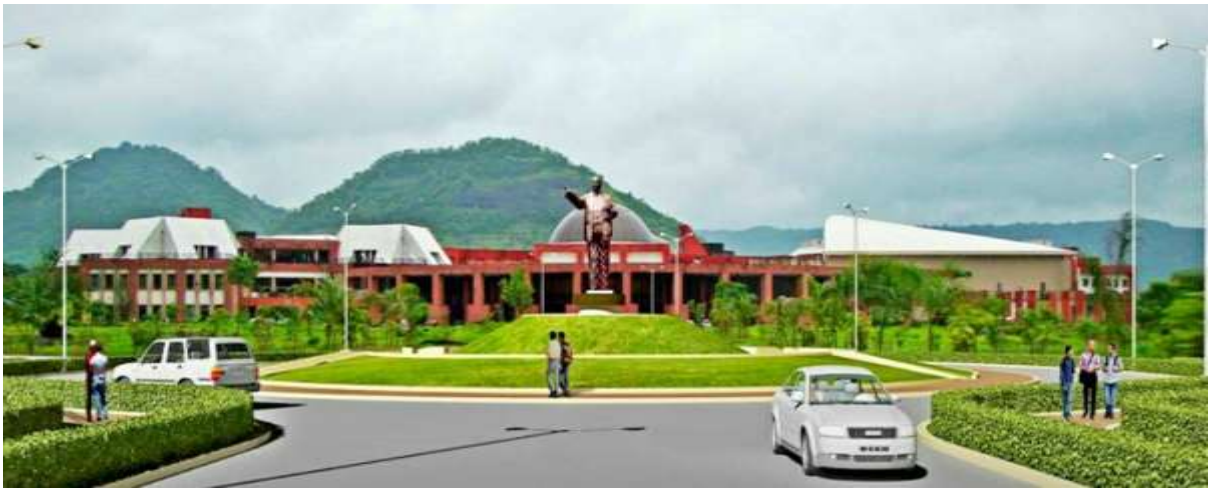
Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
Telephone and Fax. : 02140 - 275142
www.dbatu.ac.in

PROPOSED CURRICULUM
UNDER GRADUATE PROGRAMME
B. TECH

Electronics Engineering

With effect from the Academic Year 2020-2021.



Rules and Regulations

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

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students

opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

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

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

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

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

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

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be 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:

1.	MidSemester Exam (MSE) Marks	20
2.	ContinuousAssesment Marks	20
3.	End SemesterExamination(ESE)Marks	60

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

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

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

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

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

The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.

If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.

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

6. Evaluation of Performance:

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

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

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where

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

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

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

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

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

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where

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

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

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

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

Award of Degree of Honours

Major Degree

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

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

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in

the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.

4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

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

B. 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.

Bachelor of Technology in Electronics Engineering

Basic Science Course (BSC)

BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics - III	(3-1-0)4
BTBS404	Probability Theory and Random Processes	(3-0-0)3

Engineering Science Courses (ESC)

BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2

Humanities and Social Science including Management Courses(HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(3-0-0)3
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM706	Foreign Language Studies	Audit

Professional Core Courses (PCC)

BTEXC302	Electronic Devices & Circuits	(3-1-0)4
BTEXC303	Digital Electronics	(3-1-0)4
BTEXC304	Network Theory	(3-1-0)4
BTEXL305	Electronic Devices & Circuits Lab	(0-0-2)1
BTEXL306	Digital Electronics Lab & Network Theory Lab	(0-0-4)2
BTEXL406	Signals and Systems Lab	(0-0-2)1
BTEXC501	Analog Circuits	(2-2-0)4
BTEXC502	Digital Signal Processing	(3-1-0)4
BTEXC503	Microelectronics	(3-1-0)4

BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES401	Electrical Machines and Instruments	(3-1-0)4

Professional Elective Course (PEC)

BTEXPE405	(A) Numerical Methods and Computer Programming	(3-1-0)4
	(B) Data Compression & Encryption	
	(C) Computer Organization and Architecture	
	(D) Introduction to MEMS	
BTEXPE504	(A) Electromagnetic field theory	(3-1-0)4
	(B) VLSI design and Technology	
	(C) Electronics in smart city	
	(D) Electronics measurement and Instruments	
	(E) Mixed Signal Design	
	(F) Automotive Electronics	
BTEXPE603	(A) Information Theory and Coding	(3-1-0)4

BTEXL507	Analog Circuits Lab & Digital Signal Processing Lab	(0-0-4)2
BTEXC601	Power Electronics	(3-1-0)4
BTEXC602	Microprocessors and Microcontrollers	(3-1-0)4
BTEXL606	Power Electronics Lab and Microprocessors and Microcontrollers Lab	(0-0-4)2
BTEXC701	Embedded System Design	(3-1-0)4
BTEXL707	Embedded System Design Lab	(0-0-2)1

Open Elective Course (OEC)

BTEXOE505	(A) Digital System Design	(3-1-0)4
	(B) Artificial Intelligence and Machine learning	
	(C) Optimization Techniques	
	(D) Project Management and Operation Research	
	(E) Augmented, Virtual and Mixed Reality	
BTEXOE604	(A) IoT and Industry 4.0	(3-1-0)4
	(B) Communication Engineering	
	(C) Computer Network & Cloud Computing	

	(B) Control System Engineering	
	(C) Electronics Circuit Design	
	(D) Nanoelectronics	
	(E) Advanced Digital Signal Processing	
BTEXPE702	(A) Microwave Engineering	(3-1-0)4
	(B) Advanced Industrial Automation	
	(C) Satellite Communication	
	(D) Fiber Optic Communication	
	(E) CMOS Design	

Seminar/Mini Project/ Internship

BTES209S	Seminar	(0-0-2)1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time). (Internship – 1)	Audit
BTEXS307	Seminar I	(0-0-4)2
BTEXS407	Seminar II	(0-0-4)2
BTEXP408	(Internship – 2)	Audit
BTEXM508	Mini Project – 1	(0-0-4)2
BTEXM606	Mini Project – 2	(0-0-4)2

	(D) Industrial Drives and Control	
	(E) Robotics Design	
BTEXOE703	(A) Wireless Sensor Networks	(3-1-0)4
	(B) Block Chain Technology	
	(C) Cyber Security	
	(D) Bio-medical signal processing	
	(E) Mobile Communication and Networks	
BTEXOE704	(A) Soft Computing	(3-1-0)4
	(B) Big Data Analytics	
	(C) Data Structure & Algorithms Using Java Programming	
	(D) Entrepreneurship Development	
	(E) Software Defined Radio	

Project (MP)

BTEXP801	Project work/ Internship	(0-0-24)12

Minor Courses (MC)

BTEXC302	Electronic Devices & Circuits	(3-1-0)4
BTEXC303	Digital Electronics	(3-1-0)4
BTEXC501	Analog Circuits	(3-1-0)4
BTEXC503	Microelectronics	(3-1-0)4
BTEXC602	Microprocessors and	(3-1-0)4

BTEXP607	(Internship – 3)	Audit	Microcontrollers
BTEXM708	Mini Project – 3	(0-0-4)2	

Suggested Plan of Study:

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTBS301	BTES401	BTEXC501	BTEXC601	BTEXC701	BTEXP801 (Project/Internship)
2	BTBS102	BTBS202	BTEXC302	BTEXC402	BTEXC502	BTEXC602	BTEXPE702 **(Elective)**	--
3	BTES103	BTES203	BTEXC303	BTHM403	BTEXC503	BTEXPE603 **(Elective)**	BTEXOE703 **(Elective)**	--
4	BTHM104	BTES204	BTEXC304	BTBS404	BTEXPE504 **(Elective)**	BTEXOE604 **(Elective)**	BTEXOE704 **(Elective)**	--
5	BTES105	BTES205	BTEXL305	BTEXPE405 **(Elective)**	BTEXOE505 **(Elective)**	BTHM605	BTHM705	--
6	BTES106	BTES206	BTEXL306	BTEXL406	BTEXL507	BTEXL606	BTHM706	--
7	BTBS107L	BTBS207L	BTEXS307	BTEXS407	BTEXM508	BTEXM607	BTEXL707	--
8	BTES108L	BTES208L	BTES211P (Internship - 1 Evaluation)	BTEXP408 (Internship – 2)	BTEXP408 (Internship – 2 Evaluation)	BTEXP608 (Internship – 3)	BTEXM708	--
9	BTHM109L	BTES209S	--	--	--	--	BTETP608 (Internship – 3 Evaluation)	--

10	--	BTES211P (Internship - 1)	--	--	--	--	--	--

Degree Requirements:

Category of courses	**Minimum credits to be earned**
Basic Science Course (BSC)	**25**
Engineering Science Course (ESC)	**19**
Humanities and Social Science including Management Courses (HSSMC)	**12**
Professional Core Course (PCC)	**49**
Professional Elective Course (PEC)	**16**
Open Elective Course (OEC)	**16**
Seminar/Mini Project/ Internship/Major Project	**23**
Total	**160**

B. Tech in Electronics Engineering
Program Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

Graduates will able to–

1. To equip graduates with a strong foundation in engineering sciences and Electronics Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
2. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to Electronic Circuits, Embedded & wireless communication Systems and Signal Processing to solve engineering/ societal problems in the field of Electronics Engineering.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirements.

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B. Tech in (Electronics Engineering)

Curriculum for Second Year

Semester III									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTEXC302	Electronic Devices & Circuits	3	1	-	20	20	60	100	4
PCC 2	BTEXC303	Digital Electronics	3	1	-	20	20	60	100	4
PCC 3	BTEXC304	Network Theory	3	1	-	20	20	60	100	4
LC	BTEXL305	Electronic Devices & Circuits Lab	-	-	2	60	-	40	100	1
LC	BTEXL306	Digital Electronics Lab & Network Theory Lab	-	-	4	60	-	40	100	2
Seminar	BTEXS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship – 1 Evaluation	-	-	-	-	-	50	50	Audit
		Total	**12**	**4**	**10**	**260**	**80**	**410**	**750**	**21**
Semester IV										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
ESC	BTES401	Electrical Machines and Instruments	3	1	-	20	20	60	100	4
PCC 4	BTEXC402	Signals and Systems	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC 1	BTEXPE405	Numerical Methods and Computer Programming Data Compression & Encryption Computer Organization and Architecture Introduction to MEMS	3	1	-	20	20	60	100	4
LC	BTEXL406	Signals and Systems Lab	-	-	2	60	-	40	100	1
Seminar	BTEXS407	Seminar II	-	-	4	60	-	40	100	2
Internship	BTEXP408 (Internship – 2)	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in V Sem.
		Total	**16**	**3**	**6**	**220**	**100**	**380**	**700**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course

PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

HSSMC = Humanities and Social Science including Management Courses

B. Tech in (Electronics Engineering)

Curriculum for Third Year

Semester V										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 5	BTEXC501	Analog Circuits	2	2	-	20	20	60	100	4
PCC 6	BTEXC502	Digital Signal Processing	3	1	-	20	20	60	100	4
PCC 7	BTEXC503	Microelectronics	3	1	-	20	20	60	100	4
PEC 2	BTEXPE504	Group A	3	1	-	20	20	60	100	4
OEC 1	BTEXOE505	Group B	3	1	-	20	20	60	100	4
LC	BTEXL507	Analog Circuits Lab & Digital Signal Processing Lab	-	-	4	60	-	40	100	2
Project	BTEXM508	Mini Project – 1	-	-	4	60	-	40	100	2
Internship	BTEXP408	Internship – 2 Evaluation	-	-	-	-	-	50	50	Audit
		Total	**14**	**6**	**8**	**220**	**100**	**430**	**750**	**24**

Semester VI										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 8	BTEXC601	Power Electronics	3	1	-	20	20	60	100	4
PCC 9	BTEXC602	Microprocessors and Microcontrollers	3	1	-	20	20	60	100	4
PEC 3	BTEXPE603	Group A	3	1	-	20	20	60	100	4
OEC 2	BTEXOE604	Group B	3	1	-	20	20	60	100	4
HSSMC	BTHM605	Employability & Skill Development	3	-	-	20	20	60	100	3
LC	BTEXL606	Power Electronics Lab & Microprocessors and Microcontrollers Lab	-	-	4	60	-	40	100	2
Project	BTEXM607	Mini Project – 2	-	-	4	60	-	40	100	2
Internship	BTEXP608 (Internship – 3)	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in VII Sem.
		Total	**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course

PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

HSSMC = Humanities and Social Science including Management Courses

Semester V

(BTEXPE 504) Program Elective 2 (Group A)	(BTEXOE 505) Open Elective 1 (Group B)
(A) Electromagnetic Field Theory	(A) Digital System Design
(B) VLSI Design & Technology	(B) Artificial Intelligence and Machine learning
(C) Electronics in Smart City	(C) Optimization Techniques
(D) Electronics Measurements and Instruments	(D) Project Management and Operation Research
(E) Mixed Signal Design	(E) Augmented, Virtual and Mixed Reality
(F) Automotive Electronics	

Semester VI

(BTEXPE 603) Program Elective 3 (Group A)	(BTEXOE 604) Open Elective 2 (Group B)
(A) Information Theory and Coding	(A) IoT and Industry 4.0
(B) Control System Engineering	(B) Communication Engineering
(C) Electronics Circuit Design	(C) Computer Network & Cloud Computing
(D) Nano Electronics	(D) Industrial Drives and Control
(E) Advanced Digital Signal Processing	(E) Robotics Design

Dr. Babasaheb Ambedkar Technological University, Lonere.

B. Tech in (Electronics Engineering)

Curriculum for Final Year

Semester VII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTEXC701	Embedded System Design	3	1	-	20	20	60	100	4
PEC 4	BTEXPE702	Group A	3	1	-	20	20	60	100	4
OEC 3	BTEXOE703	Group B	3	1	-	20	20	60	100	4
OEC 4	BTEXOE704	Group C	3	1	-	20	20	60	100	4
HSSMC	BTHM705	Engineering Economics and Financial Mathematics	3	-	-	20	20	60	100	3
HSSMC	BTHM706	Foreign Language Studies	-	-	-	-	-	-	-	Audit
LC	BTEXL707	Embedded System Design Lab	-	-	2	60	-	40	100	1
Project	BTEXM708	Mini Project – 3	-	-	4	60	-	40	100	2
Internship	BTEXP608	Internship – 3 Evaluation	-	-	-	-	-	50	50	Audit
		Total	**15**	**4**	**6**	**220**	**100**	**430**	**750**	**22**
Semester VIII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
Project/ Internship	BTEXP801	Project work/ Internship	-	-	24	60	-	40	100	12
		Total	**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course

PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

HSSMC = Humanities and Social Science including Management Courses

(BTEXPE 702) Program Elective 4 (Group A)	(BTEXOE 703) Open Elective 3 (Group B)	BTEXOE 704) Open Elective 4 (Group C)
(A) Microwave Engineering	(A) Wireless Sensor Networks	(A) Soft Computing
(B) Advanced Industrial Automation	(B) Block Chain Technology	(B) Big Data Analytics
(C) Satellite Communication	(C) Cyber Security	(C) Data Structure & Algorithms Using Java Programming
(D) Fiber Optic Communication	(D) Bio-medical Signal Processing	(D) Entrepreneurship Development
(E) CMOS Design	(E) Mobile Communication and Networks	(E) Software Defined Radio

Total Credits: 160

Semester III

BTBS301 Engineering Mathematics-III **4 Credits**

Second Year B. Tech Classes (Common to all Branches)

Course Objectives:

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

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in 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:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: Laplace Transform **09 Hours**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of

integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

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

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

Unit 3: Fourier Transform **09 Hours**

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

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

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

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

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

Text Books

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

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

Reference Books

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

General Instructions:

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

   The minimum number of assignments should be eight covering all topics.

BTEXC302 Electronic Devices and Circuits — 4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce Static characteristics of ideal two terminal and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results.

Course Outcomes:

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

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.
3. Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feedback amplifiers and oscillators..

UNIT – 1 Bipolar Junction Transistor: **07 Hours**

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier , Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier, Emitter follower, Cascaded Amplifier, Need for multistage amplifiers and suitability of CE, CC and CB configurations in multistage amplifiers.

UNIT – 2 Junction Field Effect Transistor and MOSFET **07 Hours**

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET, The FET as VVR.

MOSFET: Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p - MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT – 3 Power amplifiers: **07 Hours**

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, efficiency, calculation of power output, power dissipation, cross over distortion and its elimination methods, need of heat sink and its design.

UNIT – 4 Feedback amplifiers: **07 Hours**

Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt,

Current series, Current shunt types of Negative feedback, Typical transistor circuits effects of Negative feedback on Input and Output impedance, Voltage and Current gains, Bandwidth, Noise and Distortion

UNIT – 5 Oscillators & Voltage Regulator Circuits **07 Hours**

Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, RC, Clapp, Wien Bridge, Colpitt, Hartley, Tuned LC, UJT, Relaxation Oscillators.

T**ransistor application:** Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator

TEXT/REFERENCE BOOKS:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, “Electronics Devices & Circuits”, Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.

BTEXC303 Digital Electronics 4 Credits

Course Objectives:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

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

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.
3. Design and implement hardware circuit to test performance and application.
4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT – 1 Combinational Logic Design: 07 Hours

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don‘t care conditions, Design Examples: Arithmetic Circuits, BCD - to - 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and De-multiplexers, Decoders.

UNIT – 2 Sequential Logic Design: 07 Hours

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops, Conversion of flip flops. Application of Flip-flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT – 3 State Machines: 07 Hours

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT – 4 Digital Logic Families: 07 Hours

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND

gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L and DCTL

UNIT – 5 Programmable Logic Devices, Semiconductor Memories and Introduction to VHDL: 07 Hours

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India, 2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd 2001 Edition.

BTEXC304 Network Theory 4 Credits

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.

4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

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

1. Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze the same.
2. Design passive filters and attenuators theoretically and practically. To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
3. Identify issues related to transmission of signals, analyze different RLC networks.
4. Find technology recognition for the benefit of the society.

UNIT – 1 Network Theorems: 07 Hours

Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin's, Norton's and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

UNIT – 2 Transient Analysis and Frequency Domain Analysis: 07 Hours

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

UNIT – 3 Laplace transform and its circuit applications: 07 Hours

Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response.

UNIT – 4 Two Port Networks: 07 Hours

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

UNIT – 5 State Variable Analysis and RL & RC Network Synthesis: 07 Hours

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press. 2003.
3. M.E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson 2006.
4. M.E. Van Valkenburg, "Network Synthesis," PHI 2007.
5. Kuo, F.F., "Network Analysis and Synthesis", 2nd Ed., Wiley India. 2008.
6. D Roy Choudary, "Network and Systems" 1st edition, New Age International, 1988
7. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill, 1982.
8. Royal Signal Handbook on Line Communication.

Semester IV

BTES401 Electrical Machines and Instruments — 4 Credits

Course Objectives:

1. Model and Analyze the performance of different types of DC machines
2. Learn the applications of DC generators
3. Analyze the performance of different types of DC motors
4. Analyze the performance of different types of Sensors and Transducers
5. Familiarize with the applications of DC machines
6. To prepare students to perform the analysis of any electromechanical system.
7. To empower students to understand the working of electrical equipment used in everyday life.

Course Outcomes:

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

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.
2. The skill to analyze the response of any electrical machine.
3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

UNIT – 1 DC Machines: **07 Hours**

DC machines construction, working principle (motor & generator), EMF equation of DC Machine (motor and generator), Types and its characteristics of DC machines (motor and generator), back emf, starters of dc machine, Speed control of DC motor Breaking of DC motor, applications of DC machines (motor and generator).

UNIT – 2 Induction Motor and Synchronous Motor: **07 Hours**

Induction Motor: Construction, working principle, types, torque equation, torque slip characteristics, power stages, losses and efficiency, starters speed control, breaking, applications.

Synchronous motor: Construction, working principle, starting methods, effect of load, hunting, V-curve, synchronous condenser, applications.

UNIT – 3 Special Purpose Machines: **07 Hours**

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

UNIT – 4 Sensors and Transducers: **07 Hours**

Classification selection of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types, interfacing techniques of transducers with microprocessor and controller.

UNIT – 5 Industrial Measurement and Industrial Applications: **07 Hours**

Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm,

object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.

TEXT/REFERENCE BOOKS:

1. A course in Electrical and Electronic Measurement and Instrumentation" by A. K. Sawhney (Publisher name: Dhanpat Rai & Co.)
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGraw Hill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai and publication
4. Instrumentation Devices System edition C. S. Rajan, G. R. sharma
5. Abhijit Chakrabarti & Sudipta Debnath, "Electrical Machines", Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, "Electrical Machinery", Tata McGraw-hill Publication 6th Edition.
8. I.J Nagarath & D.P Kothari, "Electrical Machines", Tata McGraw-hill Publication 4th Edition.
9. T. J. E. Miller, "Brushless permanent-magnet and reluctance motor drives", Oxford University Press (1989).
10. Ned Mohan, "Electric Machines and Drives": A first course, Wiley.
11. B. L. Theraja, "Electrical technology" volume 2, S. Chand.

BTEXC402 Signals and Systems — 4 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

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

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.

UNIT – 1 Introduction to Signals and Systems: 07 Hours

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

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

UNIT – 2 Time domain representation of LTI System: 07 Hours

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulse response.

UNIT – 3 Fourier Series: 07 Hours

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties.

UNIT – 4 Fourier Transform: **07 Hours**

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of bandpass signals.

UNIT – 5 Laplace and Z-Transform: **07 Hours**

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI system analysis.

Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z-transform, Z-transform for discrete time system LTI analysis.

TEXT/REFERENCE BOOKS:

1. Alan V. *Oppenheim*. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware, 2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley India.
4. Shaila Apte, “Signals and Systems-principles and applications”, Cambridge University press, 2016.
5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.
6. Peyton Peebles, “Probability, Random Variable, Random Processes”, 4th Edition, Tata McGraw Hill.
7. A. Nagoor Kanni “Signals and Systems”, 2nd edition, McGraw Hill.
8. NPTEL video lectures on Signals and Systems.
9. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw Hill. 2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th 2001 Ed., Pearson Education.

BTHM403 Basic Human Rights **3 Credits**

Course Objectives:

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

Course Outcomes:

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

UNIT – 1 **07 Hours**

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

UNIT – 2 **07 Hours**

Fundamental rights and economic programme. Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social

Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT – 3 **07 Hours**

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

UNIT – 4 **07 Hours**

Human rights in Indian constitution and law:-

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

UNIT – 5 **07 Hours**

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

Reference books:

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

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

BTBS404 Probability Theory and Random Processes 3 Credits

Course Objectives:

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

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT – 1 Introduction to Probability: **07 Hours**

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications

UNIT – 2 Random variables: **07 Hours**

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation; independent,

UNIT – 3 Random vector and distributions: **07 Hours**

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT – 4 Sequence of random variables **07 Hours**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT – 5 Random process: **07 Hours**

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS:

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

BTEXPE405A Numerical Methods and Computer Programming 4 Credits

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.

3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

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

1. Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.
2. Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. Prepare them to write computer programs for the numerical computational techniques.
5. Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Understand procedure-oriented and object-oriented programming concepts.
7. Capable of writing C and C++ programs efficiently.

UNIT – 1 Introduction to Computational Methods and Errors: 07 Hours

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques. Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

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

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

UNIT – 3 Interpolation and Polynomial Approximation: 07 Hours

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

UNIT – 4 Numerical Integration and Differentiation: 07 Hours

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

UNIT – 5 Object Oriented Programming: 07 Hours

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

TEXT/REFERENCE BOOKS:

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3^{rd} edition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3^{rd} Edition.

3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi, 1996.
4. D. Ravichandran, "Programming with C++", TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2nd Edition
6. Yeshwant Kanetkar, "Let us C++, BPB Pub.", Delhi, 2002, 4th Edition.
7. Stroupstrup Bjarne, "C++ Programming Language", Addison Wesley, 1997, 3rd Edition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai, 1998.

BTEXPE405B Data Compression & Encryption — 4 Credits

Course Objectives:

1. The concept of security, types of attack experienced.
2. Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT – 1 Data Compression and Encryption: 07 Hours

Need for data compression, Lossy/lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT – 2 Statistical Methods and Dictionary Methods: 07 Hours

Statistical Methods: Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPM method.

Dictionary Methods: String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT – 3 Image Compression: **07 Hours**

Lossless techniques of image compression, gray codes, two-dimensional image transform, Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT – 4 Audio Compression: **07 Hours**

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT – 5 Conventional Encryption: **07 Hours**

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS:

1. Data compression- David Solomon Springer Verlag publication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmann publication.
4. The data compression book- Mark Nelson BPB publication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc., publications.

BTEXPE405C Computer Organization and Architecture **4 Credits**

Prerequisites: Digital Electronic Circuits.

Course Objectives:

1. To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
2. To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
3. Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
4. Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computer's working
3. analyze the performance of computers
4. know how computers are designed and built.

UNIT – 1 Overview of computer organization: 07 Hours

Overview of computer organization – components and system buses; Concepts of assembly and machine language programs. Machine language program execution – instruction cycles, machine cycles and bus cycles. Overview of memory and I/O addressing; CPU organization – components and subsystems, register banks, internal bus structure, information flow;

UNIT – 2 Instruction set: 07 Hours

Instruction set – characteristics and functions, types of operation and operands. Addressing modes – various ways of addressing memory and input-output devices and their timing characteristics.

UNIT – 3 CISC and RISC architectures: 07 Hours

CISC and RISC architectures – examples; ALU – flags, logical operations, fixed point number representations and arithmetic, floating point number representations and arithmetic, exceptions. Control Unit – how it operates, hardwired control unit, concepts of microprograms and microprogrammed control unit;

UNIT – 4 Memory: 07 Hours

Memory hierarchy – main memory – types and interfacing; Cache memory – its organizations and operations, levels of caches; Memory management module – paging and segmentation, virtual memory; Disk memory, RAIDs. Back-up memory.

UNIT – 5 Interrupts and interrupt structures and DMA controller: 07 Hours

Interrupts and interrupt structures – interrupt cycles, handling multiple simultaneous interrupts, programmable interrupt controllers; I/O interfacing and modes of I/O data transfer. Direct memory access – DMA controller; Instruction level parallelism – instruction pipelining, pipeline hazards; Concepts of multiprocessor systems; Examples will be drawn from real life RISC and CISC processors.

TEXT/REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization,” McGraw Hill, 2011.
2. D A Patterson and J L Hennessy, “Computer Architecture – A Quantitative Approach,” Morgan Kaufmann, 2011.
3. W Stallings, “Computer Organization and Architecture – Designing for Performance,” Pearson, 2013.
4. J. P. Hayes, “Computer Architecture and Organization,” McGraw-Hill, 1998.
5. D A Patterson and J L Hennessy, “Computer Organization and Design – The Hardware/Software Interface,” ARM Edition, Morgan Kaufmann, 2012.
6. S. Tannenbaum, “Structured Computer Organization,” EEE Ed., Prentice Hall, 2013.
7. Mano, M.M., “Computer System Architecture” 3rd Ed., Prentice-Hall of 2004 India.

BTEXPE405D Introduction to MEMS 4 Credits

Course Objectives:

1. The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
2. This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
3. This will enable student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT – 1 Introduction to MEMS: 07 Hours

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT – 2 Control and Materials of MEMS: 07 Hours

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT – 3 Review of Basic MEMS fabrication modules: 07 Hours

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT – 4 Micromachining: **07 Hours**

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT – 5 Mechanics of solids in MEMS/NEMS: **07 Hours**

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods. Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TEXT/REFERENCE BOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Semester V

BTEXC501 Analog Circuits **4 Credits**

Course Objectives:

1. To understand characteristics of IC and Op-Amp and identify the internal structure.
2. To introduce various manufacturing techniques.
3. To study various op-amp parameters and their significance for Op-Amp.

4. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
5. To Analyze and identify linear and nonlinear applications of Op-Amp.

Course Outcomes:

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

1. Understand the characteristics of IC and Op-Amp and identify the internal structure.
2. Understand and identify various manufacturing techniques.
3. Derive and determine various performances-based parameters and their significance for Op-Amp.
4. Verify parameters after exciting IC by any stated method.
5. Analyze and identify the closed loop stability considerations and I/O limitations.
6. Analyze and identify linear and nonlinear applications of Op-Amp.
7. Understand and verify results (levels of V & I) with hardware implementation.
8. Implement hardwired circuit to test performance and application for what it is being designed.

UNIT – 1 Introduction to operational amplifiers: 07 Hours

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots.

Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.

UNIT – 2 Linear applications of operational amplifiers: 07 Hours

Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.

UNIT – 3 Non-linear applications of operational amplifiers: 07 Hours

Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.

UNIT – 4 Oscillators: **07 Hours**

Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square-triangle oscillators

UNIT – 5 Analog and Digital interface circuits: **07 Hours**

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

TEXT/REFERENCE BOOKS:

1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV.
5. Paul R. Gray & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rd Edition.
6. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
7. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India 2008.
8. George Clayton and Steve Winder, “Operational Amplifiers”, 5th Edition Newnes.
9. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGraw Hill.
10. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

BTEXC502 Digital Signal Processing 4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems.

2. To understand the digital signal processing, sampling and aliasing.
3. To use and understand implementation of digital filters.
4. To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real-world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT – 1 DSP Preliminaries: **07 Hours**

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: **07 Hours**

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: **07 Hours**

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, 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: **07 Hours**

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Lowpass filter)

UNIT – 5 FIR Filter Design and introduction to MDSP: 07 Hours

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form. Introduction to Multirate signal processing: Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter banks, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS:

1. S. K. Mitra, Digital Signal Processing: A computer-based approach, TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTEXC503 Microelectronics 4 Credits

Course Objectives: As part of this course, students:

- Will understand the physical, electrical, and optical properties of semiconductor materials and their use in microelectronic.

- Relate the atomic and physical properties of semiconductor materials to device and circuit performance issues.
- Develop an understanding of the connection between device-level and circuit-level performance of microelectronic systems.

Course Outcomes: After successfully completing the course students will be able to upon successful completion of this course, students should be able to:

1. Compute carrier concentrations for semiconductor materials under a variety of doping conditions.
2. Compute conductivity and resistivity of semiconductor materials under a variety of condition.
3. Silicon wafer processing and formation of P N junction using diffusion and Ion Implantation technique
4. Wet and Dry oxidation process required for photolithography process.
5. Manufacturing process for P N junction, BJT, MOS, and IC fabrication.

UNIT – 1 MOSFETS: **07 Hours**

Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, Biasing in MOS amplifier Circuits, Small Signal Operation and Models, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation modes, single stage MOS amplifiers. MOSFET internal capacitances and high frequency modes, Frequency response of CS amplifiers, CMOS digital logic inverter, and detection type MOSFET.

UNIT – 2 Single Stage IC Amplifier: **07 Hours**

IC Design philosophy, Comparison of MOSFET and BJT, Current sources, Current mirrors and Current steering circuits, high frequency response.

UNIT – 3 Single Stage IC amplifiers: **07 Hours**

CS and CF amplifiers with loads, high frequency response of CS and CF amplifiers, CG and CB amplifiers with active loads, high frequency response of CG and CB amplifiers, Cascade amplifiers. CS and CE amplifiers with source (emitter) degeneration source and emitter followers, some useful transfer parings, current mirrors with improved performance. SPICE examples.

UNIT – 4 Differences and Multistage Amplifiers: 07 Hours

The MOS differential pair, small signal operation of MOS differential pair, the BJT differences pair, other non-ideal characteristics and differential pair, Differential amplifier with active loads, frequency response and differential amplifiers. Multistage amplifier. SPICE examples.

UNIT – 5 Feedback: 07 Hours

General Feedback structure, Properties of negative feedback. Four basic feedback topologies. Series-Shunt feedback. Determining the loop gain. Stability problem. Effect of feedback on amplifier poles. Stability study using Bode plots. Frequency compensation. SPICE examples.

TEXT/REFERENCE BOOKS:

1. "Microelectronic Circuits", Adel Sedra and K.C. Smith, 5th Edition, Oxford University Press, International Version, 2009.
2. "Fundamentals of Microelectronics", Behzad Razavi, John Wiley India Pvt. Ltd, 2008.
3. "Microelectronics – Analysis and Design", Sundaram Natarajan, Tata McGraw-Hill, 2007.

BTEXPE504A Electromagnetic Field Theory 4 Credits

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
3. To understand the boundary conditions for different materials /surfaces.
4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
5. To get the basics of microwave, transmission lines and antenna parameters.
6. Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

UNIT – 1 Mathematical Fundamentals and Static Electric Fields: 07 Hours

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density, Poisson's and Laplace's Equations, Uniqueness Theorem, Method of Images, Electrostatic boundary value problem.

UNIT – 2 Steady Electric Currents and Static Magnetic Fields: 07 Hours

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, Continuity Equation and Kirchhoff's Current Law, Power Dissipation and Joule's Law, Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

UNIT – 3 Time Varying Field & Maxwell's Equations: 07 Hours

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

UNIT – 4 Transmission Lines: 07 Hours

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT – 5 Electromagnetic Waves: **07 Hours**

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

TEXT/REFERENCE BOOKS:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, “Electromagnetics”, Prentice Hall.
5. Sadiku, "Elements of Electromagnetics", Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi, 1999.
8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", Wiley Eastern.

BTEXPE504B VLSI Design & Technology 4 Credits

Course Objectives:

1. To study HDL based design approach.
2. To learn digital CMOS logic design.
3. To nurture students with CMOS analog circuit designs.
4. To realize importance of testability in logic circuit design.
5. To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications

UNIT – 1 VHDL Modeling: **07 Hours**

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

UNIT – 2 PLD Architectures: **07 Hours**

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

UNIT – 3 SoC & Interconnect: **07 Hours**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

UNIT – 4 Digital CMOS Circuits: **07 Hours**

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

UNIT – 5 Analog CMOS Design and Testability: **07 Hours**

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier, Operational amplifier.

Testability: Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS:

1. Charles H. Roth, "Digital systems design using VHDL", PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.
3. Allen Holberg, "Analog CMOS Design", Oxford University Press.
4. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication.

BTEXPE504C Electronics in Smart City 4 Credits

Course Objectives:

1) To understand necessity of smart city
2) To explore applications of IOT in smart city.

Course Outcome: At the end of this course student will able to-

1) Understand the need of smart city.
2) Find various applications of IOT in smart city.
3) Apply various wireless communication protocols for smart city framework.

UNIT – 1 Necessity of SMART CITY: 07 Hours

The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework in GCC.

UNIT – 2 SMART CITY and IOT: 07 Hours

Introduction to Internet of Things, applications in smart city & their distinctive advantages - smart environment, smart street light and smart water & waste management. What is an IOT? Role and scope of IOT in present and future marketplace.

UNIT –3 SMART Objects 07 Hours

Smart objects, Wired – Cables, hubs, etc., Wireless – RFID, WiFi, Bluetooth, etc. Different functional building blocks of IOT architecture.

UNIT –4 Smart Cities: Distributed Intelligence and Central Planning 07 Hours

On the Interplay between Humans and Smart Devices, Theoretical Tools, Intelligence-Artificial Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamics and Allometry in Smart Cities.

UNIT –5 Wireless Protocols for Smart Cities **07 Hours**

IPv6 over Low-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking Basics, Wireless Networking Assumptions, Bluetooth Low Energy, Constrained Application Protocol, Message Queue Telemetry Protocol.

BTEXPE504D Electronics Measurements and Instruments 4 Credits

Course Objectives:

1. To Study various analog measuring Instruments.
2. .To Study various digital measuring Instruments.
3. To introduce with Signal generator and Signal Analyzers.
4. To study the working of CRO, its type with applications.
5. To introduce with sensors and types of Data acquisition system.

Course Outcome: After successful completion of this course the student will be able to:

1. Explain the principle and operation for analog instruments, like LCR Q` meter, Vector voltmeter, impedance meter.
2. Understand the principle and operation of Digital Instruments and its working.
3. Demonstrate operation and application of Signal generator & Signal Analyzers.
4. Demonstrate the detail study of voltage indicating device CRO and its applications.
5. Understand the working of different types of data acquisition system.

UNIT 1 **07 Hours**

Analog Instruments: Definition of different terms: Accuracy, precision, sensitivity, resolution, Errors: gross error, systematic error, random error, limiting errors. Q meter :- Basic Q meter circuit, Measurement methods, Direct Connection, series connection and parallel connection with circuit diagram (Derivation not Required)Sources of errors with its derivation.(Numerical on sources of errors), True RMS responding voltmeter, Vector voltmeter: - Block diagram and its explanation. Vector impedance meter: - Block diagram and its explanation. Field strength meter: - Block diagram and its explanation. Automatic bridges: - Circuit diagram and its explanation.

UNIT 2 **07 Hours**

Digital Instruments: Digital Frequency Meter: - Basic circuit of a Digital frequency meter, basic circuit for frequency measurement, High frequency measurement. Digital measurement of time: - Time base selector, measurement of time (period measurement), Ratio and multiple ratio measurement. Universal Counter, Electronic Counter:-Totalizing, Frequency mode, ratio mode, Period mode, Time interval mode. Digital tachometer, Digital Ph meter, Phase meter, Capacitance meter. Microprocessor based instruments.

UNIT 3 **07 Hours**

Signal Generators and Analyzers Sine wave Generator Frequency synthesized signal generator. Random noise generator Function Generator, Optical Time Domain Reflectometer (OTDR). Frequency selective wave analyzer, heterodyne wave Analyzer. Harmonic distortion analyzers – Harmonic Distortion, Tuned circuit Harmonic analyzer, Heterodyne Harmonic Analyzer, Fundamental suppression Harmonic distortion analyzer. Spectrum analyzer- Basic spectrum analyzer using Swept receiver design. Applications of spectrum analyzer.

UNIT 4 **07 Hours**

Oscilloscope : Block diagram of CRO - vertical amplifiers, horizontal deflecting systems, triggered sweep CRO, trigger pulse Circuit. Delay line – lumped parameter delay line, distributed parameter delay line. Dual beam CRO, Dual trace CRO .Sampling (VHF) oscilloscope, storage oscilloscope (for VLF signal) and digital read out oscilloscope. Probes

for CRO- direct probe, passive voltage probe and active probe using FET. Digital storage oscilloscope.

UNIT 5 **07 Hours**

Transducers and Data Acquisition system : Classification of Electric transducer, Selection criteria of transducer. Temperature Transducer - Thermometer and Thermocouple. Generalized Data Acquisition System, Objectives of DAS, Single channel and multichannel DAS:- (Analog multiplexed, multiplexing outputs of ample/hold, multiplexing after ADC and multiplexing low level data)Computer based testing of an Audio amplifier and a radio Receiver.

TEXT/REFERENCE BOOKS:

1.H. S. Kalsi, "Electronic Instrumentation", TMH, 2nd Edition, 2007.

2. D. Helfric and W. D. Cooper, "Modern Electronic Instrumentation and Measurement Technique", Pearson LPE, 3rd Edition, 2005.

3. K. Lal Kishore, "Electronic Measurement and Instrumentation", Pearson 4th, Edition, 2012

BTEXPE504E Mixed Signal Design 4 Credits

Course Objectives:

1. To introduce how to handle the practical situations where mixed signal analysis is required.
2. To analyze and handle the inter-conversions between signals.
3. To introduce the students how to design systems involving mixed signals.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the practical situations where mixed signal analysis is required.
2. Analyze and handle the inter-conversions between signals.
3. Design systems involving mixed signals.

UNIT – 1 Analog and discrete-time signal processing: **07 Hours**

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters. Basics of analog discrete-time filters and Z-transform.

UNIT – 2 Switched-capacitor filters: **07 Hours**

Switched-capacitor filters- Non idealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

UNIT – 3 Basics of data converters: **07 Hours**

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT – 4 Mixed-signal data transmission: **07 Hours**

Mixed-signal layout, Interconnects and data transmission, Voltage-mode signaling and data transmission, Current-mode signaling and data transmission.

UNIT – 5 PLLs: **07 Hours**

Introduction to frequency synthesizers and synchronization, Basics of PLL, Analog PLLs, Digital PLLs, DLLs.

TEXT/REFERENCE BOOKS:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, and 2008.
4. Rudy V. de Plassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition, 2008.

BTEXPE504F Automotive Electronics **4 Credits**

Course Objectives:

1. To understand the concepts of Automotive Electronics and it's evolution and trends Automotive systems & subsystems overview.
2. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
3. To understand, design and model various automotive control systems using Model based development technique.
4. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
5. To describe various communication systems, wired and wireless protocols used in vehicle
6. To understand Safety standards, advances in towards autonomous vehicles.
7. To understand vehicle on board and off board diagnostics.

Course Outcomes:

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

1. Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.
2. Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.
3. Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
4. Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

UNIT – 1 Automotive Fundamentals Overview: **07 Hours**

Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse

generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System , Starter Battery –Operating principle

UNIT – 2 The Basics of Electronic Engine Control: 07 Hours

Motivation for Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

UNIT – 3 Automotive Sensors and Actuators: 07 Hours

Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor, Solenoid, Fuel Injector, EGR Actuator, Ignition System

UNIT – 4 Digital Engine Control Systems: 07 Hours

Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics

UNIT – 5 Vehicle Motion Control: 07 Hours

Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)

TEXT/REFERENCE BOOKS:

1. William B. Ribbens, ―Understanding Automotive Electronics‖, 6th Edition, Elsevier Publishing.

2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc., 2007.

BTEXOE505A Digital System Design 4 Credits

Course Objectives:

1. The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
2. The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
3. This course will explore the basic concepts of digital electronics.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

UNIT – 1 Introduction to VHDL: 07 Hours

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, and VHDL data types, concurrent and sequential statements.

UNIT – 2 Subprograms: 07 Hours

Subprograms – Functions, Procedures, attributes, generio, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration.

UNIT – 3 Combinational logic circuit design and VHDL implementation: 07 Hours

Combinational logic circuit design and VHDL implementation of following circuits – first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, multiplier, divider.

UNIT – 4 Synchronous sequential circuits design: **07 Hours**

Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT – 5 Asynchronous sequential circuit designs: **07 Hours**

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like metastability, synchronizers, clock skew and timing considerations, Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD (Xilinx / Altera)

TEXT/REFERENCE BOOKS:

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition, 2006.
4. D.V. Hall, “ Digital Circuits and Systems” , Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

Bhasker J, “VHDL Primer” Prentice-Hall of India Pvt. Ltd 3rd Edition.

BTEXOE505B Artificial Intelligence and Machine learning 4 Credits

Course Objectives:

1. Apply AI techniques to solve the given problems.
2. Implement trivial AI techniques on relatively large system
3. Explain uncertainty and Problem-solving techniques.
4. Compare various learning techniques.

Course Outcomes:

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 Behaviour: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

UNIT – 2 Search Techniques: **07 Hours**

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyon Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT – 3 Game Playing: **07 Hours**

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT – 4 Logic and inference: **07 Hours**

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, **Backtracking** Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents

Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, Planning Graphs.

UNIT – 5 Learning: **07 Hours**

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation-Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

TEXT/REFERENCE BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. III Edition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford UniversityPress-2015.

BTEXOE505C Optimization Techniques 4 Credits

Course Objectives:

1. Introduction to optimization techniques using both linear and non-linear programming
2. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization.

Course Outcomes:

After completion of this course students will be able to

1. Cast engineering minima/maxima problems into optimization framework.
2. Learn efficient computational procedures to solve optimization problems.

UNIT – 1 Introduction and Basic Concepts: **07 Hours**

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques.

UNIT – 2 Optimization using Calculus: **07 Hours**

Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples.

UNIT – 3 Linear Programming: **07 Hours**

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar's projective scaling method.

UNIT – 4 Dynamic Programming: **07 Hours**

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

UNIT – 5 Integer Programming and Advanced Topics in Optimization: 07 Hours

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples.

Advanced Topics in Optimization: Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search.

TEXT/REFERENCE BOOKS:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International, New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

BTEXOE505D Project Management and Operation Research 4 Credits

Course Objectives:

1. To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
2. To introduce students to framework that are useful for diagnosing problems involving human behavior.
3. To enable the students, apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
4. To teach students about networking, inventory, queuing, decision and replacement models.
5. To introduce students to research methods and current trends in Operations Research.

Course Outcomes:

Student will be able to

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
2. Solve transportation problems using various OR methods.
3. Illustrate the use of OR tools in a wide range of applications in industries.
4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.
5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT – 1 **07 Hours**

Definition, need and importance of organizational behaviour, nature and scope, frame work, organizational behaviour models.

UNIT – 2 **07 Hours**

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 **07 Hours**

Evolution of Management thoughts, Contribution of Selected Management Thinkers, Various approaches to management, contemporary management practice, Managing in global environment, Managerial functions.

UNIT – 4 **07 Hours**

Importance of planning, Types of planning, decision making process, Approaches to decision making, Decision models, Pay off Matrices, Decision trees, Break Even Analysis. Departmentation, Span of Control, Delegation, Centralisation and Decentralisation, Committees, Line and Staff relationships, Recent trends in organization structures.

UNIT – 5 **07 Hours**

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.

BTEXOE505E Augmented, Virtual and Mixed Reality — 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. To develop 3D virtual environments.
2. To develop 3D interaction techniques and immersive virtual reality applications.

UNIT – 1 Introduction & Geometry of Virtual Worlds: 07 Hours

Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view

Geometric modeling, transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, Viewport transform

UNIT – 2 Light and Optics: 07 Hours

Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

UNIT – 3 Visual Physiology & Visual Perception: 07 Hours

Photoreceptors, Sufficient resolution for VR, light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision, Depth perception, Depth perception, Motion perception, Frame rates and displays, Frame rates and displays

UNIT – 4 Tracking Systems & Visual Rendering: 07 Hours

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering image warp

UNIT – 5 Audio & Interfaces and Augmented Reality: 07 Hours

Physics and physiology, auditory perception, Auditory localization, Rendering, Spatialization and display, combining other senses, Interfaces, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

Augmented Reality: System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

TEXT/REFERENCE BOOKS:

1. http://msl.cs.uiuc.edu/vr/
2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.
3. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition, 2009.

Semester VI

BTEXC601 Power Electronics 4 Credits

Course Objectives:

1. To introduce students to different power devices to study their construction, characteristics and turning on circuits.
2. To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
3. To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design-controlled rectifier, DC to DC converters, DC to AC inverters.
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT – 1 Characteristics of Semiconductor Power Devices: 07 Hours

Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

UNIT – 2 Controlled Rectifiers: 07 Hours

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT – 3 Choppers: **07 Hours**

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

UNIT – 4 Single-phase inverters: **07 Hours**

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

UNIT – 5 Switching Power Supplies and Applications: **07 Hours**

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive. P M Stepper Motor Drive.

TEXT/REFERENCE BOOKS:

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V. R. Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

BTEXC602 Microprocessors and Microcontrollers **4 Credits**

Course Objectives:

1. Objective of this course is to introduce to the students the fundamentals of microprocessor and Microcontrollers.
2. After learning Microprocessors and Microcontrollers course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
3. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
4. The students will get acquainted with recent trends in microprocessor like pipelining, cache memory etc.
5. To understand the applications of Microprocessors and Microcontrollers.
6. To learn interfacing of real-world input and output devices.
7. The learner can microcontroller design-based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.

Course Outcomes:

1. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
2. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
3. Students can identify and formulate control and monitoring systems using microprocessors.
4. Learn use of hardware and software tools.
5. Develop interfacing to real world devices.
6. Graduates will be able to design real time controllers using microcontroller-based system.
7. Learn importance of microcontroller in designing embedded application.

UNIT – 1 **07 Hours**

CISC and RISC Processor Architectures. Harvard and Von Neumann memory architectures. Introduction to 8085 Microprocessor based System: Architecture, Pin Description. Addressing modes. Instruction set and assembler directives. Timing Diagram.

UNIT – 2 **07 Hours**

Introduction to 8085 Assembly language programming. Programming examples using Data Transfer, Arithmetic, Logical, Branching and control instructions. Stacks and subroutine related programs. Serial data transfer. Interrupts.

UNIT – 3 **07 Hours**

Introduction to 8051 Microcontroller based System: Architecture, Pin Description, Internal Memory Organisation. Addressing modes. Instruction set and assembler directives. Assembly Language Programing examples. I/O port structure and programming. Embedded C Programming with I/O port programming examples.

UNIT – 4 **07 Hours**

Introduction to 8051 Timers. Timer programming in assembly and C. Introduction to 8051 serial communication. Serial Programming in assembly and C. Introduction to 8051 interrupts. Interrupt Programming in assembly and C.

UNIT – 5 **07 Hours**

Interfacing of 8255, 8254, 8259 with 8085 microprocessor. External memory interfacing with 8085 microprocessor and 8051 microcontroller. Interfacing of LED, 7 Segment display, LCD, Keypad, ADC, DAC, DC Motor, Stepper Motor, Temperature sensors, Motion detectors, Relay, Buzzer, Opto-isolators with 8051 microcontroller.

TEXT/REFERENCE BOOKS:

1. Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.
2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
3. M. A. Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearson edu.
4. Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing, Cengage Learning, Jan2011.
5. David Calcutt, 8051 microcontrollers: Applications based introduction, Elsevier.
6. Udayashankara V., Mallikarjuna Swamy, 8051 microcontroller, TMH.
7. K. J. Ayala, 8051 microcontroller, Cenage (Thomson).

BTEXPE603A Information Theory and Coding 4 Credits

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.
2. To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
3. To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy.
2. Understand Shannon's theorem for coding.
3. Calculation of channel capacity.
4. Apply coding techniques.

UNIT – 1 Theory of Probability and Random Processes: 07 Hours

Concept of probability, random variables, random process, power spectral density of a random process, probability models, statistical averages, central limit theorem, correlation, linear mean square estimation.

UNIT – 2 Noise in Communication Systems: 07 Hours

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT – 3 Information Theory: 07 Hours

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT – 4 Error Correcting Codes and Markov sources: 07 Hours

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ

Markov sources: Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

UNIT – 5 Speech Coding: 07 Hours

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

TEXT/REFERENCE BOOKS:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering (2nd Edition), TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Inter science.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2nd Edition), Pearson India.
7. N. Abramson, Information and Coding, McGraw Hill, 1963.
8. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

BTEXPE603B Control System Engineering 4 Credits

Course Objectives:

1. To introduce the elements of control system and their modeling using various Techniques.
2. To introduce methods for analyzing the time response, the frequency response and 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 Introduction to control problem: 07 Hours

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.

UNIT – 2 Time Response Analysis and Stability Analysis: 07 Hours

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response.

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram.

UNIT – 3 Frequency-response analysis: 07 Hours

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT – 4 Introduction to Controller Design: 07 Hours

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and Bode Plot.

UNIT – 5 State variable Analysis: 07 Hours

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigenvalues and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT/REFERENCE BOOKS:

1. N. J. Nagrath and M. Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2009.
2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall of India, 7th Edition,1995.
3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
4. Schaum’s Outline Series, “Feedback and Control Systems” Tata McGraw-Hill, 2007.
5. John J. D’Azzo& Constantine H. Houpis, “Linear Control System Analysis and Design”, Tata McGraw-Hill, Inc., 1995.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

BTEXPE603C Electronics Circuit Design 4 Credits

Course objectives:

1. This course will provide students a good understanding of the design and implementation of analog circuits for various applications such as amplification, filtering, frequency generation.

2. Students will able to apply concepts for design of regulators and amplifiers & verify through laboratory experiments.

3. Students will learn the analysis and design of multistage and feedback amplifiers for given specifications.

4. To prepare the students for analog integrated circuit design using operational amplifier, timer. 5. To Provide students with sufficient fundamental of therotical and practical knowledge to pursue advanced topics in analog integrated circuits.

Course outcomes: After successful completion of this course:

1. Students will demonstrate the knowledge and skill to design, build and troubleshoot analog circuits.

2. Students will able to implement and test complex electronic circuits in the laboratory.

3. Students will learn the analysis and design analog circuits for various applications using analog components.

4. Analysis and design of power supply and amplifiers for various practical applications.

5. Students will be able to design and implement analog circuits using op amp and other analog ICs.

UNIT 1 **07 Hours**

Design of Power Supplies Design of unregulated power supply (full wave rectifier with capacitor and inductor filters), Design of Series Voltage Regulator (with error amplifier), fold back protection circuit, Improvement of Stabilization factor by using Darlington pair for regulator, Design of three terminal IC based voltage regulator circuits, design of dual tracking power supply using with unregulated power supply, Design of SMPS and switching regulators using IC LM 2575 / 2577 (buck and boost regulators – fixed and adjustable output voltage)

UNIT 2 **07 Hours**

Design of Small Signal Amplifiers using BJT / FET Design of single stage CE / CS amplifier with biasing circuit, Design of single stage CB / CG amplifier with biasing circuit, Design of Single stage CC/ CD amplifier with biasing circuit, Design of feedback amplifiers using BJT / JFET(Current series and Voltage shunt)

UNIT 3 **07 Hours**

Power and Tuned Amplifiers Design of Class A Amplifier (resistive load and transformer coupled load), Design of Class B amplifier, Design of Class AB amplifier, Design of power amplifier using IC LM380, Design of single tuned amplifiers BJT / FET

UNIT 4 **07 Hours**

Design of Oscillators and wave shaping circuits Design RC and LC Oscillators – RC Phase shift oscillator, Hartley, Colpitts and Clapp oscillator using BJT/FET, Design of collector coupled Astable multivibrator and collector coupled Monostable multivibrator using BJT/FET, Design of UJT relaxation Oscillator, Design of Schmitt trigger using BJT.

UNIT 5 **07 Hours**

Design using Analog Integrated Circuits Design of single supply ac inverting and non-inverting amplifier using IC324, Design of ASK/FSK modulator using IC555, Design of ramp generator using IC555, Design of V/F and F/V converters using TC9400, Design of VCO, IC 565 PLL & Applications, IC 8038 Waveform generator, Design of active Butterworth filters, Sallen Key filters using opamp 741.

TEXT/REFERENCE BOOKS:

1. M.M. Shah - Design of Electronics Circuits and Computer Aided Design, New Age Int.

2. Michael Jacob - Application and Design with Analog Integrated Circuits, PHI 2

3 .Bell - Electronics Devices and Circuits, PHI or Pearson 4/e

4. Goyal, Khetan - Monograph on Electronics Design Principles, Khanna Pub.

5. Rashid – Microelectronics Circuits Analysis and Design, Cenage Learning, 2/e.

6. Sergio Franco – Design with OP-AMP and Analog Integrated Circuits, TMH, 3/e

7. IC datasheets.

BTEXPE603D Nano Electronics 4 Credits

Course Objectives:

1. To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
2. Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.
3. This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
4. Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
5. The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT – 1 Overview Nano Technology and Basics of Quantum Mechanics: 07 Hours

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

Basics of Quantum Mechanics: Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones

UNIT – 2 MOS Scaling theory: **07 Hours**

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT – 3 Nano electronics Semiconductor devices: **07 Hours**

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

UNIT – 4 Properties of Nano devices: **07 Hours**

Vertical transistors, Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

UNIT – 5 Characterization techniques for Nano materials: **07 Hours**

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self-assembly.

TEXT/REFERENCE BOOKS:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

BTEXPE603E Advanced Digital Signal Processing 4 Credits

Course Objectives:

1. This Multirate Signal Processing course covers advanced techniques for the design of digital filters, which are essential components in almost every digital signal processing system, as well as cyclostationary signals, so important to the understanding of modulation systems.
2. The course then moves on to treat multi-rate systems and presents multi-rate processing of both deterministic and random signals, culminating in a full case study exercise.
3. To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
4. To analyze the effects of interpolation and decimation on random signals.
5. To design interpolation and decimation filters to a given specification.

Course Outcomes:

After successfully completing the course students will have:

1. Ability to understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.
2. Able to explain how the multirate implementation of ADC and DAC converters works.
3. Able to describe basic sampling rate conversion algorithms.
4. Able to draw and describe different kinds of interpolator and decimator.
5. Able to analyze how the interpolated FIR filter works.
6. Able to do sampling rate conversion.

UNIT – 1 Fundamentals of Multirate Systems: 07 Hours

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems, Special filter and filter banks.

UNIT – 2 Maximally Decimaled Filter Banks: 07 Hours

Introduction, Errors created in the QMF bank, A simple alias free QMFsystem, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Treestructured filter banks, Transmultiplexer.

UNIT – 3 Paranitary Perfect Reconstruction Filter Banks: 07 Hours

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Tranformcoding and LOT.

UNIT – 4 Linear Phase and Cosine Modulated Filter Banks: 07 Hours

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT – 5 The Wavelet Transform and its Relation to Multirate Filter Banks: 07 Hours

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis.

Multidimensional, Multivariable and Lossless Systems: Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals.Review of discrete time multi-input multi-output LTI System, ParaUNITary and lossless system.

TEXT/REFERENCE BOOKS:

1. P. P. Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey,Multirate System and Filter Banks.
2. N. J. Fliege , John Wiley & Sons, Multirate Digital Signal Processing.
3. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia, Wavelet Transforms Introduction to Theory and Application.
4. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

BTEXOE604A IoT and Industry 4.0 4 Credits

Course Objectives:

1. Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS),

Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.

2. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Outcomes:

1. Understand the drivers and enablers of Industry 4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world
4. Appreciate the power of Cloud Computing in a networked economy.
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits

UNIT – 1 Introduction and Industry 4.0: 07 Hours

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Cybersecurity in Industry 4.0

UNIT – 2 Basics of Industrial IoT and Introduction: 07 Hours

Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

UNIT – 3 Industrial IoT- Layers: 07 Hours

Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III., Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

UNIT – 4 Industrial IoT: Big Data Analytics and Software Defined Networks: 07 Hours

Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT – 5 Industrial IoT- Application Domains: 07 Hours

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies:

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab

TEXT/REFERENCE BOOKS:

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress)
2. “Industrial Internet of Things: Cybermanufacturing Systems”by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)
3. Research papers.

BTEXOE604B Communication Engineering 4 Credits

Course Objectives:

1. To introduce the concepts of analog communication systems.
2. To equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
3. To understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase)

Course Outcomes:

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

1. Understand and identify the fundamental concepts and various components of analog communication systems.
2. Understand the concepts of modulation and demodulation techniques.
3. Design circuits to generate modulated and demodulated wave.
4. Equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
5. Understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase).
6. Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.
7. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

UNIT – 1 Introduction to Communication System 07 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 **07 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 **07 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 **07**

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 and noise **07**

Hours AM Detectors: Envelop detector and practical diode detector.

FM Detectors: Slope detector, phase discriminator and ratio detector.

Noise: Introduction, Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.

TEXT/REFERENCE BOOKS:

1. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4th Edition.
2. Anokh Singh, "Principles of communication engineering"S.Chand
3. Roddy&Coolen, "Electronic communication"PHI
4. Taub & Schilling "Principles of communication systems" Tata Mc GrawHill
5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.

6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.

BTEXOE604C Computer Network & Cloud Computing 4 Credits

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming
4. To provide a WLAN measurement idea.

Course Outcomes:

1. To master the terminology and concepts of the OSI reference model and the TCP- IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issue s in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.
5. To be familiar with network tools and network programming.
6. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
7. For a given problem related TCP/IP protocol developed the network programming.
8. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

UNIT – 1 Physical Layer: 07 Hours

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT – 2 Data Link Layer: 07 Hours

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT – 3 Wireless LANS & Virtual Circuit Networks and Network Layer: 07 Hours

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – 4 Transport Layer: 07 Hours

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT – 5 Application Layer: 07 Hours

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TEXT/REFERENCE BOOKS:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, Tata McGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

BTEXOE604D Industrial Drives and Control **4 Credits**

Course Objectives:

To expose the students to the Engineering fundamentals of various Drives and its control, Dynamic operation and their Applications.

Course Outcomes:

At the end of the course, students will demonstrate the ability to gain an ability to design and conduct performance experiments, as well as to identify, formulate and solve drives related problems.

UNIT – 1 Electrical Drives: **07 Hours**

Introduction &Dynamics Introduction, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives, Fundamental Torque equations, Speed Torque conventions and Multi-quadrant Operation, Equivalent values of Drive Parameter, Measurement of Moment of Inertia, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy-Loss in Transient Operations, Steady State Stability, Load Equalization.

UNIT – 2 Selection of Motor Power Rating and Control of Electrical Drives: **07 Hours**

Thermal Model of Motor for Heating and Cooling, Classes of Motor Rating, Determination of Motor Rating. Control of Electrical Drives: Modes of Operation, Speed Control, Drive Classification, and Closed loop Control of Drives

UNIT – 3 DC Drives: **07 Hours**

Review of Speed Torque relations for Shunt, Series and Separately excited Motors, Review of Starting, Braking (Regenerative, Dynamic, Plugging), Review of Speed control, Controlled rectifier fed DC drives (separately excited only): Single phase fully-controlled Rectifier, Single phase Half controlled Rectifier, Three phase fully-controlled Rectifier, Three phase Half-controlled Rectifier, Dual Converter Control, Chopper Control – Motoring and Braking of separately excited and Series Motor. (No numerical from this module).

UNIT – 4 AC Drives: **07 Hours**

Induction Motor drives, Review of Speed-Torque relations, Review of Starting methods, Braking (Regenerative, Plugging and AC dynamic braking), Transient Analysis, Speed Control: Stator voltage control, Variable frequency control from voltage source, Static Rotor

Resistance control, Slip Power Recovery - Static Scherbius Drive, Review of d-q model of Induction Motor, Principle of Vector Control, Block diagram of Direct Vector Control Scheme, Comparison of Scalar control and Vector control, Basic Principle of Direct Torque Control (block diagram) of induction motor. Introduction to Synchronous Motor Variable Speed drives.

UNIT – 5 Special Motor Drives: **07 Hours**

Stepper Motor drives- Types, Torque vs. Stepping rate characteristics, Drive circuits, Introduction to Switched reluctance motor drives and Brushless DC motor drives.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Electrical Drives by G. K. Dubey, Narosa Publication
2. A First Course on Electrical Drives by S. K. Pillai, New Age International.
3. Electrical Drives: Concepts and Applications by Vedam Subramanyam, T.M.H
4. Modern Power Electronics and AC Drives by B. K. Bose, Prentice Hall PTR
5. Special Electrical Machines by E.G. Janardanan, PHI
6. Electric Motor Drives: Modeling, Analysis and Control by Krishnan. R, PHI
7. Power Electronics by Joseph Vithayathil, Tata McGraw Hill
8. Power Semiconductor Controlled Drives by G. K. Dubey, Prentice Hall International.

BTEXOE604E Robotics Design — 4 Credits

Course Objectives:

1. To prepare students with basics of robotics
2. To familiarize students with kinematics & dynamics of robots
3. To familiarize students with path & Trajectory planning of robots
4. To familiarize students with robot vision

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Describe kinematics and dynamics of stationary and mobile robots
2. Describe trajectory planning for robots.

3. Implement trajectory generation and path planning various algorithms
4. Work in interdisciplinary projects.

UNIT – 1 Fundamentals of Robotics: 07 Hours

Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications.

UNIT – 2 Forward & Inverse Kinematics of Robots: 07 Hours

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation**,** Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies

UNIT – 3 Velocity Kinematics & Dynamics and Robot Motion Planning: 07 Hours

Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. Dynamic Analysis of Forces: Lagrangian mechanics, Newton Euler formulation, Dynamic equations of robots, Transformation of forces and moment between coordinate frames.

Robot Motion Planning: Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug

UNIT – 4 Potential Functions and Visibility Graphs: 07 Hours

Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods

UNIT – 5 Trajectory planning and Robot Vision: 07 Hours

Trajectory planning: Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories. Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.

TEXT/REFERENCE BOOKS:

1. Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of India
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, "Principles of Robot Motion – Theory, Algorithms and Implementations", Prentice-Hall of India, 2005.
4. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, "Robot Modeling & Control ", Wiley India Pvt. Ltd., 2006
5. John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India, 2009
6. Aaron Martinez & Enrique Fernandez, "Learning ROS for Robotics Programming", Shroff Publishers, First Edition, 2013.
7. Mikell P. Groover et.al," Industrial Robots-Technology, Programming & applications", McGraw Hill, New York, 2008

BTHM605 Employability & Skill Development 3 Credits

Course Objectives:

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successful in a profession.
4. To expose the students to leadership and team-building skills.

Course Outcomes:

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

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT – 1 Soft Skills & Communication basics: 07 Hours

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume,

Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT – 2 Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability: 07 Hours

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy)

UNIT – 3 Grammar and Comprehension: 07 Hours

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT – 4 Skills for interviews: 07 Hours

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT – 5 Problem Solving Techniques: 07 Hours

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chand publications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.

3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum's Outline of English Grammar", McGraw Hills.

David F. Beer, David A. Mc Murrey, "A Guide to Writing as an Engineer", ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

Semester VII

BTEXC701 Embedded System Design 4 Credits

Prerequisites: Good understanding of the concepts of basic electronics such as circuits, logic gates, Number systems, fundamentals of C programming

Course Objectives:

1. To understand Embedded Design Specification.
2. Understand the ARM Design Philosophy
3. Understand the ARM architecture and the pipeline structure
4. Understand the instruction sets of ARM Processor

Course Outcomes:

1. The student will study ARM Processor based Embedded System design
2. The student will be able to do programming in Embedded programming in C, C++
3. The student will understand Linux operating system and device driver
4. The student will demonstrate the knowledge of Real Time Operating System

UNIT – 1 INTRODUCTION TO EMBEDDED SYSTEMS 07 Hours

Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip.

Embedded system design and development: Embedded system design, Life-Cycle Models, Problem solving, The design process, Requirement identification, Formulation of requirements specification. Development tools.

System design specifications: System specifications versus system requirements, Partitioning and decomposing a system, Functional design, Architectural design, Functional model versus architectural model, Prototyping, Other considerations, Archiving the project

UNIT – 2 ARM PROCESSOR FUNDAMENTALS AND INSTRUCTION SET 07 Hours

Registers, Current Program Status Registers(CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM-Thumb Interworking, other branch instructions, Data Processing instructions, Stack instructions, Single -register load -store instruction, multiple -register load- store instruction, software interrupt instructions

UNIT – 3 EMBEDDED LINUX 07 Hours

Embedded Linux: System architecture, BIOS versus boot-loader, Booting the kernel, Kernel initialization, Space initialization, Boot loaders, Storage considerations

Linux kernel construction: Kernel build system, Obtaining a custom Linux kernel, File systems, Device drivers, Kernel configuration.

UNIT – 4 COMMUNICATION PROTOCOLS 07 Hours

Use of communication protocols in embedded systems, Serial communication basics, synchronous/asynchronous interfaces, UART Protocol, I2C protocol, SPI protocol, USB Protocol, SPI protocol, CAN Protocol, 1 Wire protocol

UNIT – 5 REAL TIME OPERATING SYSTEMS 07 Hours

RTOS fundamentals, Multitasking in small embedded systems, Memory management, Task management, Queue management, software timer management, interrupt management, resource management, event, Task notification

TEXT BOOKS:

1. Steve Furber, “ARM System-on-Chip Architecture”, Second Edition, Pearson Education Publication
2. James K. Peckol, “Embedded Systems: A Contemporary Design Tool”, WILEY Student Edition Publication
3. Andrew N. Sloss, “ARM system developer's guide”, Morgan Kaufmann elsevier.com

4. Tammy Noergaard, "Embedded Systems Architecture", Elsevier Publication
5. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Pearson Education Publication
6. "Real -Time System Design and analysis -Tools for the practioner " By Phillip A Laplante (Wiley Publication)

REFERENCE BOOKS:

1. Mastering the FreeRTOS Real time Kernel A hands on tutoral guide by Richard Barry
2. The FreeRTOS Reference manual API functions and configuration options

BTEXPE702A 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 cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull 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 BOOKS:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010
2. Microwave Devices and circuits- Liao / Pearson Education
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition, McGraw- Hill Education Pvt. Ltd., 2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn, 2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTEXPE702B Advanced Industrial Automation 4 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 Outcome: At the end of this course student will be able to

1) To identify suitable automation hardware for the given application.

2) To recommend appropriate modelling and simulation tool for the given manufacturing application.

Unit 1 **07 Hours**

Introduction:

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines).

Unit 2 **07 Hours**

Material handling and Identification Technologies:

Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods (SLE: Material Identification Methods).

Unit 3 **07 Hours**

Automated Manufacturing Systems:

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

Unit 4 **07 Hours**

Control Technologies in Automation:

Industrial Control Systems, Process Industries versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms, (SLE: Sensors, Actuators and other Control System Components).

Unit 5 **07 Hours**

Computer Based Industrial Control:

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems (SLE: Display Systems in Process Control Environment).

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.

BTEXPE702C Satellite Communication 4 Credits

Course Objectives:

1. To provide students with good depth of knowledge in radar and Satellite communication.
2. Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
3. This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT – 1 Basic Principles and Earth Station: **07 Hours**

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems.

Earth Station: Introduction, earth station subsystem, different types of earth stations.

UNIT – 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.

BTEXPE702D Fiber Optic Communication — 4 Credits

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
5. Understand the properties of optical fiber that affect the performance of a communication link.
6. Understand basic optical amplifier operation and its effect on signal power and noise in the system.
7. Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

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 a cylindrical dielectric rod, Ray model, wave model.

UNIT – 2 Types of optical fibers: **07 Hours**

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT – 3 Optical sources: **07 Hours**

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, 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).

BTEXPE702E CMOS Design 4 Credits

Course Objectives:

1. Model the behaviour of a MOS Transistor
2. Design combinational and sequential circuits using CMOS gates.
3. Analyze SRAM cell and memory arrays.
4. To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
5. To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Identify the sources of power dissipation in a CMOScircuit.
3. Analyze SRAM cell and memory arrays
4. Use tools for VLSI IC design.

UNIT– 1 **07 Hours**

MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Fabrication, Packaging, and Testing, MOS transistor Theory, Long Channel I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics

UNIT– 2 **07 Hours**

CMOS Processing Technology, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Technology-Related CAD Issues, Manufacturing Issues, Circuit Simulation, A SPICE Tutorial, Device Models, Device Characterization, Circuit Characterization, Interconnect Simulation. Combinational Circuit Design, Circuit Families, Silicon-On- Insulator Circuit Design, Sub Threshold Circuit Design. Sequential Circuit Design, Circuit Design of Latches and Flip-Flops, Static Sequencing Element Methodology, Sequencing Dynamic Circuits, Synchronizers, Wave Pipelining

UNIT– 3 **07 Hours**

Power, Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures, Robustness, Variability, Reliability, Scaling, Statistical Analysis of Variability, Variation-Tolerant Design. Delay, Transient Response, RC Delay Model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding, Shifters, Multiplication

UNIT– 4 **07 Hours**

Array Subsystems, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays, Robust Memory Design, Special- Purpose Subsystems.

UNIT– 5 **07 Hours**

Packaging and Cooling, Power Distribution, Clocks, PLLs and DLLs, I/O, High-Speed Links, Random Circuits, Design Methodology and Tools, Testing, Debugging, and Verification.

TEXT/REFERENCE BOOKS:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

BTEXOE703A Wireless Sensor Networks 4 Credits

Course Objectives:

1. To introduce the emerging research areas in the field of wireless sensor networks
2. To understand different protocols and there uses in WSN.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

UNIT – 1 Introduction: **07 Hours**

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT – 2 Networks: **07 Hours**

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT – 3 Protocols: **07 Hours**

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT – 4 Dissemination protocol: **07 Hours**

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT – 5 Design Principles for WSNs: **07 Hours**

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS:

1. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, By John Wiley & Sons Publications, 2011.
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science

5. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009.

BTEXOE703B Block Chain Technology 4 Credits

Course Objectives:

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

UNIT – 1 Introduction to Block chain: 07 Hours

History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, and Privacy.

UNIT – 2 Block chain Architecture and Design and Consensus: 07 Hours

Basic crypto primitives: Hash, Signature, Hash chain to Block chain, Basic consensus mechanisms. Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols, Permissioned Block chains: Design goals, Consensus protocols for Permissioned Block chains

UNIT – 3 Hyperledger Fabric: 07 Hours

Hyperledger Fabric I: Decomposing the consensus process, Hyperledger fabric components, Chain code Design and Implementation

Hyperledger Fabric II: Beyond Chain code: fabric SDK and Front End, Hyperledger composer tool.

UNIT – 4 Use Cases: 07 Hours

Use case I: Block chain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance.

Use case II: Block chain in tradesupply chain: Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc

Use case III: Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system social welfare systems.

UNIT – 5 Blockchain Cryptography Privacy and Security on Blockchain: 07 Hours

Research aspects I: Scalability of Block chain consensus protocols, Case Study "Various recent works on scalability,

Research aspects II: Secure cryptographic protocols on Block chain, Case Study "Secured Multi-party Computation, Block chain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more.

TEXT/REFERENCE BOOKS:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

BTEXOE703C Cyber Security 4 Credits

Course Objectives:

1. For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
2. The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still more complicated
3. To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

Course Outcomes:

Students should be able to understand:

1. The difference between threat, risk, attack and vulnerability.
2. How threats materialize into attacks.
3. Where to find information about threats, vulnerabilities and attacks.
4. Typical threats, attacks and exploits and the motivations behind them.

UNIT – 1 Introduction to Cyber Security: 07 Hours

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT – 2 Cyber Security Vulnerabilities and Cyber Security Safeguards: 07 Hours

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT – 3 Securing Web Application, Services and Servers: 07 Hours

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT – 4 Cryptography and Network Security: 07 Hours

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT – 5 Cyberspace and the Law, Cyber Forensics: 07 Hours

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

TEXT/REFERENCE BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education, 2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015.
1. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.

BTEXOE703D Bio-medical Signal Processing 4 Credits

Course Objectives:

1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in bio signals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signal problems.

Course Outcomes:

After successfully completing the course students will be able to:

1. The student will be able to model a biomedical system
2. The student will be able to understand various methods of acquiring bio signals.
3. The student will be able to understand various sources of bio signal distortions and its Remedial techniques
4. The students will be able to analyze ECG and EEG signal with characteristic feature points.
5. The student will have a basic understanding of diagnosing bio-signals and classifying them.

UNIT – 1 Introduction to Biomedical Signals: 07 Hours

ECG, EEG, EMG, ENG etc. Event related potentials Biomedical Signal Analysis- Computer Aided Diagnosis. Concurrent, coupled and correlated processes - illustration with case studies. Noise Filtering: Random noise structured noise and physiological interference- noise and artifacts in ECG.

UNIT – 2 Time domain filters and Frequency domain Filters: 07 Hours

Principles of adaptive filters- Winer Filtering- Steepest Descent algorithms- Widrow Hopf Least mean square adaptive algorithms- Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electro surgery.

UNIT – 3 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 Filter.

UNIT – 5 Pattern classification and diagnostic decision: 07 Hours

Supervised and unsupervised pattern classification Probabilistic models and statistical decisions- Logistic regression analysis- training and test steps neural networks- Measures of diagnostic accuracy and cost- Reliability of classifiers and decisions. Application: Normal versus Ectopic ECG beats- Detection of Knee Joint cartilage pathology.

TEXT/REFERENCE BOOKS:

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis: A case study Approach", Wiley Interscience2002.24.
2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGrawHill, NewDelhi, 2005.
3. 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.

BTEXOE703E Mobile Communication and Networks 4 Credits

Course Objectives:

1. To provide an overview of Mobile Communication Networks area and its applications in communication engineering.
2. To appreciate the contribution of mobile communication networks to overall technological growth.
3. To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Mobile Communication Networks.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.

3. Analyze mobile communication systems for improved performance.

UNIT – 1 Cellular concept: **07 Hours**

Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

UNIT – 2 Signal propagation: **07 Hours**

Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate, Capacity of flat and frequency selective channels.

UNIT – 3 Antennas and Multiple access schemes: **07 Hours**

Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays. FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM

UNIT – 4 Receiver structure: **07 Hours**

Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff

UNIT – 5 Performance measures: **07 Hours**

Outage, average SNR, average symbol/bit error rate, System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

TEXT/REFERENCE BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

BTEXOE704A Soft Computing 4 Credits

Course Objectives:

1. Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real-world problems.
2. Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
3. To create awareness of the application areas of soft computing technique.
4. Provide alternative solutions to the conventional problem-solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real-world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT – 1 Artificial Neural Network –I: 07 Hours

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch- Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron

for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule of Perceptron and its limitations Draft.

UNIT – 2 Artificial Neural Network-II: **07 Hours**

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self- organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover's theorem, mapping functions (Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associative memories.

UNIT – 3 Fuzzy Logic –I: **07 Hours**

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T- conorm) o Fuzzy if- then rules.

UNIT – 4 Fuzzy Logic –II: **07 Hours**

Fuzzification, Membership Value Assignment techniques, De- fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes- Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems - Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two- input single output FIS employing Mamdani model Computing.

UNIT – 5 Fuzzy Control Systems and Adaptive Neuro-Fuzzy Inference Systems (ANFIS): **07 Hours**

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene Fausett, Pearson Education, Inc, 2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons, 2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall International Inc-1999.
7. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag, 2007.

BTEXOE704B Big Data Analytics — 4 Credits

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability

5. To introduce to the students several types of big data like social media, web graphs and data streams
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data.

UNIT – 1 Big Data Platforms: 07 Hours

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

UNIT – 2 YA TRAP: 07 Hours

YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

UNIT – 3 Fog Computing: 07 Hours

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

UNIT – 4 Web Enhanced Building and Technologies for Healthcare: 07 Hours

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements.

Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

UNIT – 5 Sustainability Data and Analytics: 07 Hours

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

TEXT/REFERENCE BOOKS:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and the Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015. 2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates, 2015.
2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates, 2015.

BTEXOE704C Data Structure & Algorithms Using Java Programming 4 Credits

Prerequisites: Basic knowledge of C language is required.

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. To choose the appropriate data structure and algorithm design method for a specified application.
3. To study the systematic way of solving problems, various methods of organizing large amounts of data.

4. To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
5. To employ the different data structures to find the solutions for specific problems

Course Outcomes:

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

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT – 1 Introduction: **07 Hours**

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT – 2 Stacks and Queues: **07 Hours**

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT – 3 Linked Lists: **07 Hours**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT – 4 Trees: **07 Hours**

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with

complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT – 5 Sorting and Hashing: **07 Hours**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT/REFERENCE BOOKS:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
3. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928.
4. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum's Outlines, Tata Mc Graw Hill. ISBN-10: 1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10: 8120311779.

BTEXOE704D Entrepreneurship Development **4 Credits**

Course Objectives:

1. To Develop and Strengthen Entrepreneurial Quality and Motivation in Students and To Impart Basic Entrepreneurial Skills and Understanding to Run a Business Efficiently and Effectively.
2. The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

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

1. Have the ability to discern distinct entrepreneurial traits.
2. Know the parameters to assess opportunities and constraints for new business ideas.
3. Understand the systematic process to select and screen a business idea.
4. Design strategies for successful implementation of ideas.
5. Write a business plan.

UNIT – 1 Entrepreneurship: **07 Hours**

Entrepreneur – Types of Entrepreneurs – Difference Between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT – 2 Motivation: **07 Hours**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT – 3 Business: **07 Hours**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps Involved in Setting Up A Business – Identifying, Selecting A Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT – 4 Financing and Accounting: **07 Hours**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT – 5 Support to Entrepreneurs: **07 Hours**

Sickness in Small Business – Concept, Magnitude, Causes and Consequences, Corrective

Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in Small Industry – Expansion, Diversification, Joint Venture, Merger And Sub Contracting.

TEXT/REFERENCE BOOKS:

1. Khanka. S.S., "Entrepreneurial Development" S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.
3. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
4. Mathew J Manimala, "Enterprenuership Theory At Cross Roads: Paradigms and Praxis" 2nd Edition Dream Tech, 2005.
5. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
6. EDII "Faulty and External Experts – A Hand Book For New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
8. , Design of analog filters by, Prentice-Hall 1990 (or newer additions).
9. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition, 2008.

BTEXOE704E Software Defined Radio — 4 Credits

Course Objectives:

1. The objective of this course is to provide knowledge of fundamental and state-of the art concepts in software defined radio.
2. To understand the various components of software-defined-radios with the understanding of their limitation and application of 'software-defined-solutions' to overcome such limitations.
3. To Understanding the interplay of analog and digital signal processing for power as well as spectrum efficient transmission and reception of signal leads to an optimized, yet, practical radio solution.

Course Outcomes:

1. The student will study Needs, Characteristics, Benefits and Design Principles of a Software Radio.
2. The student will be study design aspects of software radios.
3. The student will understand concept of Smart Antennas.
4. The student will study key hardware elements and related Trade-Offs.

UNIT – 1 Fundamentals of SDR: **07 Hours**

Software Radios, Needs, Characteristics, Benefits, Design Principles of a Software Radio, Radio frequency implementation issues, Principal Challenge of Receiver Design

UNIT – 2 RF and SDR: **07 Hours**

RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Transmitter Architectures and their issues, Noise and Distortion in the RF Chain, Timing Recovery in Digital Receivers Using Multirate Digital Filters

UNIT – 3 Signals in SDR: **07 Hours**

Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Band-pass Signal Generation, Hybrid DDS-PLL Systems, Generation of Random Sequences, Parameters of data converters

UNIT – 4 Smart Antennas: **07 Hours**

Concept of Smart Antennas, Structures for Beam-forming Systems, Smart Antenna Algorithms, Digital hardware choices, Key Hardware Elements, DSP Processors, Field Programmable Gate Arrays, Trade-Offs in Using DSPs, FPGAs and ASICs.

UNIT – 5 Case studies in Radio System: **07 Hours**

Power Management Issues, Object-oriented representation of radios and network resources, Mobile Application Environments, Joint Tactical Radio System, Case studies in software radio design.

TEXT/REFERENCE BOOKS:

1. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering", Prentice Hall PTR; May 2002 ISBN: 0130811580
2. Dillinger, Madani, Alonistioti (Eds.), "Software Defined Radio, Architectures, Systems and Functions", Wiley 2003
3. Bard, Kovarik, "Software Defined Radio, The Software Communications Architecture", Wiley 2007
4. Johnson, C.R. and W.A. Sethares, "Telecommunication Breakdown: Concepts of Communication Transmitted via Software-Defined Radio, Pearson Prentice Hall, 2004
5. Bard, John and Kovarik, Vincent, "Software Defined Radio: The Software Communications Architecture", Wiley Series in Software Radio, 2007.

BTHM705 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 – 5 Depreciation: **07 Hours**

Depreciation − Introduction, Straight line method of depreciation, − Declining balance method of depreciation − Sum of the years digits method of depreciation, − Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation − Evaluation of public alternatives − Introduction − Examples – Inflation adjusted decisions − Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TEXT BOOKS/REFERENCES:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, “ Managerial economics”, Oxford university 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.
10. Cost Accounting: by Jawahar Lal, McGraw Hill.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Semester	Course Code	Sr. No	Name of Subject as per Curriculum	Swayam / NPTEL Course	Name of University/Institute Offering Course	Relevance %	Duration of Course (In Weeks)
SEM-III	BTBS301	1	Engineering Mathematics – III	Differential Equations for Engineers	IIT Madras	80	12
	BTEXC302	2	Electronic Devices & Circuits	Fundamentals of Semiconductor Devices	IISc Bangalore	80	12
	BTEXC303	3	Digital Electronics	Digital Circuits	IIT Madras	60	14
	BTEX304	4	Network Theory	Network Analysis	IIT Kharagpur	80	12
SEM-IV	BTEXS401	5	Electrical Machines and Instruments	Electrical Machines - I	IIT Kharagpur	70	12
	BTETC402	6	Signals and Systems	Signals and Systems	IIT Bombay	90	11
	BTHM403	7	Basic Human Rights	Human Rights, International Law and International Humanitarian Law	O. P. Jindal Global University (Swayam)	80	8
	BTBS404	8	Probability Theory and Random Processes	Probability and Random Processes(Video)	IIT Kharagpur.	90	12

	BTEXPE405A	9	(A) Numerical Methods and Computer Programming	Numerical Methods for Engineers	IIT Madras	60	12
	BTEXPE405B		(B) Data Compression & Encryption	Multimedia Processing (Web)	IIT Kharagpur.	50	9
	BTEXPE405C		(C) Computer Organization and Architecture	Computer Arcitecture and Organization	IIT Kharagpur.	80	12
	BTEXPE405D		(D) Introduction to MEMS	MEMs and Microsystems	IIT Kharagpur.	90	9
SEM-V	BTEXC501	10	Analog Circuits	Analog Circuits	IIT Delhi	70	12
	BTEXC502	11	Digital Signal Processing	Digital Signal Processing	IIT Delhi	90	12
	BTEXPE504A	12	(A) Electromagnetic Field Theory	Electromagnetic Theory	IIT Kharagpur.	90	12
	BTEXPE504B		(B) VLSI Design & Technology	CMOS Digital VLSI Design	IIT Roorkee	20	8
	BTEXPE504E		(E) Mixed Signal Design	Mixed Signal Design	IITBombay	90	8
	BTEXOE505A	13	(A) Digital System Design	Digital System Design	IIT Kharagpur.	70	6
	BTEXOE505B		(B) Artificial Intelligence and Machine learning	Introduction to AI	IIT Delhi	90	12
	BTEXOE505D		(D) Project Management and Operation Research	Project Management for Managers	IIT Roorkee	90	12
	BTEXOE505E		(E) Augmented, Virtual and Mixed Reality	Virtual Reality	IIT Madras	90	12
SEM-VI	BTEXC601	14	Power Electronics	Power Electronics	IIT Delhi	55	12
	BTEXC602	15	Microprocessors and Microcontrollers	Microprocessors And Microcontrollers	IIT Kharagpur.	90	12
	BTEXPE603A		(A) Information Theory and Coding	Information Theory	IISc Bangalore	40	12
	BTEXPE603B		(B) Control System Engineering	Control Engineering	IIT Madras	90	12

	BTEXPE603F	16	(E)Advanced Digital Signal Processing	Multirate DSP	IIT Madras	25	12
	BTEXOE604A		(A) IoT and Industry 4.0	Introduction to Industry 4.0 and Industrial Internet of Things	IIT Kharagpur	100	12
	BTEXOE604B		(B) Communication Engineering	Principles of Digital Communication	IIT Delhi	50	12
	BTEXOE604C		(C) Computer Network & Cloud Computing	Computer Networks and Internet Protocol	IIT Kharagpur	70	12
SEM-VII	BTEXC701	17	Embedded System Design	Embedded System	IIT Kharagpur	70	6
	BTEXPE702A		(A) Microwave Engineering	Microwave Theory and Technique	IIT Bombay	60	12
	BTEXPE702D		(D) Fiber Optic Communication	Optical Engineering	IIT Madras	50	12
	BTEXOE703A	18	(A) Wireless Sensor Networks	Principles of modern CDMA/MIMO/OFDM, Wireless Communication, Introduction to Wireless and Cellular Communication	IIT Kharagpur	30	8
	BTEXOE703E		(E) Mobile Communication and Networks	Introduction to Wireless and Cellular Communication	IIT Madras	60	12
	BTEXOE704B	19	(B) Big Data Analytics	Data science and Engineering	IIT Madras	60	8
	BTEXOE704C		(C) Data Structure & Algorithms Using Java Programming	Data Structure & Algorithms Using Java	IIT Kharagpur	60	12

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Semester	Course Code	Sr. No	Name of Subject as per Curriculum	Coursera Course	Name of University/Institute Offering Course	Relevance %	Duration of Course (In Weeks)
SEM-III	BTBS301	1	Engineering Mathematics – III	Differential Equations for Engineers	The Hong Kong University of Science and Technology (HKUST)	70	6

	BTEXC302	2	Electronic Devices & Circuits	Introduction to Electronics	The Georgia Institute of Technology	80	7
	BTEXC303	3	Digital Electronics	Digital Systems: From Logic Gates to Processors-	Universitat Autònoma de Barcelona	70	8
	BTEX304	4	Network Theory	Linear Circuits 1: DC Analysis	The Georgia Institute of Technology	50	7
SEM-IV	BTEXS401	5	Electrical Machines and Instruments	Motors and Motor Control Circuits	University of Colorado Boulder	60	5
	BTEXC402	6	Signals and Systems	Digital Signal Processing 3: Analog vs Digital	École Polytechnique Fédérale de Lausanne	60	4
	BTHM403	7	Basic Human Rights	Human Rights for Open Societies	Utrecht University	60	6
	BTBS404	8	Probability Theory and Random Processes	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of economics	80	6
	BTEXPE405A	9	(A) Numerical Methods and Computer Programming	Introduction to Numerical Analysis	National Research University Higher School of Economics	50	7
	BTEXPE405C		(C) Computer Organization and Architecture	Computer Architecture	Princeton University	80	11
SEM-V	BTEXC501	10	Analog Circuits	Introduction to Electronics	The Georgia Institute of Technology	30	7
	BTEXC502	11	Digital Signal Processing	Digital Signal Processing 2: Filtering	École Polytechnique Fédérale de Lausanne	70	3
	BTEXPE504B	12	(B) VLSI Design & Technology	VLSI CAD Part I: Logic	University of Illinois at Urbana-Champaign	50	5
	BTEXOE505A	13	(A) Digital System Design	VLSI CAD Part I: Logic	University of Illinois at Urbana-Champaign	40	5
	BTEXOE505B		(B) Artificial Intelligence and Machine learning	Machine Learning	Stanford University	70	11
	BTEXOE505C		(C) Optimization Techniques	Discrete Optimization	MelbourneUniversity	70	8
	BTETOE505D		(D) Project Management and Operation	Managing Project Risks and Changes	University of California, Irvine	50	5

			Research				
	BTEXOE505E		(E) Augmented, Virtual and Mixed Reality	Introduction to XR: VR, AR, and MR Foundations	Unity Technologies	50	4
SEM-VI	BTEXC601	14	Power Electronics	Converter Circuits	University of Colorado Boulder	60	4
	BTEXC602	15	Microprocessors and Microcontrollers	Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30	4
	BTEXPE603A	16	(A) Information Theory and Coding	Information Theory	The Chinese University of Hong Kong	70	11
	BTEXOE604A	17	(A) IoT and Industry 4.0	Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30	4
	BTEXOE604C		(C) Computer Network & Cloud Computing	The Bits and Bytes of Computer Networking	Google	80	6
	BTEXOE604E		(E) Robotics Design	Robotics: Mobility	University of Pennsylvania	50	4
SEM-VII	BTEXOE703B	18	(B) Block Chain Technology	Blockchain: Foundations and Use Cases	Consensys Academy	70	5
	BTEXOE703C		(C) Cyber Security	Web Connectivity and Security in Embedded Systems	EIT Digital	60	6
	BTEXOE703D		(D) Bio-medical Signal Processing	The Development of Mobile Health Monitoring Systems	Saint Petersburg State University	40	5
	BTEXOE703E		(E) Mobile Communication and Networks	Wireless Communications for Everybody	Yonsei University	60	6
	BTEXOE704A	19	(A) Soft Computing	Neural Networks and Deep Learning	deeplearning.ai	30	4
	BTEXOE704B		(B) Big Data Analytics	Introduction to Big Data	University of California San Diego	30	3
	BTEXOE704C		(C) Data Structure & Algorithms Using Java Programming	Data Structures	University of California San Diego	60	6

	BTEXOE704D		(D) Entrepreneurship Development	Entrepreneurship 1: Developing the Opportunity	University of Pennsylvania	40	4

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM edX

Semester	Course Code	Sr. No	Name of Subject as per Curriculum	edX Course	Name of University/Institute Offering Course	Relevance %	Duration of Course (In Weeks)
SEM-III	BTEXC302	1	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
	BTEXC303	2	Digital Electronics	Computation Structures - Part 1: Digital Circuits	Massachusetts Institute of Technology	60	10
	BTES304	3	Network Theory	Principles of Electric Circuits	Tsinghua University	40	18
SEM-IV	BTEXC402	4	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 2)8

	BTHM403	5	Basic Human Rights	Human Rights Defenders	Amnesty International	40	4
	BTBS404	6	Probability Theory and Random Processes	Probability: Basic Concepts & Discrete Random Variables	Purdue University	50	6
SEM-V	BTEXPE504A	7	(A) Electromagnetic Field Theory	Electromagnetism	Tsinghua University	30	7
	BTEXOE505B	8	(B) Artificial Intelligence and Machine learning	Artificial Intelligence (AI), Machine Learning	Columbia University, The Georgia Institute of Technology	40	12
	BTEXOE505E		(E) Augmented, Virtual and Mixed Reality	How Virtual Reality Works	The University of California, San Diego	40	6
SEM-VI	BTEXC601	9	Power Electronics	Power Electronics	Massachusetts Institute of Technology	45	12
	BTEXC602	10	Microprocessors and Microcontrollers	Embedded Systems - Shape The World: Microcontroller Input/Output	The University of Texas at Austin	50	8
	BTEXPE603B	11	(B) Control System Engineering	Introduction to Control System Design - A First Look	Massachusetts Institute of Technology	40	4
	BTEXOE604E	12	(E) Robotics Design	Robotics	Columbia University	50	10
SEM-VII	BTEXPE702D	13	(D) Fiber Optic Communication	Optical Materials and Devices	Massachusetts Institute of Technology	20	6
	BTEXOE703B		(B) Block Chain Technology	Blockchain: Understanding Its Uses and Implications	The Linux Foundation	50	14
	BTEXOE703C		(C) Cyber Security	Introduction to Cybersecurity	University of Washington	40	6