombay,1999.

Fluid Machinery

BTMPE405C	PEC 1	Fluid Machinery	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand and apply momentum equation
CO2	Understand and explain Hydrodynamic Machines
CO3	Explain difference between impulse and reaction turbines
CO4	Find efficiencies, draw velocity triangles
CO5	Explain governing mechanisms for hydraulic turbines
CO6	Explain working of various types of pumps, draw velocity diagrams, do simple Calculations
CO7	Design simple pumping systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3		3				2					1

CO3	3	2										1
CO4	3	3	2									1
CO5			3									1
CO6	3	3	3	1	1							1
CO7	3	3		3								1

Course Contents:

Unit 1: Momentum Equation and its Applications **[07 Hours]**

Impulse momentum, Principle, Fixed and moving flat inclined plates, Curved vanes, Series of plates and vanes, Velocity triangle and their analysis, Water wheels. Hydrodynamic Machines: Classification, General theory, Centrifugal head, Fundamental equations, and Euler's equation, Degree of reaction, Head on machine, various efficiencies, Condition for maximum hydraulic efficiency.

Unit 2: Impulse and Reaction Turbines **[07 Hours]**

Impulse principle, Construction of Pelton wheel, Velocity diagrams and its analysis, Number of buckets, Jets, Speed ratio, Jet ratio.

Reaction Turbines: Constructional details of Francis, Kaplan and Propeller turbine, Deciaz turbine, and Draft tube types, Efficiencies, Cavitation.

Unit 3: Governing of Turbines **[07 Hours]**

Methods of governing, Performance characteristics, Safety devices, Selection of turbines, Unit quantities, Specific speed, Principles of similarity and model testing.

Unit 4: Centrifugal Pump **[07 Hours]**

Construction, Classification, Terminology related to pumps, Velocity triangle and their analysis, Cavitation, NPSH, Thoma's cavitation factor, Priming, Methods of priming, Specific speed, Performance characteristics, Actual thrust and its compensation, Troubleshooting.

Multistage Pumps: Pump H-Q characteristics and system H-Q Characteristics, Series and parallel operation of pumps, Systems in series and parallel, Principle of model testing and similarity.

Unit 5: Special Purpose Pumps **[07 Hours]**

Chemical pumps, nuclear pumps, Sewage pumps, Submersible deep well pumps, Pump installation, Energy efficient pumps.

Failure of Pumping System: Pump failures, Remedies, Source failure, Causes and remedies, Trouble shooting.

Miscellaneous Pumps: Reciprocating pump, Gear pump, Vane pump, Lobe pump, etc., Application field (no mathematical treatment).

Texts:

1. P. N. Modi, S. M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, Rajsons Publications Pvt. Ltd., 20th edition.
2. R. K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Lakshmi Publications Pvt. Ltd., 9th edition.

References:

1. Yunus A. Çengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications", McGraw Hill, 3rd edition, 2014.

Mechanical Engineering Lab II

BTMCL406	PCC7	Manufacturing Processes Lab I+Theory of Machines Lab -I Strength of Materials Lab	0-0-4	2 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Manufacturing Processes Lab I)

List of Practical's/Experiments/Assignments (Any Three from Group

A)

Making a job with a process plan involving plain, step and taper turning as well thread cutting as operations on a Centre lathe.

1. Preparation of process planning sheet for a job including operations such as milling, drilling and shaping.
2. Making a spur gear using universal dividing head on milling machine.
3. Making a simple component by sand casting using a split pattern.
4. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
5. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
6. An experiment on shearing operation.
7. An experiment on blanking operation.
8. An experiment on drawing operation

Group B (Theory of Machines Lab - I)

List of Practical's/Experiments/Assignments (Any Three from Group B)

1. **Four sheets** (half imperial size)
   Graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous center of rotation method and Klein's construction. At least one problem containing Corioli's component of acceleration.
2. **Experiments (any 2**
   a) Experimental determination of velocity and acceleration of Hooke's joint.
   b) Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
   c) Experiment on Corioli's component of acceleration.
3. **Assignment**

Develop a computer program for velocity and acceleration of slider-crank mechanism.

Group C (Strength of Materials Lab)

List of Practical's/Experiments/Assignments (Any Three from Group C)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Torsion test on mild steel and cast-iron solid bars and pipes
5. Flexure test on timber and cast-iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminum, and cast-iron specimens
9. Experiments on thermal stresses
10. Strain measurement in stress analysis by photo-elasticity
11. Strain measurement involving strain gauges/ rosettes
12. Assignment involving computer programming for simple problems of stress, strain Computations.

Semester - V

Heat Transfer

BTMC 501	PCC 8	Heat Transfer	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the laws of heat transfer and deduce the general heat conduction equation and to explain it for 1-D steady state heat transfer in regular shape bodies
CO2	Describe the critical radius of insulation, overall heat transfer coefficient, thermal conductivity and lumped heat transfer
CO3	Interpret the extended surfaces
CO4	Illustrate the boundary layer concept, dimensional analysis, forced and free convection under different conditions
CO5	Describe the Boiling heat transfer, Evaluate the heat exchanger and examine the LMTD and NTU methods applied to engineering problems
CO6	Explain the thermal radiation black body, emissivity and reflectivity and evaluation of view factor and radiation shields

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			1				1			
CO2	3	2			1							
CO3	3	1			2		2		1			
CO4	3	3		1	1				1			
CO5	3	3	3		1		2					
CO6	2	3		2	2		2		1			

Course Contents:

Unit1: Introduction **[07 Hours]**

Heat transfer mechanism, conduction heat transfer, Thermal conductivity, Convection heat transfer, Radiation heat transfer, laws of heat transfer Steady State Conduction: General heat conduction equation, Boundary and initial Conditions, one dimensional steady state conduction : the slab, the cylinder, the sphere, composite systems.

Unit2: Overall Heat Transfer and Extended Surfaces **[07 Hours]**

Thermal contact resistance, Critical radius of insulation, Electrical analogy, and Overall heat transfer coefficient, Heat sources systems, Variable thermal conductivity, extended surfaces. Unsteady State Con duction: Lumped system analysis, Biot and Fourier number, Heisler chart **(Numerical examples).**

Unit3: Principles of Convection **[07 Hours]**

Continuity, Momentum and Energy equations, Hydro dynamic and Thermal boundary layer for aflat plate and pipe flow. Dimensionless groups force convection, relation between fluid friction and heat transfer, turbulent boundary layer heat transfer. Forced Convection:

Empirical relations for pipe and tube flow, flow a cross cylinders, spheres, tube banks. Free Convection**:** Free convection from a vertical, inclined and horizontal surface, cylinder and sphere. **(Numericalexamples).**

Unit4: Heat Exchangers **[07 Hours]**

Heat Exchangers: Classification of heat exchangers, temperature distribution in parallel counter flow arrangement, the overall heat transfer coefficient, Analysis of heat exchangers, the log mean temperature difference (LMTD) method, the effectiveness – NTU method, selection of heat exchangers, Introduction to TEMA standard. **(Numerical examples).**

Unit5: Radiation Heat Transfer **[07 Hours]**

Introduction, thermal radiation, Black body radiation, radiation laws, Radiation properties, Atmospheric and Solar radiation, The view factor Radiation heat transfer from black surfaces, gray surfaces, diffuses surfaces, Radiation shield sand the radiation effect. **(Numerical examples).**

Texts:

1. F. P. Incoropera, D. P.Dewitt, “FundamentalsofHeatandMassTransfer”,John-Wiley,5th edition,1990.
2. S. P. Sukhatme, “A Text book On Heat Transfer”, Tata McGraw-Hill Publications,3rd edition.

References:

1. Y. A. Cengel, “Heat Transfer – A Practical Approach”, Tata McGraw HillPublications,3rdedition,2006.
2. J. P. Holman, “HeatTransfer”, Tata McGraw Hill Publications,9th edition,2004.

Machine Design - I

BTMC 502	PCC 9	Machine Design - I	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Strength of Materials

Course Outcomes: At the end of the course, students will be able to:

CO1	Formulate the problem by identifying customer need and convert into design Specification
CO2	Understand component behavior subjected to loads and identify failure criteria
CO3	Analyze the stresses and strain induced in the component
CO4	Design of machine component using theories of failures
CO5	Design of component for finite life and infinite life when subjected to fluctuating load
CO6	Design of components like shaft, key, coupling, screw and spring

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1				1

CO2	3	2		1		1		1		1		1
CO3	1	1				1		1		1		1
CO4	3	3	2	1		2		1		1		1
CO5	1	1				1		1		1		1
CO6	2	2	2	1		1		1		1		1

Course Contents:

Unit1:MechanicalEngineeringDesignProcess [07 Hours]
Traditional design methods, general industrial design procedure, design considerations, phases in design, creativity in design, use of standardization, preferred series, introduction toISO9000,use of design data book, aesthetic and ergonomic considerations in design.

Unit2:DesignofMachineElementsagainstStaticLoading [07 Hours] Theories of Failure(Yield and Fracture Criteria): Maximum normal stress theory, Maximum shear stress theory, Maximum distortion energy theory, comparisonof various theories of failure, Direct loading and combined loading, Joints subjected to static loadinge.g. cotter and knuckle joint.

Unit3: Design against Fluctuating Loads [07 Hours]
Stress concentration, stress concentration factors, fluctuating stresses, fatigue failure, endurance limit, notch sensitivity, approximate estimation of endurance limit, design for finite life and finite life under reversed stresses, cumulative damage in fatigue, Soderberg and Goodman diagrams, fatigue design under combined stresses.

Unit4:Design of Shafts Keys and Couplings [07 Hours] Various design considerations in transmission shafts, splined shafts, spindle and axles strength,lateral and torsional rigidity, ASME code for designing transmission shaft.
Types of Keys**:** Classification and fitmentin key ways, Design of various types of keys.
Couplings**:** Design consideration, design of rigid, muff and flange type couplings, and design offlexible couplings.

Unit5: Design of Threaded Joints and Mechanical Springs [07 Hours]
Power Screws**:** Forms of threads used for power screw and the it sapplications, torque analysis for square threads, efficiency of screw, overall efficiency, self- locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw,re-circulating balls crew.
Welded Joints**:** Type of welded joints, stresses in butt and fillet welds, strength of welded jointssubjected to bending moments.
Mechanical Springs: Stress deflection equation for helical spring, Wahl’s factor, style of ends, design of helical compression, shot peening.

Texts:

1. V. B. Bhandari, “Design of Machine Elements”,TataMcGrawHill Publications,NewDelhi,2008.
2. R. L.Nortan, “ Machine Design: An Integrated Approach”,PearsonEducationSingapore, 2001.

References:

1. R. C.Juvinall, K. M.Marshek, " Fundamentalofmachinecomponentdesign",John Wiley&SonsInc.,NewYork,3rdedition,2002.
2. B. J. Hamrock,B. JacobsonandSchmidSr., "FundamentalsofMachineElements", InternationalEdition,NewYork,2ndedition,1999.
3. A. S.Hall,A. R.Holowenko, H. G.Langhlin,"TheoryandProblemsofMachine Design",Schaum'sOutlineSeries, Tata McGrawHillbookCompany,NewYork,1982.
4. J. E.ShigleyandC.Mischke, "MechanicalEngineeringDesign", Tata McGrawHill Publications,7thedition, 2004.
5. M. F.Spotts, "DesignofMachineElements",PrenticeHallofIndia,NewDelhi.

Theory of Machines - II

BTMC 503	PCC 10	Theory of Machines - II	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Engineering Mechanics, TOM - I

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify and select type of belt and rope drive for a particular application
CO2	Evaluate gear tooth geometry and select appropriate gears, gear trains
CO3	Define governor and select/suggest an appropriate governor
CO4	Characterize flywheels as per engine requirement
CO5	Understand gyroscopic effects in ships, aero planes, and road vehicles.
CO6	Understand free and forced vibrations of single degree freedom systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1		2		1			2		2
CO2	2	3					1					3
CO3		2										2

CO4		2		1								
CO5	2	3		2								3
CO6	2	3		3								3

Course Contents:

Unit 1: Belt and Rope Drives **[07 Hours]**
Flat belts, Effect of slip, Creep, Crowing of pulley, Centrifugal tension, Initial tension in belts. V- Belts, Virtual coefficient of friction, Effect of V-groove on torque transmitted. Rope drives, Rope constructions, Advantages of rope drives.

Unit 2: Toothed Gears **[07 Hours]**
Classification of gears, Terminology of spur gears, Conjugate action, Involute and cycloidal profiles, Path of contact, Contact ratio, Interference, Undercutting, Rack shift, Effect of center distance variations, Friction between gear teeth, Internal gears.
Helical gear terminology, Normal and transverse module, Virtual number of teeth, Torque transmitted by helical gears, Spiral gears, Efficiency of spiral gears, Worm gears, Bevel gear terminology, Tooth forces and geometric relationship, Torque capacities.

Unit 3: Gear Trains **[07 Hours]**
Types of gear trains, Velocity ratios, Tooth load, Torque transmitted and holding torque.

Unit 4: Governor, Flywheel and Gyroscope **[07 Hours]**
Governors: Function of governor, Inertia and centrifugal type of governors, Controlling force analysis, Governor Effort and governor power, Sensitivity, stability, Isochronisms and Hunting, Friction insensitiveness.
Flywheel: Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of prime movers and machines.

Gyroscope: Principles of gyroscopic action, Precession and gyroscopic acceleration, gyroscopic couple, Effect of the gyroscopic couple on ships and vehicles, gyroscopic stabilization.

Unit 5: Vibration **[07 Hours]**
Basic concepts and definitions; vibration measuring parameters- displacement, velocity, and acceleration.
Mechanical Vibration**:** Single degree of freedom system, SHM, Undamped free vibrations, damped free vibrations, Types of damping.
Forced Vibration: Effect of excitation, Excitation due to reciprocating and rotating unbalance, Vibration isolation and transmissibility.
Critical Speeds**:** Whirling of vertical and horizontal shaft carrying single rotor with damped and un-damped system.
Torsional Vibrations**:** Single degree of freedom system Forced an free damped and undampedvibrations, Two rotor system, Natural frequency , Modes of vibrations, Torsional dampers, Introduction to Holzer's method for multi rotor system.

Texts:

1. S. S.Rattan, "Theory of Machines",Tata McGraw-Hill Publications, NewDelhi.
2. Thomas Beven,"Theory of machines",CBS Publishers,Delhi, 1984.
3. Kelly, Graham S., "Mechanical Vibrations", Schaum's Outline Series, McGraw Hill, New York, 1996.
4. Rao, J.S., "Introductory Course on Theory and Practice of Mechanical Vibration", New age International (P) Ltd, New Delhi, 2nd edition, 1999.

References:

1. Rao Singiresu, "Mechanical Vibrations", Pearson Education, New Delhi, 4th edition 2004.
2. J. E. Shigley,J. J. Vicker, "Theory of Machines and Mechanisms",Tata McGraw HillInternational.

Refrigeration and Air Conditioning

BTMPE504A	PEC 2	Refrigeration and Air Conditioning	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Unit 1: Air Refrgeration System [07 Hours]

Introduction, standard rating of refrigerating machine, coefficient of performance of refrigerator and heat pump. , Reversed Carnot cycle and its limitations, reversed Brayton cycle, application to air craft refrigeration. Bootstrap refrigeration cycle, reduced ambient air cooling system, Regenerative air cycle system

Designation of refrigerant, selection of refrigerant, Desirable Properties, Primary and secondary refrigerants, azeotropes and its uses

Unit 2: Vapour Compression System [07 Hours]

Thermodynamics analysis, theoretical and actual cycle, Use of P-h and T-s diagram for problem solving, COP, Effect of evaporator and condenser temperature on cycle performance, Effects of suction superheating

Liquid sub-cooling, liquid-vapour heat exchanger, estimation of compressor displacement, COP and power requirement, waste heat recover opportunities

Unit 3: Compound Vapour Compression System [07 Hours]

Multi-evaporator, multi-compressor systems, cascade system

Vapour Absorption System: Aqua-ammonia system, lithium bromide-water system, Electrolux refrigerator, comparison with vapour compression cycle (descriptive treatment only), use of enthalpy concentration, thermodynamic analysis, and capacity control, solar refrigeration system

Unit 4: Air Conditioning: [07 Hours]

Psychrometry, properties of moist air, Psychometric charts. Psychomeric processes, bypass factor Sensible and latent heat loads, SHF, GSHF, RSHF, All air system, all water system, unitary systems; window air-conditioner, split air-conditioners, refrigeration and air-conditioning controls

Unit 5: Air Conditioning Process Calculation [07 Hours]

Introduction to comfort air conditioning ,human comfort and comfort chart, Load calculation, outside conditions, indoor conditions, estimation of coil capacity required, evaporative cooling

Principle of air distribution, duct design methods, friction chart, duct materials, methods of noise control

Texts:

1. Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw Hills, New Delhi, Second Edition, 2000.

2. Stoeker, W.F. and Jones, J.P., Principles of Refrigeration and Air Conditioning, McGraw Hill, New York, Second Edition, 1982.

References:

1. ASHRAE Handbook – Fundamentals and Equipment, 1993.
2. ASHRAE Handbook – Applications, 1961.
3. ISHRAE Handbook
4. NPTEL Lectures by Prof. RamGopal, IIT Kharagpur
5. Carriern Handbook
6. Jord R.C., and Priester, G.B., Refrigeration and Air Conditioning, Prentice - Hall of India Ltd., New Delhi, 1969.
7. Threlkeld, J.L., Thermal Environmental Engineering, Prentice Hall, New York, 1970.

Steam and Gas Turbine

BTMPE504B	PEC 2	Steam and Gas Turbine	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State Various properties of Steam, Draw P-V, T-s, H-s (Mollier) diagrams for steam, Describe Theoretical steam turbine cycle.
CO2	Define and Understand Various Types of Design of Turbines.
CO3	Perform analysis of given steam and gas Turbine power plant (Efficiencies, Power Output, Performance)
CO4	Study and apply various Performance improvement Techniques in steam and gas Turbines
CO5	Assess factors influencing performance of thermal power plants,
CO6	Apply various maintenance procedures and trouble shootings to Turbines.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	1	1										
CO3		2			2							
CO4	1				1	2	2					
CO5	1	2										
CO6	1	1		3								

Course Contents:

Unit 1: Introduction **[07 Hours]**

Properties of steam, Theoretical steam turbine cycle. The flow of steam through Impulse andImpulse–Reaction turbine blades

Unit 2: **[07 Hours]**

Vortex flow in steam turbines, Energy lines, State point locus, Reheat factor and Design procedure. Governing and performance of steam turbine

Unit 3: Gas Turbine **[07 Hours]**

Introduction, simple open cycle gas turbine, Actual Brayton cycle, Means of Improving the efficiency and the specific output of simple cycle,

Unit 4: Gas Turbine Cycle Modifications and Performance **[07 Hours]**

Regeneration, Reheat, Intercooling, closed-cycle gas turbine, turbine velocity diagram and work done.

Unit 5: Turbine Cooling and maintenance **[07 Hours]**

Turbine blade cooling, material, protective coating, Performance of turbine, Application of turbine. Lubrication, cooling, fuel supply and control, Maintenance and trouble shooting.

Texts:

1. W. J. Kearton, "Steam Turbine Theory and Practice", ELBS.

References:

1. R. Yadav, "Steam and Gas Turbine", Central Publishing Home, Allahabad.

Jack D. Mattingly, "Elements of Gas Turbine propulsion", Tata McGraw Hill Publications.

Engineering Tribology

BTMPE504C	PEC2	Engineering Tribology	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic concepts and importance of tribology.
CO2	Evaluate the nature of engineering surfaces, their topography and surface characterization techniques
CO3	Analyze the basic theories of friction and frictional behavior of various materials
CO4	Select a suitable lubricant for a specific application
CO5	Compare different wear mechanisms
CO6	Suggest suitable material combination for tribological design.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2	1	2	2		1						
CO3	2	3	1	2	1	1	1					
CO4	2	2	2		1	1	2		1		1	
CO5	1	1	1	1	1							
CO6	2	2	2		2	2	2		1	1	1	

Course Contents:

Unit1: Introduction **[07 Hours]**

Definition of tribology, friction, wear and lubrication; importance of the tri-bological tudies. Surface Topography**:** Methods of assessment, measurement of surface roughness-different statistical parameters (R_a, R_z, R_{max},etc.),contact between surfaces, deformation between single and multiple asperity contact, contact theories involved

Unit2: Friction **[07 Hours]**

Coulomb laws of friction, its applicability and limitations, comparison between static, rollingand kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

Unit3: Lubrication **[07 Hours]**

Types of lubrication, viscosity, characteristics of fluids lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed, boundary lubrication, various additives solid lubrication.

Unit4: Wear **[07 Hours]**

Sliding wear: Abrasion, adhesion and galling, testing method spin-on-disc, block-on-ring, etc . theory of sliding wear, un-lubricated wear of metals, lubricated wear of metals,fretting wear of metals, wear of ceramics and polymers.

Wearing by plastic deformation and brittle fracture. Wear by hard particles: Two-body abrasive wear,three-body abrasive wear, erosion, effects of hardness shape and size of particles.

Unit5: Wear and Design and Materials for Bearings **[07 Hours]**

Introduction, estimation of wear rates, the systems approach, reducing ear by changingthe operating variables, effect of lubrication on sliding wear, selection of materials and surface engineering. Principles and applications of tribo design

Materials for Bearings

Introduction, rolling bearings, Fluid film lubricated bearings, marginally lubricated and dry bearings, gas bearings.

Texts:

1. I. M. Hutchings, "Tribology,Friction and Wear Engineering Materials", Edward Arnold, London.
2. R. C. Gunther, "Lubrication",Baily Brother sand Swinfen Limited.
3. F. T. Barwell, "Bearing Systems, Principles and Practice", Oxford University Press.

References:

1. B. C. Majumdar, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Private Limited, Allahabad.
2. D. F. Dudley, "Theory and Practice of Lubrication for Engineers", John Willey and Sons.
3. J. Halling, "Principles of Tribology", Mc Millan Press Limited.
4. Cameron Alas Tair, "Basic Lubrication Theory", Wiley Eastern Limited.
5. M. J. Neale, "Tribology Handbook", Butterworth's.
6. D. D. Fuller, "Lubrication".

Fundamentals of Automobile Design

BTAPE504A	Automobile Design (Product Design, PLM, CAE, Catia)	PEC 2	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify the different parts of the automobile.
CO2	Explain the working of various parts like engine, transmission, clutch, brakes etc.,
CO3	Demonstrate various types of drive systems.
CO4	Apply vehicle troubleshooting and maintenance procedures.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	1	2		2		1						
CO3	1	1		1	1							
CO4	2			3	1							

Course Contents:

Domain related training (Approx. 20 Hrs)

Unit 1: **[07 Hours]**

Introduction to Styling, Basic of Design - Introduction to Design, Good Design & it's Examples of All Time, Industrial Design & its use. Design Process - Typical Product Life Cycle, Automotive Design Process (for production release), Design Studio (Automotive studio) Process or Product Conceptualization Process, Case Study. CAS Surfaces or Digital Clay Models, Class A Surfaces - Role of Class A surface Engineer, Requirements for a Surface to fulfill " Class A Surface" Standards, Case Studies for Class A Surfaces, Class A Surface Creation for Bonnet

Unit 2: **[07 Hours]**

Introduction to Body In White: Introduction & familiarization to Body In White (BIW), various type of BIW, Types of BIW sub system, various aggregates of BIW. Bonnet Design Case Study: Function of Bonnet, Defined Input to Bonnet, Intended Input to Bonnet Design. Steps in Bonnet design, Study of Class A Surfaces, Hood Package Layout , Typical Sections, Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D, Hood Structural Members, CAE 1(Durability, Crash), Panel Detail Design, Body Assembly Process, CAE 2(Durability, crash, individual panel level), Design Updating & Detailing Prototypes, Design Updating & Production Release

Unit 3: **[07 Hours]**

Introduction to CAE & its importance in the PLM, Introduction to FEA & its applications (NVH, Durability & Vehicle Crashworthiness). Introduction of Pre-Processor, Post-Processor &Solvers. Importance of discretization & Stiffness Matrix (for automobile components). Importance of oil canning on an automobile hood with Case study related to Durability Domain. Modal analysis on the hood (Case Study related to NVH Domain). Introduction of vehicle crashworthiness & Bio-mechanics (Newtonian laws, energy management, emphasis of impulse in car crashes). Head impact analysis as a Case study on the hood of an automobile (Eurocamp test regulation). Importance of Head performance criteria (HPC). Introduction to failure criteria (By explaining the analogy of using uni-axial test results for predicting tri-axial results in reality), Mohr's Circle, Von-Mises stress criteria, application of various failure criteria on brittle or ductile materials

Unit 4: **[07 Hours]**

Introduction to CAD, CAM& CAE, FEA - Definition, Various Domains – NVH, Dura, Crash, Occupant Safety, CFD. Implicit vs. Explicit Solvers, Degree of Freedom, Stiffness Matrix, Pre-Post & Solver; Types of solvers, Animation. Durability -Oil Canning, Oil Canning on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. NVH – Constrained Modal Analysis, Constrained Modal Analysis on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. Crash – Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria, Von-Mises Stress

Unit 5: **[07 Hours]**

Sheet metal design & Manufacturing Cycle, Simultaneous Engineering (SE) feasibility study, Auto Body & its parts, important constituents of an automobile, sheet metal, sheet metal processes. Type of draw dies, Draw Model development & its considerations. Forming Simulations, Material Properties, Forming Limit Curve (FLD), Pre-Processing, Post-Processing, Sheet metal formability- Simulation

Die Design –Sheet metal parts, Sheet metal operations (Cutting, Non-Cutting etc.), Presses, Various elements used in die design, Function of each element with pictures, Types of dies, Animation describing the working of dies, Real life examples of die design. **Fixture Design -** Welding (Spot/Arc Welding), Body Coordinates, 3-2-1 principle, Need for fixture, Design considerations, Use of product GD&T in the fixture design, fixture elements. Typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Typical unit design for sheet metal parts (Rest/Clamp/Location/Slide/Dump units/Base), Types of fixture (Spot welding/ Arc welding/ Inspection fixture/Gauges)

Tools related training (Approx. 20 Hrs):

Depending on the tools available in the college, the relevant tool related training modules shall be enabled to the students.

AutoCAD, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD P&ID, Autodesk 3ds Max, Autodesk Alias, Autodesk Sketch Book, Automotive, CATIA V5, CATIA V6, FEA, Autodesk Fusion 360, Autodesk Inventor, Autodesk Navisworks, Autodesk Ravit, Autodesk

Showcase, Autodesk Simulation, PTC Creo, PTC Pro ENGINEER, Solid Edge, SOLIDWORKS.

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.
4. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.

References:

1. Ibrahim Zeid,"CAD/CAM Theoryand Practice", Tata McGraw-Hill Publication,
2. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
3. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
4. On wubiko, C., "Foundation of Computer Aided Design", West Publishing Company.1989
5. R.W. Heine, C. R. Loper and P.C.Rosenthal, *Principles of Metal Casting*, McGraw Hill,Newyork, 1976.
6. J. H. Dubois And W. I .Pribble, *Plastics Mold Engineering Handbook*, Van Nostrand Reihnhold, New York, 1987.
7. N. K. Mehta, Machine tool design, Tata McGraw-Hill, New Delhi, 1989.
8. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
9. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
10. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
11. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer Verlag, 2004. ISBN 1852338105

Automobile Engineering

BTAPE504D	PEC2	Automobile Engineering	3-0-0	

Teaching Scheme	Examination Scheme
Lecture: 3 Hrs/week	Continuous Assessment: 20 Marks Mid semester examination: 20 Marks End Semester Exam: 60 Marks (3 hrs duration)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to :

CO1	Identify the different parts of the automobile.
CO2	Explain the working of various parts like engine, transmission, clutch, brakes etc.,
CO3	Demonstrate various types of drive systems; front and rear wheels, two and four wheel
drive	
CO4	Apply vehicle troubleshooting and maintenance procedures.
CO5	Analyze the environmental implications of automobile emissions. And suggest suitable regulatory modifications.

Mapping of course outcomes with program outcomes

CourseOu tcomesC	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
O1	2	1										
CO2	1	2		2		1						
CO3	1	1		1	1							
CO4	2			3	1							
CO5		2			1	1	2					
CO6	1		2			2						

Course Contents:

Unit1: Introduction
Vehicle specifications, Classifications, Chassis layout, Frame, Main components of automobile and articulated vehicles; Engine cylinder arrangements, Power requirements, Tractive efforts and vehicle performance curves.

Unit2: Steering and Suspension Systems
Steering system; Principle of steering, Centre point steering, Steering linkages, Steering geometry and wheel alignment, power steering.
Suspension system: its need and types, Independent suspension, coil and leaf springs, Suspension systems for multi-axle vehicles, troubleshooting and remedies.

Unit3: Transmission System
Clutch: its need and types, Gearboxes: Types of gear transmission, Shift mechanisms, Over running clutch, Fluid coupling and torque converters, Transmission universal joint, Propeller shaft, Front and rear axles types, Stub axles, Differential and its types, Four wheel drive.

Unit4: Brakes, Wheels and Tyres

Brake: its need and types: Mechanical, hydraulic and pneumatic brakes, Disc and drum type: their relative merits, Brake adjustments and defects, Power brakes

Wheels and Tyres: their types; Tyre construction and specification ; Tyre wear and causes; Wheel balancing.

Unit5: Electrical Systems

Construction, operation and maintenance of lead acid batteries, Battery charging system, Principle and operation of cutout and regulators, Starter motor, Bendix drive, Solenoid drive, Magneto-coil and solid stage ignition systems, Ignition timing.

Vehicle Testing and Maintenance

Need of vehicle testing, Vehicle test standards, Different vehicle tests, Maintenance: trouble shooting and service procedure, over hauling, Engine tune up, Tools and equipment for repair and overhauling, Pollution due to vehicle emissions, Emission control system and regulations.

Texts:

1. Kripal Singh, “Automobile Engineering”,Vol.I and II, Standard Publishers.
2. G.B.S.Narang,“Automobile Engineering”,Dhanpat Rai and Sons.

References:

1. Joseph Heitner, “Automotive Mechanics”, East-West Press.
2. W.H.Crouse, “Automobile Mechanics”, Tata McGraw Hill Publishing Co.

Open Elective-I

Solar Energy

BTMOE505A	OEC1	Solar Energy	3-0-0	3 credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe measurement of direct, diffuse and global solar radiations falling on horizontal and inclined surfaces.
CO2	Analyze the performance of flat plate collector, air heater and concentrating type collector.
CO3	Understand test procedures and apply these while testing different types of collectors.
CO4	Study and compare various types of thermal energy storage systems.
CO5	Analyze payback period and annual solar savings due to replacement of conventional systems.
CO6	Design solar water heating system for a few domestic and commercial applications.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	1	2				1						
CO3	2			1	1		2					
CO4	1	1										
CO5		2			1							
CO6			2	3		1	1					

Course Contents

Unit 1: Solar Radiation **[07 Hours]**

Introduction, spectral distribution, solar time, diffuse radiation, Radiation on inclined surfaces, measurement of diffuse, global and direct solar radiation.

Unit 2: Liquid Flat Plate Collectors **[07 Hours]**

Introduction, performance analysis, overall loss coefficient and heat transfer correlations, collect or efficiency factor, collect or heat removal factor, testing procedures.

Unit 3: Solar Air Heaters **[07 Hours]**

Introduction, types of air heater, testing procedure.

Unit 4: Concentrating Collectors **[07 Hours]**

Types of concentrating collectors, performance analysis

Unit 5: Thermal Energy Storage and Economic Analysis **[07 Hours]**

Introduction, sensible heat storage, latent heat storage and thermo chemical storage

Solar Pond: Solar pond concepts, description, performance analysis, operational problems.

Economic Analysis

Definitions, annular solar savings, payback period.

Texts:

1. J. A. Duffie, W. A. Beckman, "Solar Energy Thermal Processes", John Wiley, 1974.
2. K. Kreith,J. F. Kreider, "Principles of Solar Engineering", Tata McGraw-Hill Publications,1978.

References:

1. H. P. Garg, J. Prakash, "Solar Energy: Fundamentals and Applications", Tata McGraw Hill Publications, 1997.
2. S. P. Sukhatme, "Solar Energy Principles of Thermal Collection and Storage", Tata McGraw Hill Publications, 1996.

Renewable Energy Sources

BTMOE505B	OEC1	Renewable Energy Sources	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the difference between renewable and non-renewable energy
CO2	Describe working of solar collectors
CO3	Explain various applications of solar energy
CO4	Describe working of other renewable energies such as wind, biomass , nuclear

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1

Course Contents:

Unit 1: Solar Energy **[07 Hours]**

Energy resources, Estimation of energy reserves in India, Current status of energy conversion Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.

Unit 2: Solar Collectors **[07 Hours]**

Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC.

Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.

Unit 3: Solar Energy Applications **[07 Hours]**

Air/Water heating, Space heating/cooling, solar drying, and solar still, Photo-voltaic conversion.

Unit 4: Wind Energy and Biomass

Introduction to wind energy, Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and Introduction to biomass resources, Location of plants, Biomass conversion process,

Unit 5: Other Renewable Energy Sources **[07 Hours]**

Tidal, Geo-thermal, OTEC, hydro-electric, Nuclear energy

Texts:

1. Chetan singh Solanki, "Renewable Energy Technologies", Prentice Hallo India, 2008.

References:

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw-HillPublications,NewDelhi,1992.
2. G. D.Rai, "SolarEnergyUtilization",KhannaPublisher,Delhi,1992.

Human Resource Management

BTMOE505C	OEC1	Human Resource Management	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe trends in the labor force composition and how they impact human resource management practice.
CO2	Discuss how to strategically plan for the human resources needed to meet organizational goals and objectives.
CO3	Define the process of job analysis and discuss its importance as a foundation for human resource management practice
CO4	Explain how legislation impacts human resource management practice.
CO5	Compare and contrast methods used for selection and placement of human resources.
CO6	Describe the steps required to develop and evaluate an employee training program
CO7	Summarize the activities involved in evaluating and managing employee performance.
CO8	Identify and explain the issues involved in establishing compensation systems.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2						1	
CO2											3	
CO3										2		
CO4								2		2		
CO5									2	3		
CO6										1		3
CO7										2	2	
CO8											2	

Course Contents:

Unit1: Introduction to Human Resource management [07 Hours]

Concept of management, concept of human resource management, personnel to humanresource management, human resource management model, important environmentalinfluences like government regulations, policies, labor laws and other legislation. Acquisition of human resources: Human resource planning, Demand for man power, Weaknesses of man power planningg, job analysis, job specification, recruitment sources , recruitment advertising, the selection process, selection devices ,equal opportunities :Indian and foreign practices , socializing the new employee

Unit2: Development of Human resources [07 Hours]

Employee Training and Management Development: Training, Training and Learning ,Identification of training needs , training methods, Manager Development , Methods for developing managers , evaluating training effectiveness
Career Development: Concept of career, value of effective career development,external versus internal dimensions to a career, career stages, linking career dimensions with stages

Unit3:Motivationof Human resources [07 Hours]

Definition of motivation, Nature and Characteristics of Motivation ,The ories of motivation : a slow's Need Hierarchy Theory , Drucker Theory , Likert Theory, Herzberg Two Factortheory, Mc Clell and Theory, McGregor Theory X and Y, etc.,Psychological approach .Job Design and Work Scheduling: Design,SchedulingandExpectancyTheory,Jobcharacteristicsmodel,jobenrichment, job rotation ,work modules, flex-time, new trends in work scheduling.

Unit4: Performance appraisal [07 Hours]

Performance appraisal and expect ancy theory; appraisal process, appraisal methods, factors that can destroy appraisal. Rewarding the Productive Employee: Rewards and expectancy theory, typesof rewards, qualities of effective rewards, criterions for rewards.

Unit5:Maintenanceof Human resources and Labor Relations [07 Hours]

Compensation Administration : Concept of Compensation Administration, Job evaluation, Paystructures,Incentivescompensationplans.BenefitsandServicesBenefits: Something for everybody, Services , Trends in benefits and services .Discipline:ConceptofDiscipline,typesofdisciplineproblems,generalguidelines, disciplinary action,employment-at-will doctrine, disciplining special employee groups Safety and Health:safety programs, health programs, stress, turn out.

Unions, Major labor legislation, goals of group representation. Collective Bargaining: objectives , scope, participants of collective bargaining, process of collective bargaining, trends in collective bargaining Research and the future:What is research? Types of research, hyre searching human resource management, Secondary sources: where to look it up, Primary sources: relevant research methods, current trends and implications for humanresource management.

Texts:

1.David A. De Cenzo, StephenP. Robbins, "Personnel/Human Resources Management", Prentice Hall of India Pvt. Ltd,3rd edition,2002.
2. Trevor Bolton, "An Introduction to Human Resource Management", Infinity Books, 2001.

References:

1. Ellen E. Kossek, "Human Resource Management–TransformingtheWorkplace",InfinityBooks,2001.
2. G.S. Batra, R.C. Dangwal, "Human Resource Management New Strategies",DeepandDeepPublicationsPvt.Ltd.,2001.
3. D.M. Silvera, "HRD: TheIndianExperience",NewIndiaPublications,2nd edition,1990.

Product Design Engineering

BTMOE505D	OEC1	Product Design Engineering – I	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3hr/Week	Continuous Assessment: 20 MarksMid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

- **Pre-requisites:** Knowledge of Basic Sciences, Mathematics and Engineering Drawing

Course Outcomes: At the end of the course, students will be able to

CO 01. Understand the need for product design
CO 02. Apply various methods of idea generation
CO 03. Understand various types of prototypes and testing methods
CO 04. Understand the product economics at production scale
CO 05. Appreciate the environmental concerns in product lifecycle

Course Contents:

Unit 1: Introduction to Engineering Product Design [07 Hours]

Trigger for Product/Process/System, Problem solving approach for Product Design, Disassembling existing product(s) and understanding relationship of components with each other, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept,

Unit 2: Ideation & Conceptualization [07 Hours]

Generation of ideas, funneling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Market research for need, competitions, Product architecture, Designing of components, Drawing of parts and synthesis of a product from its component parts, 3-D visualization,

Unit 3: Testing and Evaluation Prototyping:

Design Automation, Prototype testing and evaluation, Working in multidisciplinary teams, Feedback to design processes, Process safety and materials, Health and hazard of process operations.

Unit 4: Manufacturing [07 Hours]

Design models and digital tools, Decision models, Prepare documents for manufacturing in standard format, Materials and safety data sheet, Final Product specifications sheet, Detail Engineering Drawings (CAD/CAM programming), Manufacturing for scale, Design/identification of manufacturing processes

Unit 5: Environmental Concerns [07 Hours]

Product life-cycle management, Recycling and reuse of products, Disposal of product and waste. Case studies.

Reference:

1. Model Curriculum for “Product Design Engineer – Mechanical”, NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)

2. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW-HILLbookcompany.
5. Roozenburg, N. F., &Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.
6. Lidwell, W., Holden, K., & Butler, J.(2010). Universal principles of designs,revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design. Rockport Pub.

Applied Thermodynamics

BTMC506	PCC11	Applied Thermodynamics	3-0-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define the terms like calorific value of fuel, stoichiometric air-fuel ratio, excess air, equivalent evaporation, boiler efficiency, etc. Calculate minimum air required for combustion of fuel.
CO2	Studied and Analyze gas power cycles and vapour power cycles and derive expressions for the performance parameters like thermal efficiency.
CO3	Classify various types of boilers, nozzle, steam turbine and condenser used in steam power plant.
CO4	Classify various types condenser, nozzle and derived equations for its efficiency.
CO5	Draw P-v diagram for single-stage reciprocating air compressor, with and without clearance volume, and evaluate its performance. Differentiate between reciprocating androtary air compressors.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	1	2										
CO3	1											
CO4			1									
CO5		2										

Course Contents:

Unit 1: Fuels and Combustion **[07 Hours]**

Types of fuels, calorific values of fuel and its determination, combustion equation for hydrocarbon fuel, determination of minimum air required for combustion and excess air supplied conversion of volumetric analysis to mass analysis, fuel gas analysis.

Unit 2: Steam Generators **[07 Hours]**

Classification of boilers, boiler details, requirements of a good boiler; merits and demerits of fire tube and water tube boilers, boiler mountings and accessories.

Boiler Draught: Classification of draught, natural draught, efficiency of the chimney, draught

losses, types of boiler draught.
Performance of Boilers: Evaporation, equipment evaporation, boiler efficiency, boiler trial and heat balance, Introduction to IBR.

Unit 3: Vapor and Gas Power Cycles, Steam Nozzles [07 Hours]
Ideal Rankine cycle, Reheat and Regeneration, Stirling cycle, Joule-Brayton cycle. Calculation of thermal efficiency, specific steam/fuel consumption, work ratio for above cycles.
Steam Nozzles: Types of Nozzles, flow of steam through nozzles, condition for maximum discharge, expansion of steam considering friction, super saturated flow through nozzles, General relationship between area, velocity and pressure.

Unit 4: Condensers, Cooling Towers and Steam Turbines [07 Hours]
Condensers and Cooling Towers: Elements of steam condensing plants, advantages of using condensers, types of condensers, thermodynamic analysis of condensers, efficiencies, cooling towers.
Steam Turbines: Advantages and classification of steam turbines, compounding of steam turbines, velocity diagrams, work one done and efficiencies, losses in turbines.

Unit 5: Reciprocating Air Compressor [07 Hours]
Classification constructional details, theoretical and actual indicator diagram, FAD, multi staging, condition for maximum efficiency, capacity control.
Rotary Compressor– Concepts of Rotary compressors, Root-blower and type compressors, Centrifugal compressors. Velocity diagram, construction and expression for work done, introduction to slip factor, power input factor.

Texts:

1. T. D. Eastop, A. McConkey, “Applied Thermodynamics”, Addison Wesley Longman.
2. Rayner Joel, “Basic engineering Thermodynamics”, Addison Wesley Longman.

References:

1. Yunus A. Cengel, “Thermodynamics- An Engineering Approach", Tata McGraw Hill Publications.
2. P. K. Nag, “Basic and Applied Thermodynamics", Tata McGraw Hill Publications.
3. P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill Publications, 2nd edition.
4. Sharma and Mathur, “Internal Combustion Engines”, Tata McGraw Hill Publications.

Mechanical Engineering Lab – III

BTMCL 507	PCC 11	Heat Transfer Lab.+Theory of	0-0-6	3 Credit

		Machines Lab II + Machine Design Practice-I		

Practical Scheme:	**Examination Scheme:**
Practical: 6 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Heat Transfer Lab)

List of Practical's/Experiments/Assignments (Any Three from Group

1. Determination of thermal conductivity of a metal rod.
2. Determination of thermal conductivity of insulating powder.
3. Determination of conductivity of a composite slab.
4. Temperature is distribution on a fin surface.
5. Determination of film heat transfer coefficient for natural convection.
6. Determination of film heat transfer coefficient for forced convection.
7. Determination of heat transfer coefficient for cylinder in cross flow in forced convection.
8. Performance of Double pipe Heat Exchanger/Shell and Tube Heat Exchanger.
9. Determination of emissivity of a metal surface.
10. Determination of Stefan Boltzman's constant.
11. Determination of critical heat flux.
12. Calibration of measuring instruments pressure gauge, thermocouple, flow-meter etc.

Group B (Theory of Machines Lab - II)

Listof Practical's/Experiments/Assignments (Any Three from Group B)

Term work should consist of total 10 experiments from the below given list.

1. Study of various types of gear boxes such as Industrial gear box, Synchromesh gear box, Differential gear box, etc.
2. To draw conjugate profile for any general shape of gear tooth
3. To generate gear tooth profile and to study the effects under cutting and rack shift using models
4. To draw cam profile for various types of follower motions
5. To study various types of lubricating systems
6. To study various types of dynamometers
7. To determine speed vs. lift characteristic curve of a centrifugal governor and to find its coefficient of insensitiveness and stability.
8. Verification of principle of gyroscope and gyroscopic couple using motorized gyroscope
9. Study of any tow gyro-controlled systems
10. To study the dynamic balancing machine and to balance a rotor such as a fan or the rotor of electric motor or disc on the machine

11. To determine the natural frequency of damped vibration of a single degree of freedom system and to find its damping coefficient
12. To verify natural frequency of torsional vibration of two rotor system and position of node
13. To determine critical speed of a single rotor system
14. To determine transverse natural frequency of a beam experimentally using frequency measurement setup
15. To determine the frequency response curve under different damping conditions for the single degree of freedom system
16. To study shock absorbers and to measure transmissibility of force and motion.
17. Study of epicyclic gear train and its dynamic behavior

Group C (Machine Design Practice – I)

List of Practical's/Experiments/Assignments

1. The term work shall consist of 01 design projects based on syllabus of Machine Design-I. Design project shall consist of 2 full imperial size sheets-one involving assembly drawings with a part list and overall dimensions and other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, where ever necessary, so as to make it a working drawing.
   Make the Project full on AutoCAD or on any 3D Design software print the full sheet on A3 size paper.
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file. Sheets for one of the projects will be drawn using AutoCAD and computer print outs using plotter of the same will be attached along with the design report.
3. At least two assignments based on topics of syllabus of Machine Design-I.

IT – 2 Evaluation

BTMI408 (IT – 2)	IT – 2 Evaluation	PROJ-3	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester - VI

Manufacturing Processes - II

BTMC 601	PCC12	Manufacturing Processes - II	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the process of powder metallurgy and its applications
CO2	Calculate the cutting forces in orthogonal and oblique cutting
CO3	Evaluate the machinability of materials
CO4	Understand the abrasive processes
CO5	Explain the different precision machining processes
CO6	Understanding plastic

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1			2					1
CO2	3	3										1
CO3	3	3	1	2	3							1
CO4	3	3	2									1
CO5	3	3	1	3								1
CO6	3	1	3	3	3			2				1

Course Contents:

Unit 1: Abrasive Machining and Finishing Operations **[07 Hours]**
Introduction; Abrasives and Bonded Abrasives: Grinding Wheels, Bond Types, Wheel Grade and Structure; Grinding Process: Grinding-wheel wear, Grinding Ratio, Dressing, Truing and Shaping of Grinding Wheels, Grindability of Materials and Wheel Selection; Grinding Operations and Machines, Finishing Operations

Unit 2: Mechanics of Metal Cutting **[07 Hours]**
Geometry of single point cutting tools, terms and definitions; chip formation, forces acting on the cutting tool and their measurement; specific cutting energy; plowing force and the "size effect"; mean shear strength of the work material; chip thickness: theory of Ernst and merchant, theory of Lee and Shaffer.

Unit 3: Thermal aspects, Tool wear, and Machinability **[07 Hours]**

Temperature in Metal Cutting: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures
Tool life and tool Wear: progressive tool wear; forms of wear in metal cutting: crater wear, flank wear, tool-life criteria.
Cutting tool materials: Basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; use of cutting fluid.

Unit 4: Processing of Powder Metals **[07 Hours]**

Introduction; Production of Metal Powders: Methods of Powder Production, Particle Size, Shape, and Distribution, Blending Metal Powders; Compaction of Metal Powders: Equipment, Isostatic Pressing, Sintering; Secondary and Finishing Operations.

Unit 5: Processing of Plastics Ceramics and Glasses **[07 Hours]**

Plastics: Introduction; Extrusion: Miscellaneous Extrusion Processes, Production of Polymer Reinforcing Fibers; Injection Molding: Reaction-injection Molding; Blow Moulding; Rotational Moulding; Thermoforming; Compression Moulding; Transfer Moulding; Casting; Foam Moulding; Cold Forming and Solid-phase Forming; Processing Elastomers.

Texts:
1. Serope Kalpakjian and Steven R. Schmid, " Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6thedition, 2009.
2. Geoffrey Boothroyd, Winston Knight, "Fundamentals of Machining and Machine Tools", Taylor and Francis, 3rd edition, 2006.

References:
1. Milkell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul De Garmo, J. T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing",

Wiley, 10th edition, 2007.
3. M. C. Shaw, "Theory of Metal Cutting", Oxford and I.B.H. Publishing, 1st edition, 1994.

Machine Design - II

BTMC 602	PCC13	Machine Design - II	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define function of bearing and classify bearings.
CO2	Understanding failure of bearing and their influence on its selection.
CO3	Classify the friction clutches and brakes and decide the torque capacity and friction disk parameter.
CO4	Select materials and configuration for machine element like gears.
CO5	Design of elements like gears, belts for given power rating

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1				1
CO2	3	2		1		1		1		1		1
CO3	1	1				1		1		1		1
CO4	3	3	2	1		2		1		1		1
CO5	1	1				1		1		1		1

Course Contents:

Unit1: Rolling Contact Bearings **[07 Hours]**

Types, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent load, load and life relationship, selection of bearing life, Load factor, selection of bearing from manufacturer's catalogue, Taper roller bearings and their selection, Cyclic loads and speeds, Design for probability of survivalotherthan90%Lubricationand mountings of rolling contact bearings.

Unit2: Spur Gear [07 Hours]

Gear drives, Classification of gears, Law of gearing, Terminology of spur gear, Standard system of gear tooth force analysis, gear tooth failures, Selection of materials Constructional, Number of teeth, Face with, Beams strength equation, Effective load on gear tooth, Estimation of module based on beams strength. Design for maximum power capacity, Lubrication of gears.

Helical Gears: Terminology, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength equation, Effective load on gear tooth Wear strength equation.

Unit3: Bevel Gears [07 Hours]

Types of bevel gears, Terminology of straight bevel, force analysis, Beam and Wear strength, Effective load on gear tooth.

Worm Gears: Terminology, Proportions, Force analysis, Friction in worm gears, Vector method, Selection of materials, Strength and wear rating, Thermal considerations

Unit4: Belt and Flywheel [07 Hours]

Flat and V belts, Geometric relationship, analysis of belt tensions,condition for maximum power, Selection of flat and V belts from manufacturer's catalogue,Adjustment of belt tensions. Roller chains, Geometric relationship, polygonal effect.

Flywheel: Introduction, types of flywheels, stresses in disc and armed flywheel.

Unit5: Brakes, Clutches [07 Hours]

Types of clutches, torque capacity, single and multi-plate clutches, cone clutch, centrifugal clutch, friction materials.

Types of brakes, energy equation, block with shoe brake, pivoted brake with long shoe, internal expanding shoe brake, thermal considerations.

Texts:

1. V. B. Bhandari, “Design of machine Elements”, Tata McGraw Hill Publications,NewDelhi,1998
2. R. L. Nortan, “Machine Design: An Integrated Approach”, Pearson Education.

References:

1. J.E. Shigley, C.Mischke, “Mechanical Engineering Design”, TataMcGraw Hill Inc, NewYork,6thedition, 2003.
2. R. C. Juvinall, K. M. Marshek, “Fundamentals of Machine Component Design”, John Wiley&Sons, Inc,NewYork,2002.

IC Engines

BTMPE603A	PEC3	IC Engines	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Applied Thermodynamics – I

Course Outcomes: At the end of the course, students will be able to

CO1	Understand various types of I.C. Engines and Cycles of operation.
CO2	Analyze the effect of various operating variables on engine performance
CO3	Identify fuel metering and fuel supply systems for different types of engines
CO4	Understand normal and abnormal combustion phenomena in SI and CI engines
CO5	Evaluate performance Analysis of IC Engine and Justify the suitability of IC Engine for different application
CO6	Understand the conventional and non-conventional fuels for IC engines and effects of emission formation of IC engines, its effects and the legislation standards

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						3					
CO2		2										
CO3	2											
CO4	2											
CO5					2		3					
CO6	2											

Course Contents:

Unit 1: Fundamentals of IC Engines **[07 Hours]**

Applications, nomenclature, engine components, Engine classification, two and four stroke cycle engines; fundamental difference between SI and CI engines; valve timing diagrams.

Power Cycles: Air standard Otto, Diesel and Dual cycles; Valve timing diagrams, Fuel-Air cycles and deviation of actual cycles from ideal cycles.

Unit 2: Combustion **[07 Hours]**

Introduction, important qualities and ratings of SI Engines fuels; qualities and ratings of CI Engine fuels.

Combustion in S.I. Engines, flame speed, ignition delay, normal and abnormal combustion, effect of engine variables on flame propagation and ignition delay, Combustion in C.I. Engines, combustion of a fuel drop, stages of combustion, ignition delay, combustion knock; types of SI and CI Engine combustion chambers.

Unit 3: Various Engine Systems and Engine Testing and Performance **[07 Hours]**

Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems.

Engine Testing and Performance of SI and CI Engines

Parameters, Type of tests and characteristic curves.

Super charging in IC Engine: Effect of attitude on power output, types of supercharging.

Engine Emissions and control: Pollutants from SI and CI engines and their control, emission regulations such as Bharat and Euro.

Unit 4: Alternate fuels **[07 Hours]**

Need for alternative fuels, applications, various alternate fuels etc

Gaseous Fuels, Alcohols, Biodiesels, vegetable oil extraction, Trans-esterification process, properties of alternative fuels and fuel blends.

Fuel Cell Technology: Operating principles, Types, construction, working, application, advantages and limitations.

Unit 5: Layout of Electric vehicle and Hybrid vehicles **[07 Hours]**

Advantages and drawbacks of electric and hybrid vehicles, System components, Electronic control system – Different configurations of Hybrid vehicles, Power split device. High energy and power density batteries – Basics of Fuel cell vehicles

Texts References:

1. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Publications, New Delhi, 3rd edition.

2. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988.
3. "Alternative Fuels", Dr. S. S. Thipse, Jaico publications.
4. "IC Engines", Dr. S. S. Thipse, Jaico publications.
5. "Engine Emissions, pollutant formation", G. S. Springer and D.J. Patterson, Plenum Press.
6. ARAI vehicle emission test manual.
7. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, "The Biodiesel Handbook", AOCS Press
8. Champaign, Illinois 2005.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers,
10. 1997, ISBN 0-76-80-0052-1.

Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.

Mechanical Vibration

BTMPE603B	PEC3	Mechanical Vibration	3-0-0	Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Theory of Machines - II

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the cause and effect of vibration in mechanical system
CO2	Formulate governing equation of motion for physical system
CO3	Understand role of damping, stiffness and inertia in mechanical system
CO	Analyze rotating system and calculate critical speeds
CO5	Estimate the parameters of vibration isolation system
CO6	Estimate natural frequencies and mode shapes of continuous system

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	1					2
CO2	3	3	2	1	1							2
CO3	3	2	2	1	1							2
CO4	3	3	2	2	2							2
CO5	3	3	2	2	2		3					2
CO6	3	3	3	2								2

Course Contents:

Unit 1: Single DOF- Free Vibrations **[07 Hours]**

Basic concepts: Causes and effect of vibrations, practical applications, harmonic and periodic motions, vibration terminology, vibration model, Equation of motion -natural frequency, Energy method, Rayleigh method, principle of virtual work, damping model, viscously damped free vibration, Oscillatory, non-oscillatory and critically damped motions, logarithmic decrement. Coulomb's damping.

Unit 2: Single DOF- Forced Vibrations **[07 Hours]**

Analysis of linear and torsional system subjected to harmonic force excitation, force transmissibility, Magnification factor, motion transmissibility, vibration isolation, typical isolator and mounts, critical speed of single rotor, undamped and damped.

Unit 3: Two DOF Systems **[07 Hours]**

Introduction, formulation of equation of motion, equilibrium method, lagrangian method, free vibration response, Eigen values and eigen vector, Normal mode and mode superposition, Coordinate coupling, decoupling equation of motion.

Unit 4: Torsional Vibration **[07 Hours]**

Simple system with one or two rotor masses, Multi DOF system: transfer matrix method, gearedsystem, and branched system.

Unit 5: Multi Degree of Freedom System and Continuous Systems **[07 Hours]**

Formulation of equation of motion, free vibration response, natural mode and mode shapes, orthogonality of model vectors, normalization of model vectors, decoupling of modes, model analysis, mode superposition technique. Free vibration response through model analysis. DF

Continuous Systems

Vibration of strings, longitudinal and transverse vibration of rods, transverse vibrations of beams, equation of motions and boundary conditions, transverse vibration of beams, natural frequencies and mode shapes.

Texts:

1. L. Meirovich, “Elements of Vibration Analysis”, Tata McGraw Hill.

References:

1. S. S. Rao, “Mechanical Vibrations”, Pearson education.
2. W. T. Thompson, “Theory of Vibration”, CBS Publisher.

Machine Tool Design

BTMPE603C	PEC3	Machine Tool Design	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Machine design and Manufacturing processes-I

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand basic motion involved in a machine tool.
CO2	Design machine tool structures for conventional and CNC machines.
CO3	Design and analyze system for specified speeds and feeds.
CO4	Understand control strategies for machine tool operations.
CO5	Design of rotary and linear drive for machine tools.
CO6	Analyze machine tool structure for design accuracy.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1				1	1	1
CO2	3	1	3	1	2	1	1		1	1	1	1
CO3	2	1	2	1	1	1			1	1	1	1
CO4	2	1	1	1	1	1	1			1	1	1
CO5	3	1	3	1	1	1	1		1	1	1	1
CO6	2	1	2	1	1	1	1		1	1	1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**

Kinematics of different types of machine tools, selection of cutting conditions and tools, calculations of cutting force on single point and multipoint tools, hole machining, calculation of power, accuracy requirements and standards.

Unit 2: Design of Rotary Drives **[07 Hours]**

Design of spindle drives, AC motors with stepped drive, DC and AC variable speed drive motor characteristics and selection, principle of speed controllers, timing belts and other types of transmission belting, closed loop operation of mail drives, rotary indexing drives.

Unit 3: Design of Feed Drives **[07 Hours]**

Feed drive using feed boxes, axes feed drive of CNC drives, DC and AC servomotors, characteristics controllers and their selection, Ball screws and friction guide ways, linear motion systems, design calculation of drives, closed loop operations of feed drive, linear indexing drives.

Unit 4: Control Elements **[07 Hours]**

Single and multi-axis CNC controllers, hydraulic control, Pneumatic control limit switches, proximity switches, sequencing control using hardwired and PLC systems.

Design of machine tool structures: Static and dynamic stiffness, dynamic analysis of cutting process, stability, forced vibration, ergonomics and aesthetics in machine tool design.

Unit 5: Design of Spindle and Spindle Supports and Design of Special Purpose Machines **[07 Hours]**

Function of spindles, design requirements, standard spindle noses, design calculation of spindles,bearing selection and mounting.

Finite elements analysis of machine tool structures: Examples of static, dynamic and thermal analysis and optimization of typical machine tool structure like column and using a finite element analysis package.

Design of Special Purpose Machines

Modular design concepts, standard modules, example of design of typical SPM with CNC, transfer machines.

Texts:

1. N. K. Mehta, "Machine Tool Design", Tata McGraw Hill Book Co., 1991.
2. P.C. Sharma, "A Textbook of Machine Tools and Tool Design", S. Chand & Co. Ltd., 1 January 2005.
3. Sen and Bhattacharya, "Principles of Machine Tools", 1 Jan 2009.
4. Yoram Koren, "Computer control of manufacturing systems", Tata McGraw Hill Education, 2009.

References:

1. Aacherkan, "Machine Tool Design", Vol. I and Vol. III, Mir Publishers, Moscow,1970.
2. W. L. Cheney, "Details of Machine Tool Design (Classic Reprint)", Forgotten Books, 20 Sep 2016.
3. Central Machine Tool Institute, "Machine Tool Design Handbook", Tata McGraw Hill Education, 1st Edition, 16 June 2001.
4. Nicholas Lisitsyn, Alexis V Kudryashov, Oleg Trifonov, Alexander Gavryusin, N Acherkan, Nicholas Weinstein, "Machine Tool Design", Vol. I, University Press of the Pacific, 20 April 2000.

Engineering Metrology and Quality Control

BTMPE603D	PEC 3	Metrology and Quality Control	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify techniques to minimize the errors in measurement
CO2	Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts.
CO3	Choose limits for plug and ring gauges.
CO4	Explain methods of measurement in modern machineries
CO5	Select quality control techniques and its applications
CO6	Plot quality control charts and suggest measures to improve the quality of product and reduce cost using Statistical tools.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								2
CO2		2	2		2							
CO3			2	3	2							
CO4						3						
CO5	1					2		3	3		3	2
CO6	1					2		3	3		2	2

Course Contents:

Unit 1: Measurement Standard and Comparators **[07 Hours]**

Measurement Standard, Principles of Engineering Metrology, Line end, wavelength, Traceability of Standards. Types and Sources of error, Alignment, slip gauges and gauge block, Linear and Angular Measurement (Sine bar, Sine center, Autocollimator, Angle Décor and Dividing head), Calibration. Comparator: Mechanical, Pneumatic, Optical, Electronic (Inductive), Electrical

(LVDT).

Unit 2: Interferometry and Limits, Fits, Tolerances **[07 Hours]**

Principle, NPL Interferometer, Flatness measuring of slip gauges, Parallelism, Laser Interferometer, Surface Finish Measurement: Surface Texture, Measuring Surface Finish by Stylus probe, Tomlinson and Talysurf, Analysis of Surface Traces: Methods.

Design of Gauges: Types of Gauges, Limits, Fits, Tolerance; Terminology for limits and Fits. Indian Standard (IS 919-1963) Taylor's Principle.

Unit 3: Metrology of Screw Thread **[07 Hours]**

Gear Metrology: Gear error, Gear measurement, Gear Tooth Vernier; Profile Projector, Tool marker's microscope. Advancements in Metrology: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.

Unit 4: Introduction to Quality and Quality Tools **[07 Hours]**

Quality Statements, Cost of Quality and Value of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Seven Quality Tools: Check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brain storming, Quality circles.

Unit 5: Total Quality Management and Statistical Quality Control **[07 Hours]**

Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects.

Statistical Quality Control: statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability.

Acceptance Sampling**:** Sampling Inspection, sampling methods. Introduction to ISO 9000**:** Definition and aims of standardizations, Techniques of standardization, Codification system.

Texts:

1. I. C. Gupta, "Engineering Metrology", Dhanpat and Rai Publications, New Delhi, India.
2. M. S. Mahajan, "Statistical Quality Control", Dhanpat and Rai Publications.

References:

1. R. K. Jain, "Engineering Metrology", Khanna Publications, 17th edition, 1975.
2. K. J. Hume, "Engineering Metrology", McDonald Publications, 1st edition, 1950.
3. A. W. Judge, "Engineering Precision Measurements", Chapman and Hall, London, 1957.
4. K. L. Narayana, "Engineering Metrology", Scitech Publications, 2nd edition.
5. J. F. Galyer, C. R. Shotbolt, "Metrology for Engineers", Little-hampton Book Services Ltd., 5th edition, 1969.
6. V. A. Kulkarni, A. K. Bewoor, "Metrology & Measurements", Tata McGraw Hill Co. Ltd., 1st edition, 2009.
7. AmitavaMitra, "Fundamental of Quality Control and Improvement", Wiley Publication.
8. V. A. Kulkarni, A. K. Bewoor, "Quality Control", Wiley India Publication, 01st August, 2009.

9. Richard S. Figliola, D. E. Beasley, “Theory and Design for Mechanical Measurements”, Wiley India Publication.
10. E. L. Grant, “Statistical Quality Control”, Tata McGraw Hill Publications.
J. M. Juran, “Quality Planning and Analysis”, Tata McGraw Hill Publications.

Advance Automobile Design

BTAPE603C	PEC3	Automobile Body Design	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

Course Contents:

Domain Related Training

Unit 1: **[07 Hours]**

BIW: Requirement Specification in the Pre-Program Stage, Product Life Cycle & Important Gateways for BIW, Identification of Commodities for BIW, Design Concept & Considerations in BIW, BIW Materials & Grades, GD & T for BIW.

Unit 2: **[07 Hours]**

Sheet Metal Joining – Welds, Adhesives, TWBs. DFMEA, Design Verification – CAE Methods & Gateway supports Part A& B, CAE Analysis – NVH, Crash & Durability, Test Validation & Assessment.

Unit 3: **[07 Hours]**

Manufacturing – Sequence, Welding & Assembly, Future Trends in BIW, BIW: Examples & Case Studies

Unit 4: **[07 Hours]**

Trims: Requirement Specification in the Pre-Program Stage, Product Life Cycle & Important Gateways for Trims, Identification of Commodities for Trims, Design Requirements & Considerations, Trim Materials in Automotive.

Unit 5: **[07 Hours]**

Design of Plastic Part, DFMEA, Design Verification – CAE Methods & Gateway supports, CAE Analysis – Moldflow, Crash & Durability, Test Validation & Assessment
Manufacturing Process, Assembly Sequence, Future Trends & Future Material for Trims, Trims: Examples & Case Studies

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.

References:

1. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.
2. R. D. Cook, Concepts and Applications of Finite Element Analysis; John Wiley and Sons, second edition, 1981.
3. K.J. Bathe, Finite Element Method and Procedures; Prentice hall, 1996.
4. Ibrahim Zeid,"CAD/CAM Theory and Practice", Tata McGraw Hill Publication,
5. J. H. Dubois And W. I. Prebble, *Plastics Mold Engineering Handbook*, Van Nostr and Reihnhold, New York, 1987.
6. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
7. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
8. Jesper Christensen and Christophe Bastien, "Nonlinear Optimization of Vehicle Safety Structures: Modeling of Structures Subjected to Large Deformations, Butterworth-Heinemann, Kindle Edition
9. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
10. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer Verlag, 2004. ISBN 1852338105

E Vehicles

BTAPE603E	E Vehicles	PEC 3	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None
Course Outcomes: At the end of the course, students will be able to

Course Contents:

Unit I: Introduction to EV: **[07 Hours]**
Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs, Comparison of EV Vs IC Engine.
Unit II: EV System: **[07 Hours]**
EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives
EV Parameters:
Weight, size, force, energy & performance parameters.
Unit III: EV Propulsion: **[07 Hours]**
Electric Motor:
Choice of electric propulsion system, block diagram of EV propulsion system, concept of EV Motors, single motor and multi-motor configurations, fixed & variable geared transmission, In-wheel motor configuration, classification of EV motors, Electric motors used in current vehicle applications, Recent EV Motors, Comparison of Electric Motors for EV applications
Required Power Electronics & Control:
Comparison of EV power devices, introduction to power electronics converter, four quadrant DC chopper, three-phase full bridge voltage-fed inverter, soft-switching EV converters, comparison of

hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter, Basics of Microcontroller & Control Strategies

Unit IV: EV Motor Drive: **[07 Hours]**

DC Motor: Type of wound-field DC Motor, Torque speed characteristics

DC-DC Converter, two quadrant DC Chopper, two quadrant zero voltage transition converter-fed dc motor drive, speed control of DC Motor

Induction Motor Drive: Three Phase Inverter Based Induction Motor Drive, Equal Area PWM, Three Phase Auxiliary resonant snubber (ARS) Inverter Type (ZVC & ZCS), Single Phase ARS Inverter Topology, Speed Control of Induction Motor, FOC, Adaptive Control, Model Reference Adaptive Control (MARS), Sliding mode Control,

Unit V: Energy Sources & Charging: **[07 Hours]**

Different Batteries and Ultracapacitors, Battery characteristics (Discharging &Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit.

Arrangementof an off-board conductive charger, Standard power levels of conductive chargers, Inductive(Principle of inductive charging, Soft-switching power converter for inductive charging), Batteryindication methods

Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

References:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Process Equipment Design

BTMPE604A	PEC4	Process Equipment Design	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the factors influencing design of pressure vessel
CO2	Calculate thickness and thickness variation for cylindrical storage tank
CO3	Estimation of thickness for thin and thick wall pressure vessels
CO4	Design of flange and gasket selection for cylindrical pressure vessels
CO5	Selection of various blade and baffle arrangement for agitators
CO6	Design of support for horizontal and vertical vessel

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1			1	1	1				1
CO2	2	2	1			1	1	1				1
CO3	2	2	2			1	1	1				1
CO4	2	2	2			1	1	1				1
CO5	2	2	1			1	1	1				1
CO6	2	2	2			1	1	1				1

Course Contents:

Unit 1: Design Considerations for Pressure Vessel [07 Hours]

Selection of type of vessel, Methods of fabrication, Effect of fabrication methods, various criteria in vessel design, Economic considerations, Types of process equipment, Constructional requirement and applications. Fabrication and testing, Inspection and non-destructive testing of equipment.

Unit 2: Storage Vessel [07 Hours]

Design methods of atmospheric storage vessel: storage of fluids, storage of non-volatile liquids, storage of volatile liquids, storage of gases, Optimum tank proportion, Bottom design, Shell design, Wind girder for open top tank, Rub curb angle, Self-supported roof, Design of rectangular tank,

Unit 3: Pressure Vessel [07 Hours]

Unfired process vessel with internal and external pressure, Operating condition, Selection of material, Design condition, Stresses, Design criteria, Design of shell subjected to internal and external pressure, cylindrical vessel under combined loading,

Design of heads and closures: flat head and formed heads for vessel. Design consideration for rectors and chemical process vessels. Flange facings, Gaskets, Design of flanged joint, Flange thickness, and Blind flanges.

Unit 4: High Pressure Vessel [07 Hours]

Design of thick-walled high-pressure vessel, Constructional features, Materials for high-pressure vessels, Multilayer vessel with shrink fit construction, Thermal expansion for shrink fitting, stress in multi shell or shrink fit construction, autofrettage, Pre-stressing. Tall vessels and their design, Stress in shell, Determinations of longitudinal stresses, Longitudinal bending stresses due to eccentric loads, Determination of resultant longitudinal stresses.

Unit 5: Agitated Vessel and Support for Pressure Vessel [07 Hours]

Type of agitators, Baffling, Power requirement for agitation, Design based on torque and bending moment, Design based on critical speed, Blade design, Hub and key design, Stuffing box and gland design, Turbine agitator design,

Support for Pressure Vessel

Bracket or lug support: Thickness of the base plate, Thickness of web (gusset) plate, Column support for bracket base plate for column or leg support. Skirt Support: Skirt design, Skirt bearing plate, and Anchor bolt design, Design of bolting chair. Saddle Support: Longitudinal bending moment, Stresses in shell at saddle.

Texts:

1. V. V. Mahajani, S. B. Umarji, “Process Equipment Design”, Macmillan Publisher India Ltd.
2. L. E. Brownell, E. H. Young, “Process equipment design”, John Wiley and Sons.
3. C. Bhattacharya, “Introduction to process Equipment Design”.

Reference Book:

1. Dennis Moss, “Pressure Vessel Design Manual”, Elsevier.
2. John F. Harvey, “Theory and Design of Pressure Vessels”, CBS Publication

Product Life Cycle Management

BTMPE604B	PEC4	Product Life Cycle Management	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Objectives: Establishing industry partnerships that guide, support, and validate PLM research and education activities assisting with the integration of PLM into College curricula and facilitating the PLM career opportunities.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline the concept of PLM.
CO2	Illustrate the PDM system and its importance.
CO3	Illustrate the product design process.
CO4	Build the procedure for new product development.
CO5	Classify and compare various technology forecasting methods.
CO6	Outline the stages involved in PLM for a given product.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				1						1	
CO2	1				1		1				1	
CO3	1		1		1							
CO4	1		1		1						1	

CO5	1				1		1					
CO6	1				1				1			1

Course Contents:

Unit 1: Introduction and strategies to PLM **[07 Hours]**

Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning, Industrial strategies, strategy elements, its identification, selection and implementation, change management for PLM.

Unit 2: Product Data Management (PDM) **[07 Hours]**

Human resources in product lifecycle, Information, Standards, Vendors of PLM Systems and Components, PDM systems and importance, reason for implementing a PDM system, financial Justification of PDM, barriers to PDM implementation

Unit 3: Product Design **[07 Hours]**

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modeling and simulation in product design.

Unit 4: New Product Development **[07 Hours]**

Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program, Concept of redesign of product

Unit 5: Technology Forecasting and PLM Software and Tools **[07 Hours]**

Future mapping, invocating rates of technological change, methods of technology forecasting such as relevance trees, morphological methods and mission flow diagram, combining forecast of different technologies, uses in manufacture alternative.

PLM Software and Tools

Product data security. Product structure, workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications.

Texts/References:

1. Grieves, Michael, "Product Lifecycle Management", Tata McGraw-Hill, 2006, ISBN 007145230330.
2. Antti Saaksvuori, Anselmi Immonen, "Product Life Cycle Management", Springer, 1st edition, 2003.
3. Stark, John, "Product Lifecycle Management: Paradigm for 21stCentury Product Realization", Springer-Verlag, 2004.
4. Fabio Giudice, Guido La Rosa, "Product Design for the environment-A life cycle approach", Taylor & Francis, 2006.
5. Robert J. Thomas, "NPD: Managing and forecasting for strategic processes".

Finite Element Method

BTMPE604C	PEC4	Finite Element Method	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural, thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two- and three-dimensional problems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				1		1	1
CO2	2	3	2	1	2	1		1			2	1
CO3	3	2	2	1	1				1		2	1
CO4	3	3	2	1	2		1		1		2	1

CO5	3	1	1		1		1				2	1
CO6	1	1	1						1		1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**

Finite element analysis and its need, Advantages and limitations of finite element analysis (FEA), FEA procedure.

Unit 2: Elements of Elasticity **[07 Hours]**

Stress at a point, Stress equation of equilibrium, 2-D state of stress, Strains and displacements, Stress-strain relationship for 2-D state of stress, Plane stress and plane strain approach.

Unit 3: Relevant Matrix Algebra **[07 Hours]**

Addition, subtraction and multiplication of matrices, Differentiation and integration of matrices, Inverse of a matrix, Eigen values and eigen vectors, Positive definite matrix, Gauss elimination.

Unit 4: One-Dimensional Problems **[07 Hours]**

Introduction, FE modeling, Bar element, Shape functions, Potential energy approach, Global stiffness matrix, Boundary conditions and their treatments, Examples.

Unit 5: Trusses and Frames and Two-dimensional Problems **[07 Hours]**

Introduction, Plane trusses, Element stiffness matrix, Stress calculations, Plane frames, examples.

Two-dimensional Problems

Introduction and scope of 2-D FEA, FE modeling of 2-D problem, Constant strain triangle, other finite elements (no mathematical treatment included), Boundary conditions.

Texts:

T. R. Chandrupatla, A.D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.

P. Seshu, “A Textbook of Finite Element Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, “Concepts and Applications of Finite Element Analysis”, John Wiley &Sons, Inc.

References:

K. J. Bathe, “Finite Element Procedures”, Prentice Hall of India Pvt. Ltd., 2006.

Robotics

BTMPE604D	PEC4	Robotics	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	List the various components of a typical Robot, grippers, sensors, drive system and describe their functions
CO2	Calculate the word to joint and joint to word coordinates using forward and reverse transformations
CO3	Calculate the gripper forces, drive sizes, etc.
CO4	Develop simple robot program for tasks such as pick and place, arc welding, etc. using some robotic language such as VAL-II, AL, AML, RAIL, RPL, VAL
CO5	Evaluate the application of robots in applications such as Material Handling, process operations and Assembly and inspection
CO6	Discuss the implementation issues and social aspects of robotics

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				3	1		
CO2	2	3	2	1	2	1			3	2		
CO3	3	2	2	1	1				3	2		

CO4	3	3	2	1	2		1		3	2		
CO5	3	1	1		1		1		3	2		
CO6	1	1	1						3	2		

Course Contents:

Unit 1: Introduction
Various basic components of a Robotic system, various configurations, work envelopes, Manipulators, Controllers, etc., Parameters **[07 Hours]**

Unit2: Mechanical Systemin Robotics
Motion conversion, Kinematic chains, position analysis, forward and reverse transformations, natural and joint space coordinates, homogeneous transformation and robot kinematics, Manipulator path control, Robot Dynamics.
[07 Hours]

Unit3: Drives for Robot
Electrical drives**,** Stepper motor, Servo motors,DC motors ,AC motors, hydraulic and pneumatic drives, hybrid drives, drive selection for robotic joints.
[07 Hours]

Unit4: Sensors and End Effectors in Robotics
Sensors:
Position sensor, velocity sensor, proximity sensors , touch sensors, force sensors, miscellaneous sensors etc. **[07 Hours]**
End Effectors:
Types of end effectors, Mechanical Grippers, Design of End Mechanical Grippers, and Other Principles of gripping, Tools and end effectors, Considerations in gripper selection and design.

Unit5: Robot Programming **[07 Hours]**
Path planning, Lead through (manual and powered) programming, teach pendant mode, programming languages, Simple statements from AL, AML, RAIL, RPL, VAL Languages

Artificial Intelligence for Robots: Knowledge Representation, Problem representation and problem solving, search techniques in problem solving
Application of robot in: Material handling, assembly and inspection, process operations, etc.Economic Analysis for robotic implementation

Texts:
1. M. P. Grover,“ Industrial Robotics: Technology, Programming andApplications ”,Tata Mc Graw Hill Publication.

References:
1. Saeed B. Niku, “Introduction to Robotics, Analysis, Systems, Applications ”,Pearson Education.

2. Richard D. Klafter, “Robotic Engineering :An Integrated Approach”, Prentice Hall of India.

Computational Fluid Dynamics

BTAPE604B	Fundamentals of Computational Fluid Dynamics	PEC 4	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify applications of finite volume and finite element methods to solve Navier-Stoke equations.
CO2	Evaluate solution of aerodynamic flows. Appraise & compare current CFD software. Simplif flow problems and solve them exactly.
CO3	Design and setup flow problem properly within CFD context, performing solid modeling usin CAD package and producing grids via meshing tool
CO4	Interpret both flow physics and mathematical properties of governing Navier-Stokes equation and define proper boundary conditions for solution.
CO5	Use CFD software to model relevant engineering flow problems. Analyse the CFD results Compare with available data, and discuss the findings

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				3	1		

CO2	2	3	2	1	2	1			3	2		
CO3	3	2	2	1	1				3	2		
CO4	3	3	2	1	2		1		3	2		
CO5	3	1	1		1		1		3	2		
CO6	1	1	1						3	2		

Course Contents:

Unit-I: Introduction to CFD **[07 Hours]**

CFD – a research and design tool, CFD as third dimension of engineering supplementing theory and experiment, Steps in CFD solution procedure, strengths and weakness of CFD, Flow modeling using control volume - finite and infinitesimal control volumes, Concept of substantial derivative, divergence of velocity, Basic governing equations in integral and differential forms – conservation of mass, momentum and energy (No derivations), Physical interpretation of governing equations, Navier-Stoke's model and Euler's model of equations.

Unit- II: Basic Discretization Techniques **[07 Hours]**

Introduction to grid generation (Types of grids such as structured, unstructured, hybrid, multi-block, Cartesian, body fitted and polyhedral etc.), Need to discretize the domain and governing equations, Finite difference approximation using Taylor series, for first order (Forward Difference Approximation, Backward Difference Approximation, Central difference Approximation) and second order (based on 3 node, 4 node and 5 node points),explicit and Implicit approaches applied to 1D transient conduction equation, Counter flow equation () usingFTCS and Crank Nicholson's Method, Stability Criteria concept and physical interpretation,Thomas Tri-diagonal matrix solver.

Unit-III: Two Dimensional Steady and unsteady heat conduction **[07 Hours]**

Solution of two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, Robbins and mixed boundary condition – solution by Explicit and Alternating Direction Implicit method (ADI Method), Approach for irregular boundary for 2D heat conduction problems.

Unit-IV: Application of Numerical Methods to Convection – Diffusion system [07 Hours]

Convection: first order wave equation solution with upwind, Lax–Wendroff, Mac Cormack scheme, Stability Criteria concept and physical interpretation **Convection –Diffusion:** 1D and 2D steady Convection Diffusion system – Central difference approach, Peclet Number, stability criteria, upwind difference approach, 1 D transient convection-diffusion system

Unit-V: Incompressible fluid flow **[07 Hours]**

Solution of Navier-Stoke's equation for incompressible flow using SIMPLE algorithms and its variation (SIMPLER), Application to flow through pipe, Introduction to finite volume method.

CFD as Practical approach

Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition types such as no slip, free slip, rotating wall, symmetry and periodic, wall roughness, initializing and solution control for the solver, Residuals, analyzing the plots of various parameters (Scalar and Vector contours such as streamlines, velocity vector plots and animation). Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ, k-. Simple problems like flow inside a 2-D square lid driven cavity flow through the nozzle

Texts/References:

1. "Computational Fluid Dynamics", John D Anderson: The Basics with Applications, McGraw-Hill
2. "Computational Fluid Dynamics", J. Tu, G.-H. Yeoh and C. Liu: A practical approach, Elsevier.
3. "Introduction to Computational Fluid Dynamics", A. W. Date: Cambridge University Press
4. "Computer Simulation of Fluid flow and heat transfer", P.S. Ghoshdastidar: Tata McGraw-Hill.
5. "Numerical Simulation of internal and external flows", Vol. 1, C. Hirsch, Wiley
6. Computational Fluid Mechanics and Heat transfer, Tannehill, Anderson, and Pletcher, CRC Press.

Open Elective-II

Quantitative Techniques in Project Management

BTMOE605A	OEC 2	Quantitative Techniques in Project Management	3-1-0	4Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Engineering Mathematics-I/II/III

Course Outcomes: At the end of the course, students will be able to:

CO1	Define and formulate research models to solve real life problems for allocating limited resources by linear programming.
CO2	Apply transportation and assignment models to real life situations.
CO3	Apply queuing theory for performance evaluation of engineering and management systems.
CO4	Apply the mathematical tool for decision making regarding replacement of items in real life.
CO5	Determine the EOQ, ROP and safety stock for different inventory models.
CO6	Construct a project network and apply CPM and PERT method.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	3	2				3	1	3	1
CO2	3	1	1	3	2				3	2	3	1
CO3	3	1	1	3	2				3	2	3	1
CO4	3	1	1	3	2	1			3	2	3	1
CO5	3	1	1	3	2	1			3	2	3	1
CO6	3	1	1	3	2	2			3	2	3	1

Course Contents:

Unit 1: Introduction [07 Hours]

Introduction to Operations Research, Stages of Development of Operations Research, Applications of Operations Research, Limitations of Operations Research Linear programming problem, Formulation, graphical method, Simplex method, artificial variable techniques.

Unit 2: Assignment and Transportation Models [07 Hours]

Transportation Problem, North west corner method, Least cost method, VAM, Optimality check methods, Stepping stone, MODI method, Assignment Problem, Unbalanced assignment problems, Travelling salesman problem.

Unit 3: Waiting Line Models and Replacement Analysis [07 Hours]

Queuing Theory: Classification of queuing models, Model I (Birth and Death model) M/M/I (∞, FCFS), Model II - M/M/I (N/FCFS).

Replacement Theory, Economic Life of an Asset, Replacement of item that deteriorate with time, Replacement of items that failed suddenly.

Unit 4: Inventory Models [07 Hours]

Inventory Control, Introduction to Inventory Management, Basic Deterministic Models, Purchase Models and Manufacturing Models without Shortages and with Shortages, Reorder level and optimum buffer stock, EOQ problems with price breaks.

Unit 5: Project Management Techniques and Time and Cost Analysis [07 Hours]

Difference between project and other manufacturing systems. Defining scope of a project, Necessity of different planning techniques for project managements, Use of Networks for planning of a project, CPM and PERT.

Time and Cost Analysis

Time and Cost Estimates: Crashing the project duration and its relationship with cost of project, probabilistic treatment of project completion, Resource allocation and Resource leveling.

Texts:

1. P. K. Gupta, D. S. Hira, “Operations Research”, S. Chand and Company Ltd., New Delhi, 1996.
2. L. C. Jhamb, “Quantitative Techniques for managerial Decisions”, Vol. I and II, Everest Publishing House, Pune, 1994.
3. N. D. Vohra, “Operations Research”, Tata McGraw Hill Co., New Delhi.

References:

1. H. Taha, "Operations Research–An Introduction", Maxwell Macmillan, New York.
2. J. K. Sharma, "Operations Research–An Introduction", Maxwell Macmillan, New Delhi.
3. Harvey M. Wagner, "Principles of Operations Research with Applications to Managerial Decisions", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd edition, 2005.
4. Rubin and Lewin, "Quantitative Techniques for Managers", Prentice Hall of India Pvt. Ltd., New Delhi.

Nanotechnology

BTMOE605B	OEC2	Nanotechnology	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.
CO2	To impart basic knowledge on various synthesis and characterization techniques involved in Nanotechnology
CO3	To educate students about the interactions at molecular scale
CO4	Evaluate and analyze the mechanical properties of bulk nanostructured metals and alloys, Nano-composites and carbon nanotubes.
CO5	To make the students understand about the effects of using nanoparticles over conventional methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		3	3	2	1		3		1	3
CO2	3	2			3	3	2				1	3
CO3	1	1	1	3	2				2	1		1

CO4	1	1		3	3	2	1		3		1	3
CO5	1	1	1	3	2				2	1		1

Course Contents:

Unit 1: Scientific Revolutions [07 Hours]

Types of Nanotechnology and Nano machines: the Hybrid nanomaterial. Multiscale hierarchical structures built out of Nano sized building blocks (nano to macro). Nanomaterial's in Nature: Nacre, Gecko, Teeth. Periodic table, Atomic Structure, Molecules and phases, Energy, Molecular and atomic size, Surfaces and dimensional space: top down and bottom up.

Unit 2: Forces between Atoms and Molecules [07 Hours]

Particles and grain boundaries, strong Intermolecular forces, Electrostatic and Vander Waals forces between surfaces, similarities and differences between intermolecular and inter particle forces covalent and coulomb interactions, interaction polar molecules.

Thermodynamics of self-assembly.

Unit 3: Opportunity at the Nano Scale [07 Hours]

Length and time scale in structures, energy landscapes, Inter dynamic aspects of inter molecular forces, Evolution of band structure and Fermi surface.

Unit 4: Nano Shapes [07 Hours]

Quantum dots, Nano wires, Nano tubes, 2D and 3D films, Nano and mesopores, micelles, bilayer, vesicles, bio nano machines, biological membranes.

Unit 5: Influence of Nano Structuring and Nano Behavior [07 Hours]

Influence of Nano structuring on mechanical, optical, electronic, magnetic and chemical properties-gram size effects on strength of metals- optical properties of quantum dots.

Nano Behavior

Quantum wires, electronic transport in quantum wires and carbon nano-tubes, magnetic behavior of single domain particles and nanostructures, surface chemistry of Tailored monolayer, self-assembling.

Texts:

1. C. Koch, "Nanostructured materials: Processing, Properties and Potential Applications", Noyes Publications, 2002.
2. C. Koch, I. A. Ovidko, S. Seal and S. Veprek, "Structural Nano crystalline Materials: Fundamentals & Applications", Cambridge University Press, 2011.

References:

1. Bharat Bhushan, "Springer Handbook of Nanotechnology", Springer, 2nd edition, 2006.

2. Laurier L. Schramm, “Nano and Microtechnology from A-Z: From Nano-systems to Colloids and Interfaces”, Wiley, 2014.

Energy Conservation and Management

BTMOE605C	OEC2	Energy Conservation and Management	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand energy problem and need of energy management
CO2	Carry out energy audit of simple units
CO3	Study various financial appraisal methods
CO4	Analyze cogeneration and waste heat recovery systems
CO5	Do simple calculations regarding thermal insulation and electrical energy conservation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		2	3			2	2		2
CO2	1	1	3	1	2	3			2	2		2
CO3	2	1	1							1		2
CO4	3	3			2	3						1

CO5			3			2						1

Course Contents:

Unit1: Introduction [07 Hours]
General energy problem, Energy use patterns and scope of conservation. Energy Management Principles: Need, Organizing, Initiating and managing an energy management program.

Unit2: Energy Auditing [07 Hours]
Elements and concepts, Types of energy audits, Instruments uses in energy auditing . Economic Analysis: Cash flows, Time value of money, Formula are relating present and future cash flows-single amount, uniform series.

Unit3: Financial Appraisal Methods [07 Hours]
Payback period, Net present value , Benefit-cost ratio, Internal–rate of return,Lifecyclecosts/benefits.Thermodynamicsofenergyconservation,Energyconservationin Boilers and furnaces, Energy conservation in Steam and condensate system.

Unit4: Cogeneration and Insulation and Heating [07 Hours]
Concept, Types of cogeneration systems, performance evaluation of a cogeneration system. Waste Heat Recovery: Potential, benefits, waste heat recovery equipment's.
Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building,Transfer of heat, Space heating methods, Ventilation and air conditioning, Heat pumps, Insulation, Cooling load, Electric water heating systems, Electric energy conservation methods.
Insulation and Heating Industrial Insulation: Insulation materials, Insulation selection, Economical thickness of insulation.Industrial Heating: Heating by indirect resistance, direct resistance heating (salt bath furnace),andHeat treatment by induction heating in the electric arc furnace industry.

Unit5: Energy Conservation in Electric Utility and Industry [07 Hours]
Energy costs and two part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illumination systems, Importance of Power factor in energy conservation, Power factor improvement methods, Energyconservation in industries

Texts:

1. Callaghan, "Energy Conservation".
2. D.L. Reeg,"Industrial Energy Conservation", Pergamon Press.

References:

1. T.L. Boyen, "Thermal Energy Recovery", Wiley Eastern.
2. L.J. Nagrath ,"System Modeling and Analysis", Tata Mc Graw Hill Publications.
3. S.P. Sukhatme, "Solar Energy", Tata Mc Graw Hill Publications.

Wind Energy

BTMOE605D	OEC2	Wind Energy	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand historical applications of wind energy
CO2	Understand and explain wind measurements and wind data
CO3	Determine Wind Turbine Power, Energy and Torque
CO4	Understand and explain Wind Turbine Connected to the Electrical Network AC and DC
CO5	Understand economics of wind energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2	2	2	1		1

CO2		3	2	1	3	2	2	2	2			1
CO3	3	3	1	1	2	2	1					1
CO4	3	3		1								1
CO5	3	2	1									1

Course Contents:

Unit 1: Introduction and Wind Measurements **[07 Hours]**
Historical uses of wind, History of wind electric generations

Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull statistics, Weibull parameters, Rayleigh and normal distribution
Wind Measurements
Biological indicators, Rotational anemometers, other anemometers, Wind direction

Unit 2: Wind Turbine Power, Energy and Torque **[07 Hours]**
Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.

Unit 3: Wind Turbine Connected to the Electrical Network **[07 Hours]**
Methods of generating synchronous power, AC circuits, the synchronous generator, per unit calculations, the induction machine, motor starting, Capacity credit features of electrical network

Unit 4: Wind Turbines with Asynchronous Electric Generators **07 Hours]**
Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self-excitation of the induction generators, Single phase operation the induction generator, Field modulated generators, Roesel generator.
Asynchronous Load: Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.

Unit 5: Economics of Wind Systems **[07 Hours]**
Capital costs, Economic concepts, Revenues requirements, Value of wind generated electricity

Texts:
1. S. Ahmad, "Wind Energy: Theory and Practice", Prentice Hall of India Pvt. Ltd.

References:
1. Garg L. Johnson, "Wind Energy Systems" Prentice Hall Inc., New Jersey, 1985.

2. Desire Le Gouriers, "Wind Power Plants: Theory and Design" Pergamon Press, 1982.

Introduction to Probability Theory and Statistics

BTMOE605D	Introduction to Probability Theory and Statistics	OEC 2	3L-1T-0P	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial:1 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Objective

The objective of this course is

(i) To acquire the knowledge of mean, median, mode, dispersion, etc.
(ii) To develop the basics of Probability theory
(iii) To get the knowledge of random variables and their expectations
(iv) To establish acquaintance with various probability distributions
(v) To Acquire the knowledge of correlation and regression.

Course Outcome

At the end of the course, the student will be able to

(i) Apply the concepts to find the measure of the central tendency, dispersion and moments forgrouped data

(ii) Make use of the correlation, and regression analyses to find the correlation and regression Coefficients

(iii) Observe and analyze the behavior of various discrete and continuous probabilityDistributions

(iv)Investigate the properties such as mathematical expectation and variance of the random Variables.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	1			1	1		2
CO2	1	1		2	1		1					2
CO3	1	2		2	2	1				2		2
CO4	1	1	1	3	3	1			1			2

Course Contents:

Unit I: Probability [07 Hours]

Probability Theory: Definition of probability, Addition theorem of probability, Multiplication theorem of probability, Conditional probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs.

Unit II: Theoretical Probability Distributions [07 Hours]

Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of Binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

Unit III: Moments, Skewness and Kurtosis [07 Hours]

Moments about mean and an arbitrary point; Skewness: positive skewness, negative skewness, symmetric frequency distribution, Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness,

Measures of skewness based on moments (β_1, γ_1); Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

Unit IV: Correlation and Regression [07 Hours]

Correlation: Types of correlation, Karl Pearson's correlation coefficient (Covariance Method), Spearman's rank correlation method, Regression: lines of regression, fitting of lines of regression by the least squares method, interpretation of slope and intercept, properties of regression coefficients.

Unit V: Sampling Theory and Testing of Hypothesis[07 Hours]

Introduction to sampling distributions, Population and sample, Null hypothesis and Alternative hypothesis, Single and two tailed test, Testing of hypothesis, Level of significance, Critical region, Procedure for testing of hypothesis.

Text Books:

1. Fundamentals of Statistics by S. C. Gupta, Himalaya Publishing House Pvt. Ltd., New Delhi.
2. Probability and Statistics by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
3. Mathematical Statistics by P. Mukhopadhyay, New Central Book Agency, Kolkata.
4. Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor, S. Chand and Sons, New Delhi.
5. An Introduction to Probability and Statistics by V. K. Rohatgi and A. K. Md. Ehsanes Saleh, Wiley Intercedence Publication, New York.
6. Introduction to Probability and Statistical Applications by P. L. Meyer, Addison Wesley Publishing Co., Massachusetts.

Reference Books:

a. Probability, Statistics with Reliability, Queuing and Computer Science Applications by KishorS. Trivedi, Wiley India Pvt. Ltd., Mumbai.

b. Probability, Queuing Theory and Reliability Engineering by G. Hari baskaran,Laxmi

Publications, New Delhi.

c. Probability and Statistics by R. S. Murray, J. S. John, R. Alu Srinivasan and D. Goswami,

Schaum's Outlines series, McGraw Hill Publications, New Delhi.

d. Introduction to Theory of Statistics by A. M. Mood, F. A. Graybill and D. C. Boes, tata McGraw – Hill Publications, Pune.

Mechanical Engineering Lab – IV

BTMCL 606	PCC 18	Manufacturing Processes Lab - II+ +Machine Design Practice-II	0-0-6	3 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 6 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Group A (Manufacturing Processes Lab - II)

List of Practical's /Experiments/Assignments (Any Three from

Group A)

1. Study of types of chips
2. Study of the effect of process parameters on cutting ratio and shear angle in oblique turning process

3. Study of the effect of process parameters on the surface roughness during oblique turning process

4. Study of the effect of cutting fluid on surface roughness during oblique turning process

5. Study of the effect of process parameters on tool wear during oblique turning process
6. Study of the effect of process parameters on cutting forces in oblique turning process
7. Study of the effect of process parameters on cutting forces in end milling process
8. To develop a manual part program of a given component on CNC Lathe using G and M codes.

9. To develop a manual part program of a given component on CNC Lathe usingstock removal cycle.

10. To develop a manual part program of a given component on CNC Lathe using canned cycle.

11. To develop a manual part program of a given component on CNC Milling machine using G and M code.

12. To develop a manual part program of a given component on CNC Milling machine using pocket milling cycle.

13. To develop a manual part program of a given component on CNC Milling machine using scanned cycle.

14. To examine the effect of parameters on MRR and TWR in Electro Discharge Machining (EDM).
15. To evaluate machining accuracy in EDM.
16. Demonstration on Wire-EDM
17. Industrial visit to study manufacturing practices.

Group B (Machine Design Practice - II)

List of Practical's/Experiments/Assignments

1. The term work shall consist of 01 design projects based on syllabus of Machine Design-II. Design project shall consist of 2 full imperial size sheets-one involving assembly drawings with apart list and Overall dimensions and other sheet involving drawing so find Individual Components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, where ever necessary, so as to make it a working drawing
   Make the Project full on Auto-cad or on any 3D Design software print the full sheet on A3 size paper.
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file. Sheets for one of the projects will be drawn using AutoCAD and computer printout using plotter of the same will be attached along with the design report.
3. At least two assignments based on topics of syllabus of Machine Design-II.

Group C (Elective - III)

Perform any three Practical's/ Assignments on elective - III

B. Tech Seminar

BTMS607	Seminar II	PROJ-3	0L-0T-2P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

Objective:

- To expose and make students aware with latest research and research publications
- To understand the research and research publication, references, citation
- To enhance the presentation skill
- To enhance the report writing
- To make the student aware about research publication sites

Students are expected to prepare a seminar report on the chosen topic/area selected with the discussion of chosen guide based on the available literature on the chosen topic.

Mini Project

BTAP608	Mini Project	PROJ-4	0L-0T-2P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks(Duration 03 hrs)

Students are expected to carry out a mini project under a project guide based on the chosen area. The project may be prototype/software based which may demonstrate Engineering application or community service. After completion the project work it is necessary that student should prepare a project report under the supervision of the assign guide and present before the committee.