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)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
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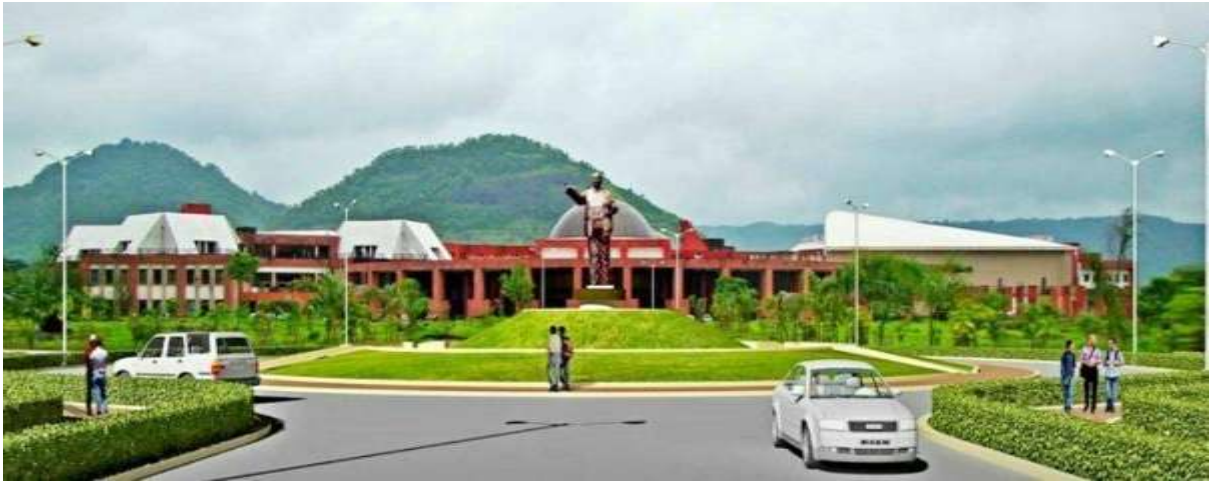
PROPOSED CURRICULUM
UNDERGRADUATE PROGRAMME B-TECH
ELECTRONICS & COMMUNICATION ENGINEERING
(SANDWICH)

With effect from the Academic Year 2018-2019.



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/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.

1. 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 implementeds 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 ≥ 5.50 &<6.00	SecondClass
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:

	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 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 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 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 (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.

Department of Electronics and Communication Engineering (Sandwich)

Bachelor of Technology in Electronics and Communication Engineering (Sandwich)

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

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
BTEXL312S	Data Structure Lab	(0-0-2)1
BTESC401	Electrical Machines and Instruments	(3-0-0)3
BTESCL407	Electrical Machines and Instruments Lab	(0-0-2)1

Humanities and Social Science including Management Courses (HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM3401	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(0-2-0)
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM706	Foreign Language Studies	Audit

Professional Core Course (PCC)

BTEXC302	Analog Circuits	(3-0-0)3
BTEXC303	Electronic Devices & Circuits	(3-0-0)3
BTEXC304	Network Analysis	(3-0-0)3
BTEXC305S	Digital Circuits & Microprocessors	(3-0-0)3
BTEXL307	Analog Circuits Lab	(0-0-2)1
BTEXL308	Electronic Devices & Circuits Lab	(0-0-2)1
BTEXL309	Network Analysis Lab	(0-0-2)1
BTEXL310S	Digital Circuits & Microprocessors Lab	(0-0-2)1
BTEXC402	Analog Communication Engineering	(3-0-0)3
BTEXC403S	Microcontroller	(3-0-0)3
BTEXC404	Signals and Systems	(3-0-0)3
BTEXC402S	Control System Engineering	(3-0-0)3
BTEXL402S	Control System EngineeringLab	(0-0-2)1

BTEXL408	Analog Communication Engineering Lab	(0-0-2)1
BTEXL409S	Microcontroller Lab	(0-0-2)1
BTEXL410	Signals and Systems Lab	(0-0-2)1
BTEXC413S	Proficiency E-learning course	(0-0-2)1
BTEXC501	Electromagnetic Field Theory	(3-1-0)4
BTEXC502S	Digital Communication	(3-1-0)4
BTEXC503S	Embedded System Design	(3-1-0)4
BTEXC504	Digital Signal Processing	(3-1-0)4
BTEXC601	Information theory and Coding	(3-1-0)4
BTEXC602S	Automotive Electronics	(3-1-0)4
BTEXC603	Digital Image Processing	(3-1-0)4
BTEXC701	Microwave Engineering	(3-1-0)4

Professional Elective Course (PEC1)

BTEXPE604A	CMOS Design	(3-1-0)4
BTEXPE604B	Power Electronics	
BTEXPE604C	Project Management and Operation Research	
BTEXPE604D	Python Programming	
BTEXPE604E	Web Development and Design	

Professional Elective Course (PEC2)

BTEXPE702A	(B) RF Circuit Design	(3-1-0)4
BTEXPE702B	(C) Satellite Communication	
BTEXPE702C	(D) Fiber Optic Communication	
BTEXPE702D	(E) Bio-medical Signal Processing	

Open Elective Course (OEC1)

BTEXC505AS	Environmental Studies	(3-1-0)4
BTEXC505B	Consumer Electronics	
BTEXC505CS	Values and Ethics in Profession	
BTEXC505D	Introduction to MEMS	

Open Elective Course (OEC2)

BTEXOE703A	(A) Wireless Sensor Networks	(3-0-0)3
BTEXOE703B	(B) Cyber Security	
BTEXOE703C	(C) VLSI Design & Technology	
BTEXOE703D	(D) Artificial Intelligence Deep learning	

Open Elective Course (OEC3)

BTEXOE704A	(A) Electric Vehicle	(3-0-0)3
BTEXOE704B	(B) Mobile Computing	
BTEXOE704C	(C) Advance Industrial Automation I	
BTEXOE704D	(D) Mechatronics	

Seminar/Mini Project/ Internship

BTES210S	Seminar	(0-0-2)1
BTES211P	Industry Internship-1 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 sem 3
BTEXW311	Electronics Workshop	(0-0-2)1
BTEXF412	Industry Internship-2 Training (Minimum 4 weeks which can be completed partially in third semester or fourth semester or in at one time	Credits to be evaluated in sem5
BTEXP507	Mini Project I	(0-0-4)2
BTEXP607	Mini-project II	(0-0-4)2
BTEXF608	Industry Internship-3 Field Training/ Internship/ Industrial Training (Minimum 4weeks)	Credits to be evaluated in sem7

LAB Course (LC)

BTEXL506	Digital Communication & Embedded System Design Lab	(0-0-4)2
BTEXL606	Digital Image Processing & Automotive Electronics Lab	(0-0-4)2

Project (MP)

BTETP801	Project work/ Internship	(0-0-24)12

Suggested Plan of Study:

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTBSC301	BTESC401	BTEXC501	BTEXC601	BTEXC701	BTEXP801 (Project/Internship)
2	BTBS102	BTBS202	BTEXC302	BTEXC402	BTEXC502S	BTEXC602S	BTEXPE702(Program Elective)	
3	BTES103	BTES203	BTEXC303	BTEXC403S	BTEXC503S	BTEXC603	BTEXOE703 (Open Elective)	
4	BTHM104	BTHM204	BTEXC304	BTEXC404	BTEXC504	BTEXPE604 (Program Elective)	BTEXOE704 (Open Elective)	
5	BTES105	BTES205	BTEXC305S	BTEXC402S	BTEXC505A (Open Elective)	BTHM605	BTEXC705	
6	BTES106	BTES206	BTHM3401	BTETL406	BTEXL506	BTEXL606	BTEXC706	
7	BTBS107L	BTBS207L	BTEXL307	BTETS407	BTEXP507	BTEXP607	BTEXC707	
8	BTES108L	BTES208L	BTEXL308	BTETP408 (Internship – 2)	BTEXF412 (Internship – 2 Evaluation	BTEXF608(Internship – 3)	BTEXF08 (Internship – 3 Evaluation)	
9	BTHM109L	BTHM209L	BTEXL309	BTEXL402S				
10	BTBS101	BTES210S	BTEXL310S	BTESCL407				
11		BTES211P (Internship 1)	BTEXW311	BTEXL408				
12			BTEXL312S	BTEXL409S				
13			BTBSC301	BTEXL410				

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 &Communication Engineering (Sandwich)
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.

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 & Communication Engineering (Sandwich)
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	BTBSC301	Engineering Mathematics-III	3	1	0	20	20	60	100	4
PCC 1	BTEXC302	Analog Circuits	3	0	0	20	20	60	100	3
PCC 2	BTEXC303	Electronic Devices & Circuits	3	0	0	20	20	60	100	3
PCC 3	BTEXC304	Network Analysis	3	0	0	20	20	60	100	3
PCC 4	BTEXC305S	Digital Circuits & Microprocessors	3	0	0	20	20	60	100	3
HSMC	BTHM3401	Basic Human Rights	0	2	0	50	--	--	50	Audit (AU / NP)
PCC 1 Lab	BTEXL307	Analog Circuits Lab	0	0	2	60	--	40	100	1
PCC 2 Lab	BTEXL308	Electronic Devices & Circuits Lab	0	0	2	60	--	40	100	1
PCC 3 Lab	BTEXL309	Network Analysis Lab	0	0	2	60	--	40	100	1
PCC 4 Lab	BTEXL310S	Digital Circuits & Microprocessors Lab	0	0	2	60	--	40	100	1
PCC 5 Lab	BTEXW311	Electronics Workshop	0	0	2	30	--	20	50	1
ESC Lab	BTEXL312S	Data Structure Lab	0	0	2	30	--	20	50	1
Internship	BTES211P	Field Training / Internship/Industrial Training						50	50	1
		Total	15	3	12	450	100	550	1100	23
Semester IV										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
ESC	BTESC401	Electrical Machines and Instruments	3	0	0	20	20	60	100	3
PCC 1	BTEXC402	Analog Communication Engineering	3	0	0	20	20	60	100	3
PCC 2	BTEXC403S	Microcontroller	3	0	0	20	20	60	100	3
PCC 3	BTEXC404	Signals and Systems	3	0	0	20	20	60	100	3
PCC 4	BTEXC402S	Control System Engineering	3	0	0	20	20	60	100	3

B. Tech in Electronics & Communication Engineering (Sandwich)

Curriculum for Second Year

PCC 4 Lab	BTEXL406S	Control System Engineering Lab	0	0	2	60	--	40	100	1
ESC Lab	BTESCL407	Electrical Machines and Instruments Lab	0	0	2	60	--	40	100	1
PCC 1 Lab	BTEXL408	Analog Communication Engineering Lab	0	0	2	60	--	40	100	1
PCC 2 Lab	BTEXL409S	Microcontroller Lab	0	0	2	60	--	40	100	1
PCC 3 Lab	BTEXL410	Signals and Systems Lab	0	0	2	60	--	40	100	1
HSMC	BTHML411	Soft-Skill Development	0	0	2	60	--	40	100	1
	BTEXF412	Industry Internship Training (Minimum 4 weeks which can be completed partially in third semester or fourth semester or in at one time)								AuditTo be evaluated in the Vth semester
PC Lab	BTEXC413S	Proficiency E-learning course	0	0	2	--	--	--	--	1
		Total	15	0	14	460	100	540	1100	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

B. Tech in Electronics &Communication Engineering (Sandwich)
Curriculum for Third Year

Semester V											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC1	BTEXC501	Electromagnetic Field Theory	3	1	- -	20	20	60	100	4
PCC2	BTEXC502S	Digital Communication	3	1	- -	20	20	60	100	4
PCC3	BTEXC503S	Embedded System Design	3	1	- -	20	20	60	100	4
PCC4	BTEXC504	Digital Signal Processing	3	1	- -	20	20	60	100	4
Open Elective Course 1 (OEC 1)	BTEXC505AS	Environmental Studies	3	1	-	20	20	60	100	4
	BTEXC505B	Consumer Electronics								
	BTEXC505CS	Values and Ethics in Profession								
	BTEXC505D	Introduction to MEMS								
Laboratory Course (LC)	BTETL506	Digital Communication & Embedded System Design Lab			4	-	60	40	100	2
Project	BTETP507	Mini Project I				-	60	40	100	2
Internship-2 Evaluation	BTEXF412	Field Training/ Internship/Industrial TrainingEvaluation	-	-	-	-	-	-	-	Audit
		Total	**15**	**5**	**4**	**100**	**220**	**380**	**700**	**24**

Semester VI										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC1	BTETC601	Information theory and Coding	3	1	-	20	20	60	100	4
PCC2	BTETC602S	Automotive Electronics	3	1	-	20	20	60	100	4
PCC3	BTETC603	Digital Image Processing	3	1	-	20	20	60	100	4

Program Elective Course 2 (PEC 2)	BTETPE604A	CMOS Design	3	1	-	20	20	60	100	4
	BTETPE604B	Power Electronics								
	BTETPE604C	Project Management and Operation Research								
	BTETPE604D	Python Programming								
	BTETPE604E	Web Development and Design								
Humani-ties & Social Science including Manage-ment Courses (HSSMC)	BTHM605	Employability & Skill Development	3	0	0	20	20	60	100	3
Labor-atory Course (LC)	BTETL606	Digital Image Processing & Automotive Electronics Lab	0	0	4	--	60	40	100	2
Project	BTETP607	Mini-project II				--	60	40	100	2
Internship-3	BTETF608	Field Training/ In-ternship/ Industrial Training (Minimum 4weeks)								**(To be evaluated in VIIth Semester**
		Total	**15**	**4**	**4**	**100**	**220**	**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

B. Tech in Electronics & Communication Engineering (Sandwich)
Curriculum for Final Year

Semester VII									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC1	BTEXC701	Microwave Engineering	3	1	--	20	20	60	100	4
PEC1	BTEXC702	Group A	3	1	--	20	20	60	100	3
OEC1	BTEXC703	Group B	3	1	--	20	20	60	100	3
OEC 2	BTEXC704	Group C	3	1	--	20	20	60	100	3
HSSMC	BTEXC705	Engineering Economics and Financial Mathematics	3	1	--	20	20	60	100	3
LC	BTEXC706	Microwave Engineering Lab			2	60	--	40	100	1
Project	BTEXC707	Mini Project – 3			4	60	--	40	100	2
Internship	BTETF608	Internship – 3 Evaluation		--	--	--	--	--	--	Audit
		Total	**15**	**5**	**6**	**220**	**100**	**380**	**700**	**19**

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 Course

BTEXC702 **Program Elective 4 (Group A)**	**BTEXC703** **Open Elective 3 (Group B)**	**BTEXC704** **Open Elective 4 (Group C)**
(A)) RF Circuit Design	(A) Wireless Sensor Networks	(A) Electric Vehicle
(B) Satellite Communication	(B) Cyber Security	(B) Mobile Computing
(C) Fiber Optic Communication	(C) VLSI Design & Technology	(C) Advance Industrial Automation-1
(D) Bio-medical Signal Processing	(D) Artificial Intelligence Deep Learnings	(D) Mechatronics

Total Credits: 160

Semester III

Engineering Mathematics-III

BTBSC301	BSC	Engineering Mathematics-III	3-1-0	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.)

Prerequisites: Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Vector algebra, Algebra of complex numbers..

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 Electromagnetics 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:

1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.

2. Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.

3. 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.

4. Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.

5. 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 [07 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 [07 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 [07 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 [07 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 ($\partial u/\partial t = c^2 \partial^2 u/\partial x^2$), and two dimensional heat flow equation (i.e. Laplace equation : $\partial^2 u/\partial x^2 + \partial^2 u/\partial y^2 = 0$).

Unit 5: Functions of Complex Variables (Differential calculus) [07 Hours]

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.

Unit 6: Functions of Complex Variables (Integral calculus) [07 Hours]

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. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
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. RajnishVerma, 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.

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 batch-wise. Each class should be divided into three batches for the purpose.
2. The Continuous 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.

Analog Circuits

BTEXC302	PCC 1	Analog Circuits	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Course Objectives:

To understand characteristics of IC and Op-Amp and identify the internal structure

.● To introduce various manufacturing techniques.

- To study various op-amp parameters and their significance for Op-Amp.
- To learn frequency response, transient response and frequency compensation
- Techniques for Op-Amp. To analyze and identify linear and nonlinear applications of Op-Amp

.● To understand functionalities of PLL

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 for Op-Amp.
4. Comply and 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 design

Course Contents:

Unit 1: OP-AMP Basic [08 Hours]

Block diagram of OP-AMP, Differential Amplifier configurations, Differential amplifier analysis for dual-input balanced-output configurations, Need and types of level shifter, current mirror circuits. Feedback topologies: Voltage series and voltage shunt feedback amplifier and its effect on Ri, Ro, bandwidth and voltage gain.

Unit 2: Linear Applications of OP-AMP [08 Hours]

Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, and instrumentation amplifiers.

Unit 3: Non-linear Applications of OP-AMP [08 Hours]

Introduction to comparator, characteristics and applications of comparator, Schmitt trigger, clippers and clampers, voltage limiters, square wave generator, triangular wave generator, Need of precision rectifiers, Half wave and Full wave precision rectifiers.

Unit 4: Converters using OP-AMP [08 Hours]

V-F, I-V and V-I converter, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, Flash type.

Unit 5: Oscillators [08 Hours]

Principle of Oscillators, Barkhausen criterion, Oscillator types: RC oscillators (design of phase shift, Wien bridge etc.), LC oscillators (design of Hartley, Colpitts, Clapp etc.), non-sinusoidal oscillators, and voltage controlled oscillators.

Unit 6: Active filters and PLL [08 Hours]

Design guidelines of Active filters: Low pass, high pass, band pass and band stop
Filters block diagram of PLL and its function.

TEXT/REFERENCE BOOKS

1. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education 2000.

2 .Salivahanan and KanchanaBhaskaran, "Linear Integrated Circuits", Tata McGraw Hill, India 2008.

3. George Clayton and Steve Winder, "Operational Amplifiers", 5th EditionNewnes.

4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw Hill.

5. Bali, "Linear Integrated Circuits", McGraw Hill 2008.

6. Gray, Hurst, Lewise, Meyer, "Analysis & Design of Analog Integrated Circuits", Wiley Publications on Education.

Electronic Devices and Circuits

BTEXC303	PCC 2	Electronic Devices and Circuits	3-0-0	3 Credits

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

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce semiconductor devices FET and MOSFET, their characteristics, operations, circuits and applications

2. To introduce concepts of both positive and negative feedback in electronic circuits

3. To analyze and interpret 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

5. To study the different types of voltage regulators.

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.

Course Contents:

Unit 1: JFET [04 Hours]

Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET (Self).FET as an amplifier and its analysis (CS) and its frequency response, Small signal model, FET as High Impedance circuit

Unit 2: MOSFET& its DC Analysis [04 Hours]

Basics of MOS Transistor operation, Construction of n-channel E-MOSFET, E-MOSFET characteristics & parameters, non-ideal voltage current characteristics viz. Finite output resistance, body effect, sub-threshold conduction, breakdown effects and temperature effects. Common source circuit, Load Line & Modes of operation, common MOSFET configurations: DC Analysis, constant current source biasing, MOSFET as switch, diode/active resistor, Current sink and source, current mirror, Voltage references, Basic principle of band gap reference, CMOS Inverter as amplifier: Active load, Current source and Push pull configurations.

Unit 3: Electronics Amplifiers [04 Hours]

Classification of amplifiers, Fundamentals of Low noise and Power amplifiers. Feedback amplifiers: Feedback concept and topologies, Effect of feedback on terminal characteristics of amplifiers, feedback amplifier analysis, cascade amplifiers, DC Amplifiers.

Unit 4: Oscillators [04 Hours]

Barkhausen criterion, stability with feedback. Classification of oscillators, RC Oscillators: FET RC Phase Shift oscillator, Wein bridge oscillator, LC Oscillators: Hartley and Colpitts oscillators, Crystal oscillators, UJT Relaxation oscillator.

Unit 5: Multivibrators [04 Hours]

IC555 Block diagram, Types of Multivibrators: Astable, Monostable and Bistable, Operation of Multivibrators using FETs and IC555. Applications of IC555 in Engineering.

Unit 6: Voltage Regulator [04 Hours]

Block diagram of an adjustable three terminal positive and negative regulators (317,337) typical connection diagram, current boosting, Low drop out voltage regulators, Introduction to Switch Mode Power supply (SMPS), Block diagram of SMPS, Types of SMPS. Comparison of Linear Power supply and SMPS.

TEXT/REFERENCE BOOKS

1. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGraw Hill, 2000
2. Donald Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill
3. 3. BrijeshIyer, S. L. Nalbalwar, R. Dudhe, "Electronics Devices &Circuits", and Synergy Knowledge ware Mumbai, 2017. ISBN: 9789383352616.

4. David A. Bell, "Electronic Devices and Circuits", 5thEdition, Oxford Press

5. R. L. Boylstad, L. Nashlesky, "Electronic Devices and circuits Theory", 9thEdition, Prentice Hall of India, 2006.

Network Analysis

BTEXC304	PCC 3	Network Analysis	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)

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.

Course Contents:

UNIT – 1 Basic Circuit Analysis and Simplification Techniques [6 hours]

Basic circuit elements, Simplification of networks, Equivalent „T" and „Π" networks of any complicated network, Voltage and Current laws (KVL/KCL), Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Principle of duality, Source transformation and source shifting, Network Theorems such as Superposition, Thevenin"s, Norton"s and Maximum Power Transfer Theorems.

***Note**: Above circuit analysis, mentioned in this Unit-1, is for AC network only.*

UNIT – 2 Frequency Selective Networks [6 hours]

Significance of Quality factor, Series Resonance: Resonating frequency, Reactance curves, Variation of circuit parameters such as impedance, phase angle, voltage and current with frequency; Bandwidth, Selectivity, Magnification factor, Parallel resonance: Resonant frequency, Variation circuit parameters such as admittance, phase angle, voltage and current with frequency; Bandwidth and selectivity. Analysis of parallel resonating circuit with resistance present in both branches (inductive and capacitive branches) and tank circuit, Effect of generator resistance on BW & Selectivity, Comparison and applications of series and parallel resonant circuits.

UNIT – 3 Electrical Network Parameters and Passive Filters [8 hours]

Classifications: Symmetrical and Asymmetrical networks. Properties of two port Network :(i) Symmetrical Networks (T and Π only): Characteristics impedance and propagation constant in terms of circuit components, open and short circuit parameters (ii) Asymmetrical Networks: Image Impedance and Iterative Impedance. Passive Filters: Filter fundamentals, Introduction to Neper and Decibel, Relation between Neper and Decibel, Constant K-LPF, HPF, BPF and BSF, m-derived LPF and HPF, Terminating half sections, Concept of composite filters. Attenuators: Symmetrical T and Π type attenuators, Ladder attenuator.

UNIT – 4 Steady State and Transient Response [6 hours]

DC and AC response of R-L, R-C and RLC circuits, Analysis of electrical circuits Using Laplace Transform

UNIT – 5 Two Port Network Parameters and Functions [6 hours]

Terminal characteristics of network: Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Network functions for one port and two port networks, Pole-zeros of network functions and network stability.

UNIT – 6 Transmission Line Theory [6 hours]

Types of Transmission lines, Transmission Line Equation, Equivalent circuits, Primary and Secondary line constants, Terminations of transmission lines, VSWR and Reflection Coefficient, Impedance matching, Transmission line measurements using Smith chart.

TEXT/REFERENCE BOOKS

1. D Roy Choudhary, "Network and Systems" 1st edition, New Age International,1988
2. John D. Ryder, "Network Lines and Fields" 2nd edition, PHI,1955
3. C. P. Kuriakose, "Circuit Theory Continuous and Discrete Time System, Elements of Network Synthesis"PHI
4. W.H. HaytKemmerly, "Engineering Circuit Analysis", 5th Edition, Tata McGraw Hill Publications,1993.
5. M. E. Van Valkenburg, "Network Analysis", 3rd Edition, Pearson, 2004. 6. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill, 1982. 7. Royal Signal Handbook on Line Communication.

Digital Circuits & Microprocessors

BTEXC305S	PCC 4	Digital Circuits and Microprocessors	3-0-0	3 Credits

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

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.

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 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.

Course Contents:

Unit 1: Combinational Logic Design [6 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 (up to 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, and Parity generators/checkers, Design of Multiplexers and De-multiplexers, Decoders.

Unit 2: Sequential Logic Design [6 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,

Unit 3: State Machines [6 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, PLD and Semiconductor memories [8 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, I2L and DCTL

Programmable logic devices: Detail architecture, Study of PROM, PAL, and 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, and DRAM.

Unit 5: Introduction to Microprocessor 8086 [8 hours]

Comparison of 8085 and 8086 microprocessor, 8086 microprocessor salient features, pin description, architecture of 8086: functional block diagram, Register organization, concepts of pipelining, memory segmentation and physical memory address generation, assembly language programming tools: editors, assembler, linker, debugger, and assembler directives.

Unit 6: Instruction Set of 8086 and assembly language programming [8 hours]

Machine language instruction format, addressing modes, instruction set of 8086, arithmetic instructions, logical instructions, data transfer instructions, bit manipulation instructions, string operation instructions branching instructions, process control instructions.

Programming using assembler - Finding largest and smallest number from array, sorting numbers in ascending and descending order, finding odd, even, positive and negative numbers in array, block transfer, string operations- length , reverse, compare, concatenation, copy , count number of 1‟s and 0‟s in 16 bit numbers, introduction to procedure and macro

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. Microprocessor-Architecture, programming and application with 8086,Gaonkar,penram International.
5. D V kodavade, S. Narvadkar, 8085-86 microprocessors Architecture progg and interfaces, wiley.
6. Rout 8085 microprocessors-architecture, programming and application, 2nd edition,penram International.
7. Sunil Mathur, Microprocessor 8086 Architecture, Programming and Interfacing, Prentice

Hall India,

Basic Human Rights

BTHM3401	HSMC	Basic Human Rights	0-2-0	Audit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 50 Marks

Course Objectives:

1. To work for ensuring that basic human rights are respected everywhere
2. To cooperate to avoid compromising on human rights for economic or political expediency
3. To recognize democratic institutions as a fundamental human right.
4. To work towards the sovereignty and self-determination of entities with historical, cultural and ecological identity.
5. To actively engage with the Government of India and other countries to promote human rights education.
6. To bring diplomatic and commercial pressures on regimes that violates human rights, to ensure that they respect the basic rights of their citizens.
7. To keep the interests of disempowered communities foremost in all dealings with countries in which human rights violations occur.
8. To develop a more distinctive and effective role for the International Court of Justice in the field of human rights
9. To promote a culture for educating the citizenry that cultivation and promotion of human rights culture is the sine qua non for the smooth functioning of the organs of a democratic State and for the kind of development that results into overall development of the society.
10. To train the young men and women for 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
11. To study the effects of draconian laws and unlawful use of State's machinery and force by the enforcement agencies.

Course Outcomes:

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

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.

2. Strengthen the respect for human rights and fundamental freedoms.

3. Enable all persons to participate effectively in a free society.

4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.

5. Learn about regional, national, state, and local law that reinforces international human rights law. 6. Learn and know about and being able to use global, regional, national, and local human rights instruments and mechanisms for the protection of human rights.

UNIT – 1 The Basic Concepts

Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.

UNIT – 2 Human Rights and Human Duties

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

Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

UNIT – 4 Social Structure and Social Problems

Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labor, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

UNIT – 5 States, Individual Liberty, Freedom and Democracy

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

The constitution of India:

1. Preamble
2. Fundamental Right
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.

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.

Analog Circuits Lab

BTEXL307	PCC 1 Lab	Analog Circuits Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Measure Op-Amp parameters and compare with the specifications. Input bias current, input Offset current and input offset voltage. Slew rate, CMRR.
2. Design, build and test integrator for given frequency f_a.
3. Design, build and test three Op-Amp instrumentation amplifiers for typical application
4. Design, build and test precision half & full wave rectifier.
5. Design, build and test Schmitt trigger and plot transfer characteristics.
6. Design, build and test PLL.
7. 2 bit DAC and 2 bit ADC.
8. Design and implement 2bit R-2R ladder DAC.
9. Design and implement 2bit flash type ADC.
10. Design, build and test square & triangular wave generator.
11. Verify and understand practically virtual ground and virtual short concept in inverting and non-inverting configuration.
12. Plot DC transfer characteristics of emitter coupled differential amplifier.
13. Study effect of emitter resistance and constant current source on figure of merit . (CMRR) of emitter coupled differential amplifier.

14. Design and implement V-I converter.
15. Any experiment based on application of Op-Amp

Electronic Devices and Circuits Lab

BTEXL308	PCC 2 Lab	Electronic Devices and Circuits Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2hrs/batch	Continuous Assessment: 60 Marks
	External Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Verify DC operating point for a single stage BJT in CE configuration.
- Calculate values biasing resistors (R1,R2,RE) to operate BJT at a certain VCEQ &ICQ
- Build the circuit with these components
- Measure VCEQ, ICQ, IBQ and VBEQ
- Compare measured quantities with theoretical values

2. Build and test single stage CE amplifier.
- Connect coupling and emitter bypass capacitors
- To measure the voltage gain, input resistance (Ri), output Resistance (Ro) of the amplifier.
- Verify phase difference between input and output voltage.
- To measure the bandwidth.

3. Build and test a sensing circuit for slotted disc using photo diode/Opt coupler [H 21 A 1] in RPM indicator.
- Identify the terminal of optical device.
- Relevance of slot and speed.
- Measure RPM using oscilloscope/frequency counter.

4. Design a single stage FET Amplifier in CS configuration and verify DC Operating point.

5. Simulate frequency response of single stage CS amplifier (use same circuit) and find the bandwidth.

6. Simulate Voltage-Series feedback amplifier and calculate Rif, Rof, Avf and Bandwidth.

7. Simulate LC oscillator using FET.

8. Implement Wein bridge /RC phase shift oscillator using FET/MOSFET

9. Build and test MOSFET as a switch.

10. Design and implement an adjustable voltage regulator using three terminals Voltage regulator IC.

Network Analysis Lab

BTEXL309	PCC 3 Lab	Network Analysis Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	External Exam: 40 Marks

List of Practical's/Experiments/Assignments (all experiments from the list)

1. Network Theorems :
   To verify Thevenin"s and Maximum Power Transfer theorem for reactive circuits.
2. Frequency selective networks - I :To build and test Series and Parallel resonant Circuits. (Resonant frequency, Q and Bandwidth, calculations).
3. Frequency selective networks - II :
   To plot the frequency response of Twin T or Wein-bridge circuit. (Null frequency calculation)
4. Filter circuits:
   To design build and test constant K- LPF and HPF circuits. Plot the frequency response for both.
5. Attenuators: To design, build and test T and ∏ attenuator for given fixed attenuation. Plot attenuation Vs RL graph.
6. Transmission line: To measure the primary and secondary line constants of a given transmission Line i.e. flat type cable or co-axial cable.

Digital Circuits and Microprocessor Lab

BTEXSL310	PCC 4 Lab	Digital Circuits and Microprocessor Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	External Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Study of IC-74LS153 as a Multiplexer. (Refer Data-Sheet).Design and Implement 8:1 MUX using IC-74LS153 & Verify its Truth Table. Design & Implement the given 4 variable function using IC74LS153. Verify its Truth-Table.
2. Study of IC-74LS138 as a Demultiplexer / Decoder (Refer Data-Sheet). Practical) (Test Benches and FSM excluded). Design and Implement full adder and subtractor function using IC- 74LS138.Design & Implement 3-bit code converter using IC-74LS138.

(Gray to Binary/Binary to Gray.)

3. Study of IC-74LS83 as a BCD adder,(Refer Data-Sheet). Design and Implement 1 digit BCD adder using IC-74LS83. Design and Implement 4-bit Binary sub tractor using IC-74LS83.
4. Study of IC-74LS85 as a magnitude comparator,(Refer Data-Sheet) Design and Implement 4-bit Comparator. Design and Implement 8-bit Comparator.
5. Study of Counter ICs (74LS90/74LS93). (Refer Data-Sheet) Design and Implement MOD-N and MOD-NN using IC-74LS90 and draw Timing diagram. Design and Implement MOD-N and MOD-NN using IC-74LS93 and draw Timing diagram.
6. Study of synchronous counter -Design & Implement 4-bit Up/down Counter and MODN Up/down Counter using IC74HC191/ IC74HC193 & draw time diagram.
7. Verify four voltage and current parameters for TTL and CMOS (IC 74LSXX, 74HCXX), (Refer Data-Sheet).
8. Study of Shift Register (74HC194/74LS95), (Refer data-Sheet) Design and Implement Pulse train generator using IC-74HC194/IC74LS95 (Use right shift/left shift).
9. Design and Implement 4-bit Ring Counter/ Twisted ring counter using shift registers IC 74HC194/IC74LS95.
10. Write an assembly language programs to perform various arithmetic and logical operations.
11. Write an assembly language program to perform internal and external memory transfer operations.
12. Write an assembly language program to perform string operations.
13. Write assembly language program using procedure and macro.

Electronics Workshop

BTEXW311	PCC 5 Lab	Electronics Workshop	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks
	Internal Exam: 20 Marks

Mini Project based on third semester syllabus will be completed in the semester.

Data Structure Lab

BTEXL312S	ESC Lab	**Data Structure Lab**	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks
	External Exam: 20 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Write C program to store student information (e.g. Roll No, Name, Percentage etc.).
   a) Display the data in descending order of Percentage (Bubble Sort).
   b) Display data for Roll No specified by user (Linear Search).
   c) Display the number of passes and comparisons for different test cases (Worst, Average, Best case).
2. Perform following String operations with and without pointers to arrays (without using the library functions): a. substring, b. palindrome, c. compare, d. copy, e. reverse
3. Data base Management using array of structure with operations Create, display, Modify, Append, Search and Sort.(For any database like Employee or Bank database with and without pointers to structures
4. Create a singly linked list with options:
   a) Insert (at front, at end, in the middle),
   b) Delete (at front, at end, in the middle),
   c) Display,
   d) Display Reverse,
   e) Revert the SLL.
5. Implement Stack using arrays & Linked Lists. Write a menu driven program to perform following operations on stack a) Push b) Pop c) Display.
6. Implement Queue using arrays & Linked Lists. Write a menu driven program to perform following operations on Queue a) Insert b) Delete c) Display.
7. Binary search tree: Create, search, recursive traversals.
8. Graph using adjacency Matrix with BFS & DFS traversals.
9. Implement set operations using arrays and perform union, intersection, difference, symmetric difference.
10. Accept input as a string and construct a Doubly Linked List for the input string with each node contains, as a data one character from the string and perform: a) Insert b) delete, c) Display forward, d) Display backward.
11. Represent graph using adjacency list or matrix and generate minimum spanning tree using Prism‟s algorithm
12. Read & write operations in a text file.

13. Polynomial addition using array of structure.
14. Evaluation of postfix expression (input will be postfix expression).
15. Implement following Matrix operations:
    a) addition with pointers to arrays,
    b) multiplication without pointers to arrays
    c) transpose with pointers to arrays

Semester IV
Electrical Machines and Instruments

BTESC401	ESC	**Electrical Machines and Instruments**	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 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 [08 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 [8 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 [08 Hours]

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

Unit 4: Sensors and Transducers [08 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 [08 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.

Unit6: I/O Devices [08 Hours]

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: DhanpatRai&Co.).
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGrawHill)
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 6thEdition.
8. I.J Nagarath & D.P Kothari, "Electrical Machines",Tata McGraw-hill Publication 4th

Analog Communication Engineering

BTEXC402	PCC 1	Analog Communication 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 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.

Course Contents:

Unit 1: Introduction to Communication System [08 Hours]

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 [4 Hours]

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 [4 Hours]

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 [08 Hours]

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 [08 Hours]

AM Detectors: Envelop detector and practical diode detector.FM Detectors: Slope detector, phase discriminator and ratio detector

Unit-6: Noise [04 Hours]

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 4thEdition.
2. Anokh Singh, "Principles of communication engineering"S.Chand PHI
3. Roddy& Coolen, "Electronic communication “PHI

4.Taub& Schilling "Principles of communication systems" Tata McGraw-Hill

5.Beasley& Miller, "Modern Electronic Communication", Prentice-Hall India-2006,8thEdition.

6. WayneTomasi, "Electronic Communication Systems", Pearson Education-2005, 5thEdition.R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill NewDelhi-2008.

Microcontroller

BTEXC403S	PCC 2	Microcontroller	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 Objectives:

1. Objective of this course is to introduce to the students the fundamentals of microprocessor
2. After learning Microprocessor course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
3. The learner can design microprocessor based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
4. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
5. The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.
6. The students will get acquainted with recent trends in microprocessor like pipelining, cache memory etc.
7. To understand the applications of Microprocessors.
8. To learn interfacing of real world input and output devices.
9. 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. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.

4. Students can identify and formulate control and monitoring systems using microprocessors.
5. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
6. This course understanding will enforce students to acquire knowledge of recent trends like superscalar and pipelining and thus finds recognition of continuous updation.
7. Learn use of hardware and software tools. 8. Develop interfacing to real world devices.

Course Contents:

Unit 1: Introduction to Microcontroller Architecture [08 Hours]

Overview of MCS-51 architecture, 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: IO Port Interfacing-I [08 Hours]

Interfacing of: LEDS, Keypad, 7-segment multiplexed display, LCD, ADC 0809(All programs in assembly). Programming environment: Study of software development tool chain (IDE), hardware debugging tools (timing analysis using logic analyzer).

Unit 3: Parallel Port Interfacing-II [08 Hours]

Interfacing of: DAC, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Opto isolators, Design of DAS and Frequency counter: All programs in assembly.

Unit 4: PIC Microcontroller Architecture [08 Hours]

Features, comparison & selection of PIC series as per application. PIC18FXX architecture-MCU, Program and Data memory organization, Pin out diagram, Reset operations, Oscillator options (CONFIG), BOD, power down modes & configuration bit settings, timer and its programming, brief summary of Peripheral support, Overview of instruction set

Unit 5: Real World Interfacing Part I [08 Hours]

Port structure with programming, Interrupt Structure (Legacy and priority mode) of PIC18FWith SFRS. Interfacing of 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 [08 Hours]

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. Mahumad Ali Mazadi, ―The 8051 microcontroller & embedded systems, 2nd Edition ,PHI
2. Mahumad Ali Mazadi,―PIC Microcontroller & Embedded System, 3rd Edition ,Pearson.

Signals and Systems

BTEXC404	PCC 3	Signals and Systems	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 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.
5. To develop basis of probability and random variables.

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.

5. Understand the basic concept of probability, random variables & random signals and develop the ability to find correlation, CDF, PDF and probability of a given event.

Course Contents:

Unit 1: Introduction to Signals and Systems [08 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 [08 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 [08 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 [08 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 [08 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.

Unit 6: Probability and Random Signals [08 Hours]

Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Definitions: Statistical averages, mean, moments and expectations, standard deviation and variance, Introduction to Correlation: Autocorrelation, Cross correlation, and their properties.

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. MrinalMandal 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 and Systems.

Control System Engineering

BTEXC405S	PCC 4	Control System Engineering	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 60 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

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 the stability 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 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: Control System Modeling [08 Hours]

Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph.

Unit 2: Time Response Analysis [08 Hours]

Standard input signals, Time response analysis of First Order Systems, Time response analysis of second order systems, Steady state errors and error constants, design specifications for second order systems.

Unit 3: Stability Analysis [08 Hours]

Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, Construction of Root Locus, Dominant Poles, Application of Root Locus Diagram.

Unit 4: Frequency Response Analysis [08 Hours]

Frequency domain Versus Time domain analysis and its correlation, Bode Plots, Polar Plots and development of Nyquist Plots. Frequency Domain specifications from the plots, Stability analysis from plots.

Unit 5: State Variable Analysis [08 Hours]

State space advantages and representation, Transfer function from State space, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method only, Concepts of Controllability and Observability.

Unit 6: Controllers and Digital Control Systems [08 Hours]

Introduction to PLC: Block schematic, PLC addressing, any one application of PLC using Ladder diagram. Introduction to PID controller: P, PI, PD and PID Characteristics and concept of Zeigler-Nicholas method. Digital control systems: Special features of digital control systems, Necessity of sample and hold operations for computer control, z-transform and pulse transfer function, Stability and response of sampled-data 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 dition,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.

Soft-Skill Development

BTHML411	HSMC	Soft-Skill Development	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2hrs/week	Continuous Assessment: 60 Marks Internal Exam (Oral): 40 Marks

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

CO1	Acquire interpersonal communication skills
CO2	Develop the ability to work independently.
CO3	Develop the qualities like self-discipline, self-criticism and self-management.
CO4	Have the qualities of time management and discipline.
CO5	Present themselves as an inspiration for others
CO6	Develop themselves as good team leaders

Course Contents:

Unit 1: Development of Proficiency in English [06 Hours]

Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups). 5 Wsand 1 H and 7 Cs for effective communication. Imbibing etiquettes and manners. Study of different pictorial expressions of non- verbal communication and their analysis.

Unit 2: Self-Management [06 Hours]

Self-Management, 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 and Team Dynamics.

Unit 3: Time Management Techniques [06 Hours]

Practice by game playing and other learning strategies to achieve the set targets Time Management Concept; Attendance, Discipline and Punctuality; Acting in time, Quality /Productive time.

Unit 4: Motivation/Inspiration [06 Hours]

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

Unit 5: Interpersonal Skills Development [06 Hours]

Positive Relationship, Positive Attitudes, Empathies: comprehending others‟ opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills.

Unit 6: Effective Computing Skills [06 Hours]

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.

References:

1. Mitra, Barun, "Personality Development and Soft Skills", Oxford University Press,2016.
2. Ramesh, Gopalswamy, "The Ace of Soft Skills: Attitude, Communication and Etiquette for Success", Pearson Education,2013
3. .Stephen R. Covey, "Seven Habits of Highly Effective People: Powerful Lessons in Personal Change", Free Press Publisher,1989.
4. Rosenberg Marshall B., "Nonviolent Communication: A Language of Life" 3rd edition, Puddle dancer Press, 1st September,2003.

Control Systems Engineering Lab

BTEXL406S	PCC 41 Lab	Control Systems Engineering Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Practical's/Experiments/Assignments (all experiments from the list)

1. Time response of First order system.
2. Time response of Second order system.
3. Temperature controller using ON OFF controller.
4. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system.
5. Effect of P, PD, PI, PID Controller on a second order systems.
6. Temperature controller using PID controller.
7. To study DC position control system
8. To determine speed-torque characteristics of an ac servomotor

Electrical Machines and Instruments Lab

BTESC407	ESC2 Lab	Electrical Machines and Instruments Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	Internal Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics.
2. Field Test on dc series machines.
3. Speed control of dc shunt motor by armature and field control.
4. Swinburne's Test on dc motor.
5. Retardation test on dc shunt motor.
6. Regenerative test on dc shunt machines.
7. Load test on three phase induction motor.
8. No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and
   (ii) circle diagram.
9. Determination of performance parameters at different load conditions from (i) and (ii). 9. Load test on induction generator.
10. Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
11. Conduct suitable tests to draw the equivalent circuit of single phase induction motor and determine performance parameters.

Analog Communication Engineering Lab

BTEXL408	PCC 1 Lab	Analog Communication Engineering Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	External Exam: 40 Marks

List of Practical's/Experiments/Assignments (all experiments from the list)

1. AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal.

2. Generation of DSB-SC with the help of Balanced Modulator IC1496/1596 & its detection
3. SSB modulator using Filter method/ phase shift method & its detection
4. Frequency modulator & demodulator using IC 565 (PLL based), calculation of modulation index & BW of FM
5. Generate AM and FM waveform for given modulation index, signal frequency and carrier Frequency using suitable software.
6. Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal,
7. Prove sampling Theorem. Reconstruct the analog signal from its samples. Observe aliasing effect by varying sampling frequency.
8. Study of AM & FM Spectrum: Observe Spectrum of AM & FM on Spectrum Analyzer, Compare & comment on AM & FM spectrum. Observe Effect of Eigen values on carrier power in FM.
9. Measurement of Performance Characteristics of Receiver: Sensitivity, Selectivity, Fidelity
10. Design, Build & Test class C tuned amplifier for AM Generation / Simulate using desirable Software.

Microcontroller Lab

BTEXL409S	PCC 4 Lab	Microcontroller Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	External Exam: 40 Marks

List of Practical's/Experiments/Assignments (any ten experiments from the list)

1. To study development tools/environment for ATMEL/PIC microcontroller Programme and Architecture.
2. Write an assembly language program to add, subtract, multiply and divide 16 Bit data by Atmel Microcontroller.
3. Write an ALP to generate square of 10 KHz using Timer 0.
4. Write an ALP to display a string on LCD.
5. Write an ALP to interface seven segment with 8051 and display 0-9 on it.
6. Write an ALP to interface Stepper Motor with 8051.
7. Write an ALP to interface ADC with 8051.
8. Write an ALP to interface DAC with 8051.
9. Write an ALP to interface 4x4 keyboards with 8051
10. Study of Programming and Transmission of data through serial port.

11. Study of Programming and Reception of data through serial port.
12. To study implementation and programming of Temperature measurement.
13. Study and analysis of interfacing of LCD using PIC Controller.
14. Write an embedded C program to interface keyboard with PIC.
15. Write an embedded C program to interface DC motor with PIC
16. Write program to Generate square wave using PIC microcontroller.
17. Writing a C language program to implement PIC micro serial communication

Signals and Systems Lab

BTEXL410	PCC 3 Lab	**Signals and Systems Lab**	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks
	Internal Exam: 40 Marks

List of Practical's/Experiments/Assignments (all experiments from the list)

1. Write a program to generate Sinusoidal Signals.
2. Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp Plot all the sequences.
3. Write a program to perform different operations on signals.
4. Write a program to find Convolution of Signals.
5. Write a program to perform Sampling and reconstruction of continuous time signals.
6. Write a program to find the autocorrelation and cross correlation of sequences.
7. Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.

Semester V

BTEXC501 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
5. Method, Method of Moments, Finite Difference Time Domain.
6. To get the basics of microwave, transmission lines and antenna parameters.
7. Students get acquainted with different physical laws and theorems and provide basic
8. 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, 4thedition.
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.

BTEXC502S **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 of noise 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 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 Pass band 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, Noncoherent 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.

P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTEXC502S Embedded System Design 4 Credits

Course Objectives:

1. Understand the embedded system design issues.
2. To learn real time operating system concepts.
3. To understand the Embedded Linux environment.
4. To learn embedded software development and testing process.

Course Outcomes:

1. At the end of the course, students will demonstrate the ability to:
2. Suggest design approach using advanced controllers to real-life situations.
3. Design interfacing of the systems with other data handling / processing systems.
4. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
5. .Get to know the hardware – software co design issues and testing methodology for Embedded system.

Unit-1 Introduction to Embedded Systems

Introduction to Embedded Systems, Architecture, Classification and characteristics of Embedded System, Design Process, Design Metrics and optimization of various Parameters of embedded system. ARM9 architecture. ARM-CM3 Based Microcontroller LPC 1768: Features, Architecture (Block Diagram &Description), System Control, Clock & Power Control, GPIO, Pin Connect Block.

Unit-2 Real Time Systems Concepts

Foreground/ Background systems, Critical section of code, Resource, Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel, Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Advantages & disadvantages of real time kernels.

Unit-3 µCOS II

Features of µCOS II.Kernel structure. µCOS II RTOS services: Task management, Time management, Intertask Communication and Synchronization.

Unit-4 Embedded Linux Development Environment:

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot Loader, Anatomy of an Embedded System, Storage Considerations, and Embedded Linux distributions. Embedded Development Environment, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities.

Unit-5 Linux Kernel Construction

Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das UBoot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts

Unit- 6 Embedded Software Development, Testing Process and Tools

Embedded Software development process and tools, Host and Target Machines, linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware- Software Design and Co-design. Testing on Host Machine, Simulators, Laboratory Tools. Case study of Embedded system like Automatic Chocolate Vending Machine, Mobile Phone, digital camera.

Text Books

1. Jean J.Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach"2nd edition, Prentice Hall.

Reference Books

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill.
2. Frank Vahid and Tony Givargis, "Embedded System Design – A Unified hardware/ Software introduction" 3rd edition, Wiley.

BEEXC 504 Digital Signal Processing 4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems
2. .To understands 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. 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, and Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Low pass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Low pass 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 and W.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988

BTEXC505AS Environmental Studies 4 Credits

Course Objectives:

1. Understand importance of environment
2. Know key issues about environment
3. Understands the reasons for environment degradation
4. Know aspects about improvement methods
5. Know initiatives taken by the world bodies to restrict and reduce degradation

Course Outcomes:

1. Articulate an understanding of relevant concepts that underlie environmental processes, thought and governance in the natural sciences, social sciences and humanities.

2. Integrate and apply sophisticated perspectives from multiple disciplinary approaches that address complex environmental problems

3. Design and conduct research on environmental topics. Research could include a variety of methods (quantitative, qualitative, artistic, rhetorical, spatial, etc.) as well as in a variety of contexts (senior thesis, summer research, course assignments, study abroad, etc.).

4. Communicate effectively in both written and oral formats to academic and non-academic audiences.

UNIT-1 : ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem Structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio-geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a megaDiversity nation–hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT-2 ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO2, NOX, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution

(f)Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT-3 NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing

Energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT-4 SOCIAL ISSUES AND THE ENVIRONMENT :

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT-5 HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

Text Books & Reference Book

1.Dr.A.Ravikrishna,"Environmental Science & Engineering" Revised Edition, Sri Krishna Publication 2014

2. GilbertM.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.

3. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

4. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BP publications, 2010

5. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia",JaicoPubl., House, Mumbai, 2001

6. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.

BTEXC505BS Consumer Electronics 4 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

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 standard relate 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 main 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 ControlTechno1ologies 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

BTEXC505CS Values & Ethics in Profession 4 Credits

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic Guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they „ really want to be" in their life and profession
3. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
4. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcomes:

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

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical Facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the value of harmonious relationship based on trust and respect in their life and profession
4. Understand the role of a human being in ensuring harmony in society and nature.
5. Distinguish between ethical and unethical practices, and start working out the Strategy to actualize a harmonious environment wherever they work

Unit-1 Introduction: Human Values

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social, Ethics, Integrity , Work ethics ,Service learning , Virtues , Respect for others , Living peacefully ,Caring , Honesty, Courage , Valuing time , Cooperation , Commitment , Empathy , Self-confidence, Challenges in the work place , Spirituality

Unit-2 Psycho-social theories of moral development:

View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday context, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy Moral development (theories), Consensus and controversy , Profession , Models of professional roles, Responsibility ,Theories about right action (Ethical theories) Self-control, Self-interest Customs, Religion, Self-respect managing one"s affairs with rectitude of Conduct, Promoting rectitude of conduct.

Unit-3 Business Ethical Concerns:

Work Ethics and Work Values, Business Ethics, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Human values in organizations, Creating Environments of Unity built on Diversity, Unity of Action.

Unit-4 Safety, Responsibilities and Rights

Self-Awareness: Self Knowledge, Self-Esteem; Perceived Self-control, Self-serving bias, Self-presentation, Self-growth, Self-Development: Fostering Initiative, Character strengths and virtues, Emotional intelligence, Social intelligence, (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness). Safety, Responsibilities and Rights, Safety definition , Safety and risk , Risk analysis , Assessment of safety and risk , Safe exit , Risk-benefit analysis , Safety lessons from „the challenger", Conflict of interests , Occupational crime , Human rights , Employee rights , Whistle blowing ,Intellectual property rights

Unit-5 Global Issues

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Ethics and codes of business conduct in MNC

TEXT/REFERENCE BOOKS

1. Car Alan, "Positive Psychology: The Science of Happiness and Human Strengths", Brunner-Routledge.2004
2. Leary M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press. 2004
3. Louis P. P., "The Moral Life: An Introductory Reader in Ethics and Literature", Oxford University Press. 2007
4. Corey, G., Schneider Corey, M., &Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole.2011
5. Snyder, C.R., Lopez, Shane, J., &Pedrotti, J.T., "Positive Psychology" Sage, 2nd Edition 2011
6. A N Tripathy, 2003, Human Values, New Age International Publishers.
7. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
8. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
9. R. S. Naagarazan,, Professional ethics and Human values" New Age International Publishers

BTEXC 505D Introduction to MEMS 4 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. 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 Introduction to Finite Element Method

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. Chang Liu, Faundation of MEMS
3. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
4. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
5. Sergey Edward Lyshevshi, MEMS and NEMS: Systems, Devices, and Structures , CRC Press Book
6. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
7. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
8. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Semester VI

BTETC601 Information Theory and Coding 4 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, Convolution 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, Coderes for mobile communication, GSM codec, USDC codec, Performance evaluation of speech codes

BTETC602S Automotive Electronics 4 Credits

Pre-Requisites: Use of different Sensors in Automobile.

Course Objectives:

1.To understand the concepts of Automotive Electronics and its evolution and trends

2. Automotive systems & subsystems overview.

3 .To understand sensors and sensor monitoring mechanisms aligned to automotive systems, Different signal conditioning techniques, interfacing techniques and actuator mechanisms.

4. To understand, design and model various automotive control systems using Model based Development technique.

5. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.

6. To describe various communication systems, wired and wireless protocols used in vehicle networking.

7. To understand Safety standards, advances in towards autonomous vehicles.

8. To understand vehicle on board and off board diagnostics.

Course Outcomes:

After successfully completing the course students will be able to:

1. Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today‟s automotive industry

2. Interface automotive sensors and actuators with microcontrollers

3. Develop, simulate and integrate control algorithms for ECUs with hardware.

Unit-1 Automotive Systems, Design Cycle and Automotive Industry Overview

Overview of Automotive Industry: Leading players, automotive supply chain, Global challenges, Role of technology in Automotive Electronics and interdisciplinary design, Toolsand processes. Introduction to Modern Automotive Systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles. Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems, Engine control functions, Fuel control, Electronic systems in engines

Automotive transmissions: Transmission fundamentals, Types MT, AT, CVT and DCT. Vehicle Braking Fundamentals: Vehicle dynamics during braking, Hydraulic brake system components, Introduction to antilock braking systems

Steering Control: Steering system basics, Fundamentals of electronically controlled power steering, Electronically controlled hydraulic systems and electric power steering systems, Passenger safety and convenience, Occupant protection systems, Tier pressure monitoring systems. ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on chassis, and in body electronics, infotainment and clusters. Overview of hybrid vehicles.

Unit-2 Automotive Sensors and Actuators.

Systems Approach to Control and Instrumentation: Concept of a system, Analog and digital systems, Basic measurement systems, Analog and digital signal processing, Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling, Smart Nodes. Examples of Sensors: Accelerometers, Wheel speed, Brake pressure, Seat occupancy, Engine speed, Steering wheel angle, Vehicle speed, Throttle position, Turbine speed, Temperature, Mass air flow (MAF) rate, Exhaust gas oxygen concentration, Throttle plate angular position, Crankshaft angular position/RPM, Manifold Absolute Pressure (MAP), Differential exhaust gas pressure and Air bag sensors. Actuators used: Solenoids, Various types of electric motors and piezoelectric force generators. Examples of Actuators: Relays, Solenoids and motors. Chassis control systems and Automatic transmission control systems.

Unit-3 Microcontrollers/Microprocessors in Automotive domain

Critical review and overview of development within the automotive context of microprocessors, microcontrollers and digital signal processors (architecture of 8/16 bitmicrocontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watchdog timers and PWM). Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications. Automotive grade processors viz. Rennes‟s, Infineon. Understanding and working on tool chains for different processors. Development of control algorithms for different automotive subsystems, Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Engine calibration, Torque table, Dynamometer testing

Unit-4 Communication protocols, Infotainment systems

Communication protocols: Overview of automotive communication protocols, CAN, LIN , Flex Ray, MOST , Ethernet, D2B and DSI, Communication interface with ECUs, Interfacing techniques and Interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IPfor automotive applications, Wireless LAN standards such as Bluetooth, IEEE 802.11x communication protocols for automotive applications. Infotainment Systems: Application of telemetric in automotive domain, Global positioning systems (GPS) and General packet radio service (GPRS).

Unit-5 Automotive Control Systems and Model Based Development

Automotive Control System & Model Based Development: Control system approach in Automotive Electronics, Analog and digital control methods, Modelling of linear systems, System responses, Modelling of Automotive Systems with simple examples. Model based Development: Introduction to MATLAB, Simulink and SIMSCAPE tool boxes, Model-Based Design for a small system, Motor Model, Generator Model, Controller Model, SimDriveline, Introduction to Simulink simulations, Exploring the system response using different control methods, Tuning the system, Exploring system limitations, Understanding and refining motor models, Real time simulations on a simple target (Arduino / Rasberry Pi etc), Study of modeling and simulation of any one Automotive System.

Unit-6 Safety Systems in Automobiles and Diagnostic Systems

Active Safety Systems: ABS, TCS, ESP, Brake assist, etc. Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS): Combining computer vision

techniques as pattern recognition, feature extraction, learning, tracking, 3D vision, etc. to develop real-time algorithms able to assist the driving activity. Examples of Assistance Applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles. Functional Safety: Need for safety systems, Safety concept, Safety process for product life cycle, Safety by design, Validation

Diagnostics: Fundamentals of Diagnostics, Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system, Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequences, On-board and off-board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History Memory, Diagnostic tools, Diagnostic protocols KWP2000 and UDS

Text Books:

1. Williams. B. Ribbens: “Understanding Automotive Electronics”, 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch: “Automotive Electronics Handbook”, John Wiley and Sons, 2004.

Reference books:

1. Ronald K Jurgen: “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill, 1999.
2. James D. Halderman: “Automotive Electricity and Electronics", PHI Publication.
3. Terence Rybak& Mark Stefika: “Automotive Electromagnetic Compatibility (EMC)”, Springer, 2004.
4. Allan Bonnick: “Automotive Computer Controlled Systems, Diagnostic Tools and Techniques”, Elsevier Science, 2001.
5. UweKieneke and Lars Nielsen: “Automotive Control Systems: Engine, Driveline and Vehicle”, 2nd Edition, Springer Verlag, 2005.
6. David Alciatore& Michael Histand: "Introduction to Mechatronics and Measurement Systems (SIE)”, TMH, 2007.
7. Iqbal Husain: "Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
8. Tom Denton: "Advanced Automotive Diagnosis”, 2nd Edition, Elsevier, 2006.
9. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications”, Springer, 2009.
10. Tracy Martin: “How to Diagnose and Repair Automotive Electrical Systems" Motor Books / MBl Publishing Company, 2005.
11. MehrdadEbsani, Ali Emadi&YiminGao: “Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, 2009.

12. Marc E. Herniter and Zac Chambers: "Introduction to Model Based System Design", Rose-Hulman Institute of Technology.

BTETC 603 Digital Image Processing 4 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 quantizes, Optimum mean

square uniform quantizes for non-uniform densities, Analytic Models for practical quarters, 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, Quantization 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-200

BTETPE604A CMOS Design 4 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 Power Electronics 4 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 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. M.D. Singh , K.B. Khanchandani - Power Electronics, McGraw Hill.
2. Ramamurthy, power electronics, East West press.
3. G K Dubey, S R Doradla,:Thyristorised Power Controllers", New Age International Publishers.SCR manual from GE, USA.
4. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
5. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
6. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
7. V. R. Moorthi, "Power Electronics", Oxford University Press.
8. Cyril W., Lander," Power Electronics", edition III, McGraw Hill

BTETPE604C Project Management and Operation Research 4 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, 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

Definition, need and importance of organizational behavior, nature and scope, frame work , organizational behavior 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, Centralization and Decentralization, Committees, 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.

BTETPE604D Python Programming 4 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‟s 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-lf-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, VamsiKurama,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.

BTETPE604E Web Development and Design 4 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 Word Press: Design and Development, Wrox Publication, 3rd Edition, 2015
5. E. Robson, E. Freeman, Head First HTML & CSS, O"Reilly Media,2nd Edition,2012.

BTHM605 Employability & Skill Development 3 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 andnon-verbal)
3. Master the presentation skill and be ready for facing interviews.
   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 Wren and Martin, "English grammar and Composition", S. Chan publications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chan publications.
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", McGraw Hills.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

BTEXC701 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 Matric 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 cavities 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 cut off 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

Striplines: Structural details and applications of Striplines, Microstrip 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 BOOK

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.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn, 2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015 Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTEXC702A RF Circuit Design 3 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:

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: 07 Hours

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

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, and 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.

BTEXC702B Satellite Communication 3 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

4. establishing a geo- stationary satellite communication link.
5. Acquired knowledge about Satellite Navigation System.

   Acquired knowledge about Radar and Radar Equations

Unit-1 Basic Principles and Earth Station: Basic Principles: 07 Hours

Basic Principles: General features, frequency allocation for satellite service properties of Satellite communication systems. Earth Station: Introduction, earth station subsystem, Different types of earth stations.

Unit-2 Satellite 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" , CBS Publication.

6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley and Sons.

BTEXC702C Fiber Optic Communication 3 Credits

Course objective

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

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: 07 Hours

Introduction to vector nature of light, propagation of light, propagation of light in 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 Nonlinear effects in fiber optic links: 07 Hours

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).

BTEXC702D Bio-medical Signal Processing 3 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 Event 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- Homomorphic 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:: 07 Hours

Moments and spectral power ratio. Power Cepstrum- Complex Cepstrum 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 Filte

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

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, New Delhi, 2005.
3. Metin Akay, "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. cartilage pathology.

BTEXC703A Wireless Sensor Networks 3 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 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. Waltenegus Dargie, Christian Poellabauer, "Fundamentals ofWireless 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.

BTEXC703B **Cyber Security** **3 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.

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: 0**7 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 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. P fleeger 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,

4. Technology and Automation edited, Springer International Publishing Switzerland 2015.
5. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009

BTEXC703C VLSI Design & Technology 3 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 : 7 Hours

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: 7 Hours

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

Unit-3 SOC & Interconnect: 7 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: 7 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 logical efforts.

Unit-5 Analog CMOS Design: 7 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, Operational amplifier.

Unit-6 Testability: 7 Hours

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.

BTEXC703D Artificial Intelligence Deep Learnings 3 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:

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: 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 earch, 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. 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 University Press- 2015.

BTEXC 704A Electric Vehicle 3 Credits

Course Objectives:

- To study the concepts and drive train configurations of electric drive vehicles.
- To provide different electric propulsion systems and energy storage devices.
- To explain the technology, design methodologies and control strategy of electric vehicles.
- To emphasize battery charger topologies for plug in electric vehicles.

Course Outcomes:

This course will be a first level course on electric vehicles. Students will be able to understand the operation of battery driven electric vehicles. The course will start with introduction section which will enable the students to understand the focus areas that come under the umbrella of electric vehicles. Then the course will start covering these focus areas one by one such as vehicle dynamics, Motors, Power Electronics, Batteries, Charging etc. The most important part of this course will be that each topic will be analyzed and demonstrated through Matlab Simulink, so that the grip of the subject will be strong and the knowledge acquired will be useable in real time applications.

Unit 1 Introduction to Electric Vehicle 07 Hours

Historical Background of Electric Vehicle, Electric vehicle benefits, overview of types of electric vehicle and its challenges, Motor drive Technology, Energy source Technology ,Battery charging Technology, Vehicle to grid.

Unit 2. Vehicle Dynamics: Modelling and Simulation 07 Hours

Subsystem and configuration, subsystem and mode of operation, Consideration of Rolling Resistance – Transmission Efficiency – Consideration of Vehicle Mass – Tractive Effort Modelling Vehicle Acceleration – Modelling Electric Vehicle Range –Aerodynamic

Considerations – Ideal Gearbox Steady State Model – EV Motor Sizing – General Issues in Design.

Unit 3. Fundamental of Drives and DC Machine Modeling 07 Hours

Vehicle Dynamics and tractive effort, Vehicle Dynamics and dynamic equations, Vehicle Dynamics simulations dynamic equation constant Tractive effort force(Fte) ,vehicle dynamic equation variable Fte, vehicle simulation dynamic equation variable Fte, vehicle dynamic modelling and simulation in simulink .

Unit 4 Introduction to electric vehicle batteries 07 Hour

Electric vehicle battery efficiency – electric vehicle battery capacity – electric vehicle battery Charging – electric vehicle battery fast charges – electric vehicle battery discharging – electric Vehicle battery performance – testing.

Unit 5 Electric Vehicles Advanced Topics 07 Hours

Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug in Electric and Hybrid Vehicles – The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks– Sizing Ultra capacitors for Hybrid Electric Vehicle

Rreference

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design – Mehrdad Ehsani, Uimin Gao and Ali Emadi – Second Edition – CRC Press, 2010.
2. Electric Vehicle Technology Explained – James Larminie, John Lowry – John Wiley & Sons Ltd – 2003.
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes – New Delhi – 2002.
4. Hybrid electric Vehicles Principles and applications With practical perspectives -Chris Mi,
5. Dearborn – M. Abul Masrur, David Wenzhong Gao – A John Wiley & Sons, Ltd., – 2011. Electric & Hybrid Vehicles – Design Fundamentals – Iqbal Hussain, Second Edition, CRC Press, 2011.

BTEXC704B Mobile Computing 3 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.

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 Hour**

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 Hour**

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, Uwe Hansmann, Lothar Merk, Martin Nicklous, Thomas Stober, Springer
2. Mobile Computing, Tomasz Imielinski, Springer.

BTEXC704C Advance Industrial Automation-1 3 Credits

Course Objectives

1. To identify potential areas for automation and justify need for automation.
2. To select suitable major control components required to automate a process or an activity
3. 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: 07 Hours

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:: 07 Hours

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:: 07 Hours

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: 07 Hours

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: 07 Hours

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: 07 Hours

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.

BTEXC704D Mechatronics 3 Credits

Course Objective:

1. Understand key elements of Mechatronics system, representation into block diagram.
2. Understand concept of transfer function, reduction and analysis.
3. Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller.
4. Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.
5. Understand the system modelling and analysis in time domain and frequency domain.
6. 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, and 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: 07 Hours

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: 07 Hours

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: 07 Hours

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 (Programmable Logic Controller): 07 Hours

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 : 07 Hours

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: 07 Hours

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

BTEXC70 Engineering Economics and Financial Mathematics 3 Credits

Course Objective:

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, 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: 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 anew asset − capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit-4 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 press 2006

3. A Text book of Economic Theory: by stonier and hauge, pearson Publication.
4. Modern Economic Theory: by Sampat Mukherjee, New Age International Publisher.
5. Engineering Economics: by Degramo, prentice Hall.
6. International Economics: by Bo Sodersten ,Macmillan.
7. Principle of Macroeconomics : by Rangarajan and Dholokia, Tata McGraw Hill.
8. Monetary Economics: by Suraj B.Gupta, S chand.
9. Project planning analysis, Selection, Implementation and review: by Prasanna Chandra, Tata McGraw Hill Education.8.Cost Accounting: by Jawahar Lal ,McGraw Hill

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	BTBSC301	Engineering Mathematics – III	Differential equations for engineers	IIT Madras	80%	12 WEEK
2		BTEXC302	Analog Circuits	Analog Circuits	IIT Delhi	70%	12 WEEK
3		BTEXC303	Electronic Devices & Circuits	Fundamentals of semiconductor devices	IISc Bangalore	80%	12 WEEK
4		BTEXC304	Network Analysis	Network Analysis	IIT Kharagpur.	80%	12 WEEK
5		BTEXC305S	Digital Circuits & Microprocessor	Digital Circuits	IIT Madras	60%	14 WEEK
6		BTHM3401	Basic Human Rights	Human Rights, International Law and International Humanitarian Law	O.P. Jindal Global University	80%	08 WEEK
	SEM-IV	BTESC401	Electrical Machines and Instruments	Electrical Machines - I	IIT Kharagpur	70%	12 WEEK
		BTEXC402	Analog Communication	Analog Communication	IIT KHARAGPUR	90%	12 WEEK
		BTEXC403S	Microcontrollers	Microcontrollers	IIT KHARAGPUR	90%	12 WEEK
6		BTEXC404	Signals and Systems	Signals and Systems	IIT Bombay	90%	11 WEEK
7		BTEXC402S	Control System Engineering	Control Engineering	IIT Madras	90%	12 WEEK
10	SEM-V	BTEXC501	Electromagnetic Field Theory	Electomagnetic Theory	IIT KHARAGPUR	90%	12 WEEK
		BTEXC502S	Digital Communication	Principles of Digital Communication	IIT DELHI	50%	12 WEEK
		BTEXC503S	Embedded System Design	Embedded System Design	IIT KHARAGPUR	70%	6 WEEK
11		BTEXC504	Digital Signal Processing	Digital Signal Processing	IIT Delhi	90%	12 WEEK
12		BTEXC505D	Introduction to MEMS	MEMs and Microsystems	IIT Kharagpur.	90%	9 WEEK

15	SEM-VI	BTETC601	Information Theory and Coding	Information Theory	IISC BANGLORE	40%	12 WEEK
16		BTETC603	Digital Image Processing	Digital Image Processing	IIT KHARAGPUR	70%	12 WEEK
17		BTETPE604A	CMOS Design	CMOS Digital VLSI Design	IIT ROORKEE	30%	8 WEEK
17		BTETPE604B	Power Electronics	Power Electronics	IIT DELHI	55%	12 WEEK
		BTETPE604C	Project Management and Operation Research	Project Management for managers	IIT ROORKEE	90%	12 WEEK
		BTETPE604D	Python Programming	Programming, Data Structures and Algorithms using Python	IIT Madras	40%	8 WEEK
19	SEM-VII	BTEXC701	Microwave Engineering	Microwave theory and Technique	IIT Bombay	60%	12 WEEK
20		BTEXC702C	Fiber Optic Communication	Optical Engineering	IIT Madras	50%	12 WEEK
		BTEXC703A	Wireless Sensor Networks	Principles of modern CDMA/MIMO/OFDM,Wireless communication,Introduction to wireless and cellular communication	IIT KANPUR	30%	8 WEEK
21		BTEXC703C	VLSI Design & Technology	CMOS Digital VLSI Design	IIT ROORKEE	20%	8 WEEK
		BTEXC703C	VLSI Signal Processing	VLSI Signal Processing	IIT KHARAGPUR	30%	8 WEEK
		BTEXC704B	Mobile Computing	Cloud computing	IIT KHARAGPUR	25%	8 WEEK
		BTEXC703D	Artificial Intelligence and Machine learning	Introduction to AI	IIT DELHI	90%	12 WEEK
		BTEXC704A	Electrical Vehicles	Electrical Vehicles	IIT DELHI	70%	8 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	COURSERA COURSE	NAME OF THE INSTITUTE OF OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential Equations for Engineers	The Hong Kong University of Science and Technology (HKUST)	70%	6 WEEK
2		BTEXC303	Electronic Devices & Circuits	Introduction to Electronics	The Georgia Institute of Technology	80%	7 WEEK

3		BTEXC305S	Digital Circuits & Microprocessor	Digital Systems: From Logic Gates to Processors-	Universitat Autònoma de Barcelona	70%	8 WEEK
		BTEXC304	Network Analysis	Linear Circuits 1: DC Analysis	The Georgia Institute of Technology	60%	7 WEEK
4		BTHM3401	Basic Human Rights	Human Rights for Open Societies	Utrecht University	60%	6 WEEK
5	SEM-IV	BTESC401	Electrical Machines and Instruments	Motors and Motor Control Circuits	University of Colorado Boulder	60%	5 WEEK
6		BTEXC404	Signals and Systems	Digital Signal Processing 3: Analog vs Digital	École Polytechnique Fédérale de Lausanne	60%	4 WEEK
7		BTEXC403S	Microcontrollers	Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30%	4 WEEK
10	SEM-V	BTEXC504	Digital Signal Processing	Digital Signal Processing 2: Filtering	École Polytechnique Fédérale de Lausanne	70%	3 WEEK
11		BTEXC503S	Embedded System Design	Embedded Hardware and Operating System	University of Turku,Finland	30	3 WEEK
		BTEXC502S	Digital Communication	Digital Signal Processing Applications	École Polytechnique Fédérale de Lausanne	40%	3 WEEK
13	SEM-VI	BTEXPE604B	Power Electronics	Converter Circuits	University of Colorado Boulder	60%	4 WEEK
		BTEXPE604D	Python Programming	Python Data Structures	University of Michigan	80%	7 WEEK
14		BTEXC603	Digital Image Processing	Fundamentals of Digital Image and Video Processing	Northwestern University	60%	12 WEEK
		BTETC601	Information Theory and Coding	Information Theory	The Chinese University of Hong Kong	70%	11 WEEK
16	SEM-VII	BTEXC702D	Bio-medical Signal Processing	The Development of Mobile Health Monitoring Systems	Saint Petersburg State University	40%	5 WEEK
		BTEXC703C	VLSI Design & Technology	VLSI CAD Part I: Logic	University of Illinois at Urbana-Champaign	50%	5 WEEK
		BTEXC703D	Artificial Intelligence and Machine learning	Machine Learning	Stanford University	70%	11 WEEK
		BTEXC703B	Cyber Security	Web Connectivity and Security in Embedded Systems	EIT Digital	60%	6 WEEK
		BTEXC704B	Mobile Communication and Networks	Wireless Communications for Everybody	Yonsei University	60%	6 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	EDX COURSE	NAME OF INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTEXC303	Electronic Devices & Circuits	Principle of Semiconductor Devices Part I: Semiconductors, PN Junctions and Bipolar Junction Transistors	The Hong Kong University of Science and Technology	70%	8 WEEK
2		BTEXC305S	Digital Circuits & Microprocessor	Computation Structures - Part 1: Digital Circuits	Massachusetts Institute of Technology	60%	10 WEEK
		BTEXC304	Network Analysis	Principles of Electric Circuits	Tsinghua University	40%	18 WEEK
		BTHM3401	Basic Human Rights	Human Rights Defenders	Amnesty International	40%	4 WEEK
3	SEM-IV	BTEXC402S	Control System Engineering	Introduction to Control System Design - A First Look	Massachusetts Institute of Technology	40%	4 WEEK
4		BTEXC404	Signals and Systems	1) Discrete Time Signals and Systems, Part 1: Time Domain , Discrete Time Signals and Systems, Part 2: Frequency Domain 2) Discrete Time Signals and Systems	Rice University	70%	1)4 WEEK 2)8 WEEK
5		BTEXC403S	Microcontrollers	Embedded Systems - Shape The World: Microcontroller Input/Output	The University of Texas at Austin	50%	8 WEEK
8	SEM-V	BTEXC501	Electromagnetic Field Theory	Electromagnetism	Tsinghua University	30%	7 WEEK
10		BTEXC502S	Digital Communication	A System View of Communications: From Signals to Packets (Part 1)+(Part2)+(Part3)	The Hong Kong University of Science and Technology	40%	7/5/6 WEEK
11	SEM-VI	BTEXPE604D	Python Programming	Introduction to Python: Fundamentals	Microsoft	50%	5 WEEK
		BTETPE504F	(F) Power Electronics	Power Electronics	Massachusetts Institute of Technology	45%	12 WEEK
12		BTEXC603	(A) Digital Image Processing	Image Processing and Analysis for Life Scientists	École polytechnique fédérale de Lausanne	50%	7 WEEK
14	SEM-VII	BTEXC703D	Artificial Intelligence and Machine learning	AI, ML	Columbia University	40%	12 WEEK
		BTEXC702C	Fiber Optic Communication	Optical Materials and Devices	Massachusetts Institute of Technology	20%	6 WEEK
		BTEXC703B	Cyber Security	Introduction to Cybersecurity	University of Washington	40%	6 WEEK