



B.S. Abdur Rahman

Crescent

Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2017
Curriculum and Syllabi

(Amendments updated upto June 2020)

B.Tech.
**(Electronics & Communication
Engineering)**



REGULATIONS 2017
CURRICULUM AND SYLLABI
(AMENDMENTS UPDATED UPTO JUNE 2020)

B.TECH
ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

B.S.Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through scientific enquiry, applied research and innovation.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION

VISION

Department of Electronics and Communication Engineering envisions to be a leader in providing state of the art education through excellence in teaching, training, and research in contemporary areas of Electronics and Communication Engineering and aspires to meet the global and socio economic challenges of the country.

MISSION

- The Department of Electronics and Communication Engineering endeavours to produce globally competent Engineers prepared to face challenges of the society.
- To enable the students to formulate, design and solve problems in applied science and engineering.
- To provide excellent teaching and research environment using state of the art facilities.
- To provide adequate practical training to meet the requirement of the Electronics & communication industry.
- To train the students to take up leadership roles in their career or to pursue higher education and research.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.Tech. (Electronics and Communication Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

- To provide fundamental knowledge in Mathematics and Basic Sciences to solve problems in Electronics and Communication Engineering.
- To impart necessary knowledge and skills in the area of Microelectronics, Signal Processing, Telecommunication and Networking.
- To impart practical knowledge and skill sets with the state of the art industrial hardware and software tools to meet the industrial requirement.
- To provide knowledge in related disciplines of electronics engineering through elective courses to enable them to work in multidisciplinary areas.
- To train in soft skills to attain leadership roles in industries.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will be able to:

- **Engineering knowledge:** Apply the knowledge of Mathematics, Science and Electronics & communication Engineering fundamentals to solve the complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of Mathematics, Electronics and Communication Engineering sciences.
- **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.
- **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.

- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **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.
- **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.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **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.
- **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.
- **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.
- **Communication Systems:** Analyze and assess various aspects of communication systems and communication mediums for efficient utilization of resources.
- **Signal Processing:** Apply the concepts of signal processing to real world data for effective analysis and optimization of Information systems.
- **Electronic Systems:** Design and develop appropriate electronic subsystem to address the application needs of complex engineering problems.

REGULATIONS - 2017
B.TECH. DEGREE PROGRAMMES
(With Amendments incorporated upto June 2020)
(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

- i) **"Programme"** means B.Tech. Degree Programme.
- ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,
- iii) **"Course"** means theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Mathematics, Physics, Engineering Graphics, Fluid Mechanics, etc.,
- iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.
- v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.
- vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S. Abdur Rahman Crescent Institute of Science and Technology.
- vii) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman Crescent Institute of Science and Technology who is responsible for conduct of examinations and declaration of results.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight - semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight-semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the

Institution for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Mechanical Engineering
10. Polymer Engineering
11. Biotechnology
12. Artificial Intelligence and Data Science
13. Computer Science and Engineering(Cyber Security)
14. Computer Science and Engineering(Internet of Things)

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme has a curriculum with syllabi consisting of theory and practical courses such as,

- i) Basic Sciences (BS)
- ii) Humanities & Social Sciences (HS)
- iii) Management Sciences (MS)
- iv) Engineering Sciences Fundamentals (ESF)
- v) Engineering Core Courses (EC)
- vi) Professional Electives (PE)
- vii) General Electives (GE)
- viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits :

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training or 80 hours per semester.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc., of total number of credits not exceeding 26.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the respective programme of study.

4.5 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry student).

5.2 Each semester shall consist of a minimum of 90 working days.

5.3 Semester end examination shall normally follow within a week after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR**6.1 CLASS ADVISOR**

A faculty member shall be nominated by the HoD as Class Advisor for the class throughout the period of study except first year.

The Class Advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

However, for the first and second semester, the class advisors (First year class advisors) are nominated by the first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration

and enrolment in every semester and also offer advice to the students on academic and related personal matters.

7.0 COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman is constituted branch wise and semester wise

8.1 The composition of class committees for first and second semester is as follows:

- i) The first year coordinator shall be the chairman of the class committee
- ii) Faculty members of all individual courses of first / second semester
- iii) Six student representatives (male and female) of each class nominated by the first year coordinator
- iv) The class advisor and faculty advisors of the class.

8.2 The composition of the class committee for each branch from 3rd to 8th semester is as follows:

- i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
- ii) Faculty members of all courses of the semester
- iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
- iv) All faculty advisors and the class advisors.
- v) Head of the Department

8.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first

and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

8.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

8.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLLMENT

9.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

9.2 For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

10.0 COURSE CHANGE / WITHDRAWAL

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first continuous assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it shall not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

12.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 32 credits during a semester including Redo / Pre-do Courses.

12.2 The minimum earned credit required to move to the higher semester shall be

- Not less than 20 credits, to move to the 3rd semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

13.2 Appearing for semester end theory examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

13.3 Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However, a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

13.4 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory component shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical component shall be through continuous assessment.

13.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

13.6 In the case of Industrial training, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an

internship completion certificate issued by the industry / research organisation. The weightage for Industry internship report shall be 60% and 40% for viva voce examination.

13.7 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the Viva Voce examination.

13.8 Assessment of seminars and comprehension shall be carried out by a committee of faculty members constituted by the Head of the Department.

13.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall be ignored.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab component.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However there is no substitute examination for semester end examination.

14.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

- 15.1** A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the in approved events etc.) to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course. The cases in which the student is awarded “I” grade, shall register and repeat the course when it is offered next.
- 15.2** The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the Class Advisor. The Class Advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department/ Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.
- 15.3** A student who has obtained ‘I’ grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.
- 15.4** A student should register to redo a core course wherein “I” or “W” grade is awarded. If the student is awarded, “I” or “W” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of Head of the Department / Dean of School.
- 15.5** A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course in the evening when the course is offered by the department. Marks scored in the continuous assessment during the redo classes shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtained “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.
- 15.6** If a student with “U” grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

16.0 REDO COURSES

- 16.1** A student can register for a maximum of two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.
- 16.2** The Head of the Department with the approval of Dean Academic Affairs may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.
- 16.3** The number of contact hours and the assessment procedure for any redo course shall be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

- 17.1** All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	0
I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

- 17.2** A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be

repeated by the student for improvement of grade.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of the School and it shall be declared by the Controller of Examinations.

17.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to Controller of Examination. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as Convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^n (C_i)(GP_i)}{\sum_{i=1}^n C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

"I" and "W" grades are excluded for calculating GPA.

"U", "I", "AB" and "W" grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage Equivalent of Marks = CGPA X 10

17.6 After successful completion of the programme, the Degree shall be awarded with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semester for normal entry and 6 semesters for lateral entry
First Class	6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained 'U' or 'I' grade in any course during his/her study and should have completed the U.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study. For this purpose, the authorized break of study is not counted. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE:

18.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

18.2 ONLINE / SELF STUDY COURSES

Students are permitted to undergo department approved online courses under SWAYAM up to 20% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Students of final year can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise students with less credits can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both Odd and Even Semester.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes such as NCC, NSS, NSO, YRC, Rotaract, etc., and undergo related activities during the period of study.

21.0 DISCIPLINE

21.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

22.0 ELIGIBILITY FOR THE AWARD OF DEGREE

22.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

- i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study
- ii) no dues to the Institution, Library, Hostels, etc.
- iii) no disciplinary action pending against him/her.

22.2 The award of the degree must have been approved by the Institution.

23.0 MINOR DEGREES OFFERED FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 21

23.1 The students admitted in the following B.Tech. Programmes from the academic year 2020 – 21 can graduate with a minor degree, which is optional, along with a major degree:

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering

<ul style="list-style-type: none"> • Polymer Engineering 	<ul style="list-style-type: none"> • Biotechnology Engineering
<ul style="list-style-type: none"> • Electronics and Instrumentation Engineering 	<ul style="list-style-type: none"> • Computer Science and Engineering
<ul style="list-style-type: none"> • Information Technology 	<ul style="list-style-type: none"> • Artificial Intelligence and Data Science
<ul style="list-style-type: none"> • Computer Science and Engineering (IoT) 	<ul style="list-style-type: none"> • Computer Science and Engineering(Cyber Security)

23.2 The eligibility for choosing the minor degree is given as below:

Sl. No.	Minor Degree (Optional)	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering
2.	Block Chain	Polymer Engineering
3.	Cyber Security	Automobile Engineering
4.	Data Science	Civil Engineering
5.	Internet of Things (IoT)	Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg.
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engineering Electronics & Instrumentation Engg. Electronics & Communication Engg.
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg.
8.	Robotics	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology

		Electrical & Electronics Engg. Electronics & Instrumentation Engg.
9.	3D Printing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electronics & Communication Engg.
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics & Communication Engg.
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering

		Automobile Engineering Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.

23.3 A student shall earn an additional 18 to 20 credits for the award of minor degree.

23.4 A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

24.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1181	Differential Calculus and Geometry	3	1	0	4
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182 / LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3
3.	BS	PHC 1182	Physics I	3	0	2	4
4.	BS	CHC 1181	Chemistry	3	0	2	4
5.	ESF	GEC 1101	Engineering Graphics	2	0	2	3
6.	ESF	GEC 1102	Engineering Design	2	0	0	2
7.	ESF	GEC 1103	Basic Engineering Practices Laboratory	0	0	2	1
8.	ESF	GEC 1104	Computer Programming I	1	0	2	2
							23

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC 1211	Engineering Mechanics	3	1	0	4
5.	BS	GEC 1212	Environmental Science	2	0	0	2
6.	ESF	GEC 1213	Computer Programming II	1	0	2	2
7.	EC	ECC 1201	Circuit and Network Analysis	2	0	2	3

8.	EC	ECC 1202	Electron Devices	3	0	0	3	
9.	EC	ECC1203	Electron Devices Laboratory	0	0	3	1	25

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC 2181	Oral Communication	0	0	2	1	
4.	EC	ECC 2101	Electronic Circuits	3	1	0	4	
5.	EC	ECC 2102	Signals and Systems	3	0	2	4	
6.	EC	ECC 2103	Digital Electronics	3	0	0	3	
7.	EC	ECC 2104	Electromagnetic Fields and Transmission Lines	3	1	0	4	
8.	EC	ECC 2105	Electronic Circuits Laboratory	0	0	2	1	
9.	EC	ECC 2106	Digital Electronics Laboratory	0	0	2	1	24

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	-	Mathematics Elective I	3	1	0	4	
2.	HS	-	Humanities Elective II	2	0	0	2	
3.	HS	ENC 2282	Written Communication	0	0	2	1	
4.	EC	ECC 2201	Digital Signal Processing	3	1	0	4	
5.	EC	ECC 2202	Linear Integrated Circuits	3	0	0	3	
6.	EC	ECC 2203	Communication Theory and systems	3	0	0	3	
7.	EC	ECC 2204	Microprocessors and Microcontrollers	3	0	0	3	
8.	EC	ECC 2205	Microprocessor & Microcontroller Laboratory	0	0	2	1	
9.	EC	ECC 2206	Digital Signal Processing Laboratory	0	0	2	1	
10.	EC	ECC 2207	Linear Integrated Circuits Laboratory	0	0	2	1	23

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	GE	-	General Elective I	3	0	0	3
3.	HS	ENC 3181	Soft Skills for Career	0	0	2	1
4.	EC	ECC 3101	Digital Communication	3	1	0	4
5.	EC	ECC 3102	Computer Networks	3	0	0	3
6.	EC	ECC 3103	VLSI Design	3	0	0	3
7.	EC	ECC 3104	VLSI Laboratory	0	0	2	1
8.	EC	ECC 3105	Computer Networks Laboratory	0	0	2	1
9.	EC	ECC 3106	Communication System Laboratory	0	0	2	1
10.	PE	-	Professional Elective I	3	0	0	3*
11.	PE	-	Professional Elective II	3	0	0	3* 26

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181/ MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	BS	-	Mathematics Elective II	2	0	0	2
3.	HS	ENC 3281	English for Workplace	0	0	2	1
4.	EC	ECC 3201	Microwave and Antenna Theory	3	0	0	3
5.	EC	ECC 3202	Embedded Systems	3	0	0	3
6.	EC	ECC 3203	Microwave and Antenna Laboratory	0	0	2	1
7.	EC	ECC 3204	Embedded System Design Laboratory	0	0	2	1

8.	PE	-	Professional Elective III	3	0	0	3*	
9.	PE	-	Professional Elective IV	3	0	0	3*	
10.	PE	-	Professional Elective V	3	0	0	3*	23

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	GE		General Elective II	3	0	0	3	
2.	EC	ECC 4101	Introduction to Wireless Communication	3	0	0	3	
3.	EC	ECC 4102	Optical Communication	3	0	0	3	
4.	EC	ECC 4103	Optical Communication Laboratory	0	0	2	1	
5.	EC	ECC 4104	Wireless Communication Laboratory	0	0	2	1	
6.	PE		Professional Elective VI	3	0	0	3*	
7.	PE		Professional Elective VII	3	0	0	3*	
8.	PE		Professional Elective VIII	3	0	0	3*	
9.	EC	ECC 4105	Internship / Industry Training / Mini Project				1 [#]	21

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	ECC 4201	Project Work	0	0	24	12	12

Total credits – 177

Industrial training will be undertaken during Third year summer vacation for 15 days. The credit for the same will be awarded in the 7th Semester.

* PE - Student has to take courses from the list of professional electives for the corresponding semester.

* Professional electives in RF Communication & Signal Processing, Artificial Intelligence & Robotics, VLSI and Embedded Systems Streams are available to choose from Sixth semester onwards.

PROFESSIONAL ELECTIVES**SEMESTER V**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 01	Digital System Design	3	0	0	3
2.	PE	ECCX 02	Computer Architecture	3	0	0	3
3.	PE	ECCX 03	Control Systems	3	0	0	3
4.	PE	ECCX 04	Biomedical Electronics	3	0	0	3
5.	PE	ECCX 05	Image Processing	2	0	2	3
6.	PE	ECCX 06	Advanced Microprocessor and Microcontrollers	3	0	0	3
7.	PE	ECCX 07	PCB Design	1	0	2	2
8.	PE	ECCX 08	Data structure and its algorithms	1	0	2	2
9.	PE	ECCX 09	Java Programming	3	0	0	3
10.	PE	ECCX 10	MATLAB Programming	1	0	0	1
11.	PE	ECCX 11	Python Programming	1	0	0	1

SEMESTER VI**RF COMMUNICATION AND SIGNAL PROCESSING STREAM**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 12	Introduction to Satellite Communication	3	0	0	3
2.	PE	ECCX 13	Biomedical Signal Processing	3	0	0	3
3.	PE	ECCX 14	Radar Systems Engineering	3	0	0	3
4.	PE	ECCX 15	Wireless Networks	3	0	0	3
5.	PE	ECCX 16	Multimedia Communication Systems	3	0	0	3

B.Tech.	Electronics & Communication Engineering			Regulations 2017			
6.	PE	ECCX 18	Information Coding Techniques	3	0	0	3
7.	PE	ECCX 19	RF MEMS Circuit Design	3	0	0	3
8.	PE	ECCX 20	Display Technologies	2	0	0	2
9.	PE	ECCX 21	Simulation of RF Circuits and Components	0	0	2	1
10.	PE	ECCX 22	RF Test and Measurement	0	0	2	1

ARTIFICIAL INTELLIGENCE AND ROBOTICS STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 16	Multimedia Communication Systems	3	0	0	3
2.	PE	ECCX 17	Introduction to Network security	3	0	0	3
3.	PE	ECCX 23	Data Science	3	0	0	3
4.	PE	ECCX 24	Machine Learning	2	0	2	3
5.	PE	ECCX 25	Robotics and its applications	3	0	0	3
6.	PE	ECCX 29	Neural Networks and Fuzzy Logic	3	0	0	3
7.	PE	ECCX 30	Artificial Intelligence	2	0	2	3
8.	PE	ECCX 36	Programming in Embedded systems	3	0	0	3
9.	PE	ECCX 37	Multicore Architecture and Parallel Programming	3	0	0	3

VLSI & EMBEDDED SYSTEM STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 26	DSP Architecture and Programming	3	0	0	3
2.	PE	ECCX 31	Introduction to Reconfigurable Computing	3	0	0	3
3.	PE	ECCX 32	Introduction to System Verilog for verification	3	0	0	3

B.Tech.	Electronics & Communication Engineering			Regulations 2017			
4.	PE	ECCX 33	Fundamentals of Nano technology	3	0	0	3
5.	PE	ECCX 34	Embedded processor for Digital signal processing	3	0	0	3
6.	PE	ECCX 36	Programming in Embedded systems	3	0	0	3
7.	PE	ECCX 37	Multicore Architecture and Parallel Programming	3	0	0	3
8.	PE	ECCX 38	Advanced Computer Architecture	3	0	0	3
9.	PE	ECCX 40	IC technology	3	0	0	3
10.	PE	ECCX 41	Design using EDA Tools	0	0	2	1

SEMESTER VII

RF COMMUNICATION AND SIGNAL PROCESSING STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 42	Principles of Wireless Sensor Network	3	0	0	3
2.	PE	ECCX 43	Electromagnetic Interference & Compatibility	3	0	0	3
3.	PE	ECCX 45	RF System Design	3	0	0	3
4.	PE	ECCX 46	Video Processing Techniques	3	0	0	3
5.	PE	ECCX 47	Advanced Antenna Design	2	0	2	3
6.	PE	ECCX 48	Advanced Error control coding	3	0	0	3
7.	PE	ECCX 49	Medical Image Processing	3	0	0	3
8.	PE	ECCX 50	Software defined radio	3	0	0	3
9.	PE	ECCX 51	Optical Signal processing	3	0	0	3
10.	PE	ECCX 52	GNU radio realization through python and C++	1	0	2	2
11.	PE	ECCX 53	Implementation of GSM 2G, 3G stack	1	0	2	2
12.	PE	ECCX 54	Massive MIMO Technology	1	0	0	1

ARTIFICIAL INTELLIGENCE AND ROBOTICS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 27	Deep Learning	3	0	0	3
2.	PE	ECCX 28	Augmented Reality and Virtual Reality	3	0	0	3
3.	PE	ECCX 35	GPU Architecture and Programming	3	0	0	3
4.	PE	ECCX 39	Robotics and Autonomous systems	3	0	0	3
5.	PE	ECCX 42	Principles of Wireless Sensor Network	3	0	0	3
6.	PE	ECCX 44	Fundamentals of Internet of Things.	3	0	0	3
7.	PE	ECCX 49	Medical Image Processing	3	0	0	3
8.	PE	ECCX 55	Artificial Intelligence for Robotics	3	0	0	3
9.	PE	ECCX 61	Mechatronics	3	0	0	3

VLSI & EMBEDDED SYSTEM STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX 44	Fundamentals of Internet of Things.	3	0	0	3
2.	PE	ECCX 56	VLSI Signal Processing	3	0	0	3
3.	PE	ECCX 57	Digital VLSI Testing	3	0	0	3
4.	PE	ECCX 58	Fin FET Technology	3	0	0	3
5.	PE	ECCX 59	Real Time Embedded Systems	3	0	0	3
6.	PE	ECCX 60	Introduction to RTOS	3	0	0	3
7.	PE	ECCX 61	Mechatronics	3	0	0	3
8.	PE	ECCX 62	Nanoscale Devices and Circuit Design	3	0	0	3
9.	PE	ECCX 63	System Design with FPGA	3	0	0	3

**Physics Elective Courses
(to be offered in II Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

**Chemistry Elective Courses
(to be offered in II Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CHCX01	Analytical Instrumentation	2	0	2	3
2.	CHCX02	Corrosion and its Control	2	0	2	3
3.	CHCX03	Electrical Materials and Batteries	2	0	2	3
4.	CHCX04	Engineering Materials	2	0	2	3
5.	CHCX05	Fuels and Combustion	2	0	2	3
6.	CHCX06	Fundamentals of Physical Chemistry	2	0	2	3
7.	CHCX07	Green Technology	2	0	2	3
8.	CHCX08	Organic Chemistry of Biomolecules	2	0	2	3
9.	CHCX09	Polymer Science and Technology	2	0	2	3

Maths Elective Courses
(to be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX 02	Probability And Statistics	3	1	0	4
3.	MACX 03	Random Processes	3	1	0	4
4.	MACX 04	Applied Numerical Methods	3	1	0	4

Maths Elective Courses
(to be offered in VI Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2
4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

Humanities Elective I
(to be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX01	Fundamentals of Economics	2	0	0	2
2.	SSCX02	Principles of Sociology	2	0	0	2
3.	SSCX03	Sociology of Indian Society	2	0	0	2

Humanities Elective II
(to be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX04	Economics of Sustainable Development	2	0	0	2
2.	SSCX05	Industrial Sociology	2	0	0	2
3.	SSCX06	Law for Engineers	2	0	0	2

General Elective
Group I Courses
(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 101	Disaster Management	Civil
2.	GECX 102	Total Quality Management	Mechanical
3.	GECX 103	Energy Studies	Mechanical
4.	GECX 104	Robotics	Mechanical
5.	GECX 105	Transport Management	Automobile
6.	GECX 106	Control Systems	EEE
7.	GECX 107	Introduction to VLSI Design	ECE
8.	GECX 108	Plant Engineering	EIE
9.	GECX 109	Network Security	CSE
10.	GECX 110	Knowledge management	CSE
11.	GECX 111	Cyber security	IT
12.	GECX 112	Genetic Engineering	LS
13.	GECX 113	Fundamentals of Project Management	CBS

14.	GECX 114	Operations Research	Mathematics
15.	GECX 115	Nano Technology	Physics / Chemistry
16.	GECX 116	Vehicle Maintenance	Automobile
17.	GECX 117	Fundamentals of Digital Image Processing	ECE

**Group II Courses
(To be offered in VII semester)**

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 201	Green Design and Sustainability	Civil
2.	GECX 202	Appropriate Technology	Civil / Mechanical
3.	GECX 203	Engineering System Modelling and Simulation	Mechanical
4.	GECX 204	Value Analysis and Engineering	Mechanical
5.	GECX 205	Industrial Safety	Mechanical
6.	GECX 206	Advanced Optimization Techniques	Mechanical
7.	GECX 207	Matlab Simulation	EEE
8.	GECX 208	Embedded Systems and its Applications	ECE
9.	GECX 209	Usability Engineering	CSE
10.	GECX 210	Supply Chain Management	CBS
11.	GECX 211	System Analysis and Design	CA
12.	GECX 212	Advanced Materials	Physics & Chemistry
13.	GECX 213	National Service Scheme	School of Humanities
14.	GECX 214	Automotive Pollution and Control	Automobile

Sl. No.	Course Code	Course Title	Offering Department
15.	GECX 215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX 216	Principles of Communication Systems	ECE
17.	GECX 217	Lean Management	Civil
18.	GECX 218	Spatial Data Modeling & Analysis	Civil
19.	GECX 219	Advanced Entrepreneurship	MBA
20.	GECX 220	Electric Vehicles	EEE
21.	GECX 221	Artificial Intelligence and Evolutionary Computing using Matlab	EEE

Lagrange's multiplier method.

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients, method of variation of parameters

**MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL 7+3
EQUATIONS**

Solution of Ordinary Differential Equation Related to Electric Circuits – Bending of Beams- Motion of a Particle in a resisting medium – Simple harmonic motion.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
5. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengage learning,UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigen values and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.
- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181**ENGLISH**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming , scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I**8**

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

Language Focus: Affixes, Simple Present tense , Connective & Prepositions.

MODULE II**8**

L: Listening for specific information (from dialogues)

S:Exchanging opinion.

R: Skimming technical Passages

W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.

Language Focus: Idioms, use of Modals, Simple Past tense & use of "Wh" and question tags.

MODULE III**7**

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV**7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V**8**

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an experience

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI**7**

L: Learning Story telling techniques (stories & visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

TOTAL HOURS :45**REFERENCES:**

1. Carol Rosenblun perry(2011). The Fine Art of Technical Writing. Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan. G and Prakash , C.L.N. (2007) A course in Communication Skills. Cambridge Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004) . Wings of Fire : An Autobiography(Simplified and Abridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical

contexts

- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC1181**ARABIC**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC**7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

MODULE II FUNCTIONAL ARABIC**7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

MODULE III FUNCTIONAL ARABIC**8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:

Family, travel

Market, Prayer hall

Writing skills:

Note making.

Sequencing of sentences.

Developing answers from the questions.

Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.

Reading and writing skills.

Audio & Video aided listening.

Introduction to Arabic terms related to administration.

Situation communication:

Air travel, Office administration, passport, visa.

Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:

Contractual work, machineries and equipments..

Computer, internet browsing.

Banking,

Exercises.

TOTAL HOURS :45

TEXT BOOKS:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

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

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

LNC1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

General Introduction to Chinese • Pinyin and Tones • Introduction to the Writing System: basic strokes and stroke order · Numbers 1-100, song · Days of the Week · Months of the Year

MODULE II **8**

Chinese names and related culture · Chinese family structures and values · Greetings
Introducing Yourself · Family members · Occupations

MODULE III **7**

Languages and Nationalities · Daily Routine · Chinese breakfast · Negative Sentences and Interrogative Sentences · Asking for Personal Information · The Verb *shi* and Basic Sentence Structures

MODULE IV **7**

Answering an Affirmative-negative Question · Food and drinks · Transportation · Likes and dislikes · Adverbs *bu*, *jiu* and *dou* · Verb-absent Sentences

MODULE V **8**

Jisui and *duoda* Questions · S+V+O Construction · Routines and Daily Activities
Haishi Questions · Modal Verbs · Hobbies and Habits

MODULE VI **7**

· Making Suggestions with *haoma* · Colors · Clothing · Body parts · Talking about Likes and Dislikes · Measurement Words in Chinese

TOTAL HOURS :45

TEXT BOOKS:

1. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Textbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.
2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC1182**GERMAN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I**8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II**8**

Understanding and responding to everyday queries like instruction, questions, - number & gender, pronouns, present and past tense.

MODULE III**7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV**7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V**8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI**7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner-- Understanding of matters that are familiar and are encountered regularly like instances at school,

work, at public places, places of leisure etc.

TOTAL HOURS :45

TEXT BOOKS:

1. Course book :Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7
2. Practice book:Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7.

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch als Fremdsprache,Stefanie Dengler,Paul Rusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509
3. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159 –
4. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC1183**JAPANESE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I**7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II**8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III**7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV**8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V**7**

Comprehension of passages in simple Japanese and writing of composition in Japanese applying lower intermediate grammatical patterns.

MODULE VI**8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately

TOTAL HOURS :45**REFERENCES:**

1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exercise book 1 of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo Gaikokugo Daigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1181**PHYSICS**

L	T	P	C
3	0	2	4

OBJECTIVES:

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures – Defects in crystals-Point defects – Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III APPLIED OPTICS 8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, CO₂ laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI RENEWABLE ENERGY SOURCES 7

Present Energy sources and sustainability - Solar energy - Solar photovoltaics - Solar cells – Bioenergy - Biomass – production of liquid fuels from biomass – Wind energy – Wind turbines – energy and power from wind turbines - Geothermal energy - Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – Tidal power basics – power generation –Tidal energy potential – Environmental benefits and impacts of renewable energy sources

PRACTICALS

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.

9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES :

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.
- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

CHC1181**CHEMISTRY**

L	T	P	C
3	0	2	4

OBJECTIVES:

The students should be conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water used for domestic and industrial purpose and treatment process involved.
- the synthesis, properties and applications of nanomaterials.
- the importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean and their limitations.
- the basic analytical techniques like UV-Visible, FT-IR, NMR, AAS, AES, Circular Dichroism and XRD etc.
- photochemistry concepts related to physical processes and chemical reactions induced by photon absorption and their applications.
- basic principles of electrochemistry, cell construction and evaluation and to understand general methodologies for construction & design of electrochemical cell

MODULE I WATER TECHNOLOGY 9

Impurities present in water, hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment method: – lime soda and zeolite process (principle only), Ion exchange process – Internal treatment : colloidal, carbonate, phosphate and calgon methods – drinking water: standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration, disinfection }– desalination: electrodialysis, reverse osmosis.

MODULE II NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis (top-down and bottom-up approach) : sol-gel, thermolysis (hydrothermal and solvothermal), electrodeposition, chemical vapour deposition, laser ablation – properties and applications (electronic, magnetic and catalytic) – risk factors and future perspectives.

MODULE III ENERGY SOURCES 8

Energy: past, today, and future – a brief history of energy consumption – present energy scenario of conventional and renewable energy sources – renewable energy : needs of renewable energy, advantages and limitations of renewable energy – solar energy: basics, solar energy in the past , photovoltaic, advantages and disadvantages – bioenergy: conversion, bio degradation, biogas generation, biomass gasifier, factors affecting biogas generation, advantages and disadvantages – geothermal energy: geothermal resources (hot dry rock and magma resources, natural and artificial), advantages and disadvantages – wind energy: wind resources, wind turbines, advantages and disadvantages – ocean energy: wave energy, wave energy conversion devices, ocean thermal energy, advantages and disadvantages.

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission, chromophores, auxochromes – laws of photochemistry : Grotthus-Draper law, Stark Einstein law – quantum yield (problems) –photo physical processes : fluorescence and phosphorescence - Jablonski diagram (electronic states and transitions) – quenching, annihilation – photosensitization: principle and applications – chemiluminescence, bioluminescence.

MODULE V ANALYTICAL TECHNIQUES 7

Spectroscopy: electromagnetic radiation and spectrum – types of transitions – types of spectra (atomic and molecular with their chemical usefulness) – Beer-Lamberts law (problems) – principles, instrumentation and applications of: Colourimetry – UV-Vis spectrophotometer – atomic absorption spectroscopy – atomic emission spectroscopy – principles and applications of: IR, NMR, mass and X-ray diffraction analysis.

MODULE VI ELECTROCHEMISTRY 8

Electrochemistry - types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode and fluoride ion selective electrode) – Electrolytic and galvanic cells, construction of cell, EMF measurement and applications (problems), standard cell (Weston-cadmium), reversible and irreversible cell, concentration cell. Determination of fluoride ion using fluoride ion selective electrode – Chemically modified electrodes (CMEs) : concept, approaches and applications.

PRACTICALS

1. Estimation of hardness in given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of strong acid by conductometry.
4. Estimation of Fe^{2+} present in the given sample by potentiometry.
5. Verification of Beer-Lamberts law and estimation of Cu^{2+} present in unknown sample.
6. Estimation of sodium and potassium present in the given sample by flame photometry.
7. Determination of molecular weight and degree of polymerisation of a polymer by viscosity method.
8. Synthesis of thermosetting polymer.

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, "Nanotechnology: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge, 2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
5. G.D.Rai, "Non conventional energy sources," Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, "Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES:

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- classify nanomaterials and apply the nanotechnology approach to synthesize the nanomaterials.

- explain the principle and enumerate the advantages and disadvantages of various renewable energy sources.
- state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- construct a electrochemical cell and describe the various types of electrodes and determine the fluoride content.

GEC 1101	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, isometric projection, perspective projection and free hand drawing.
- To introduce computerized drafting.

MODULE I BASICS AND ENGINEERING CURVES 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola.

Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, second angle, third angle and fourth angle projections –setup - assumptions, principle. Free hand sketching of orthographic views of simple machine parts as per first angle projection. Orthographic projection of points in all quadrants. Some commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Projection of straight lines in first quadrant – true length and true inclinations – Rotating line and trapezoidal methods –traces of straight line.

Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids in first quadrant: Axis inclined to one reference plane only- prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional view – true shape of section Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE VI PICTORIAL PROJECTIONS 10

Isometric projection: Isometric scale – isometric axes- iso sheet - Isometric projection and view of prism, pyramid, cylinder, cone, frustums, truncated solids and simple products

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid, cylinder and frustums by Visual ray method.

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 53rd Edition, (2014)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2009)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

- Students should be able to read the specifications and standards of technical drawing and able to draw conic sections and special curves.
- Students should be able to understand the insight of orthographic projection and to draw the various views of orthographic projection of a point and various components.
- Students should be able to draw the orthographic views of straight lines and plane figures.
- Students should be able to draw the orthographic views of simple solids.
- Students should be able to draw the sections of solids and development of solid surfaces.
- Students should be able to draw the isometric and perspective projection of simple solids and components.

GEC 1102	ENGINEERING DESIGN	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To describe the role of design in Engineering
- To analyze the basic design concepts
- To apply the idea of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodology Design of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

TOTAL HOURS – 30**REFERENCES:**

1. Clive L. Dym and David C. Brown, "Engineering Design: Representation and Reasoning", 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, "Information Needs Analysis: Principles and practice in information organizations", Published by Faced Publishing, London. 2015.
3. Cliff Matthews, "Case Studies in Engineering Design", John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, "The Design-Inspired Innovation Workbook", World Scientific, 2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, "Jugaad Innovation",

Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Recognize the need based problems and requirements in the social and domestic environment.
- Describe and Design by introducing innovations into manufacture of engineering products.
- Apply innovative approaches to engineering design and provide effective solutions to real world problems by improvising upon the existing method.
- Analyze any kind of problem and provide newer solutions.
- Build the design into prototype / real products
- Evaluate by testing, verification and validations followed by operation and maintenance.

GEC1103	BASIC ENGINEERING PRACTICES	L	T	P	C
	LABORATORY	0	0	2	1

OBJECTIVES:

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
2. Machining of a simple component like a table weight using lathe
3. Mold preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC, MCCB, ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project.

TOTAL HOURS – 30

OUTCOMES:

Upon the completion of the course, students should be able to

- Appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Attend minor defects especially in items used in day to day life
- Aware of the safety aspects involved in using tools and instruments

GEC 1104	COMPUTER PROGRAMMING I	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To identify the hardware and software components of the computer.
- To know the basic concept of operating system and get knowledge about different operating systems.
- To learn various database concepts and operations
- To develop efficient algorithms for solving a problem.
- To implement the algorithms in C language.
- To use arrays in solving problems.

MODULE I COMPUTER FUNDAMENTALS 7

Introduction -. Number System - Planning the computer program - Computer Software - Basic operating system concepts - Database Operations

MODULE II PROGRAMMING IN C 8

Introduction to C Programming Language – Operators - Control statements - Iterative statements - Arrays.

LIST OF EXPERIMENTS:

1. Computer organization –Hardware in a typical computer Identification – Booting-error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types: Type conversions
5. Input / Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Ashok N Kamthane, "Computer Programming", Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012
2. Paul J. Deitel, Deitel & Associates, "C How to Program", Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

- Recognize Modular design, logic flow, data abstraction
- Analyze the working of the programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programs developing cycle for different applications
- Debug the programs and solve some practical problems in programming
- Develop programs using arrays.

SEMESTER II**MAC 1281****ADVANCED CALCULUS**

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of this course are to

- train the students in solving problems using multiple integration.
- provide knowledge in using special functions to find out the area and volume of a region.
- acquire knowledge in tangent and normal vectors.
- gain knowledge in finding the areas of a curve and surface using vector integration.
- learn about the analytic functions and their properties along with bilinear transformation.
- know complex integration using Cauchy's theorems.

MODULE I MULTIPLE INTEGRATION AND ITS APPLICATIONS 8+2

Multiple integrals– Cartesian and Polar coordinates – change of order of integration – Multiple integral to compute area and volume.

MODULE II TRANSFORMATION OF COORDINATES AND 7+3
SPECIAL FUNCTIONS

Change of variables between Cartesian, polar, cylindrical and spherical coordinates - Beta and Gamma functions – Properties and applications.

MODULE III VECTOR DIFFERENTIATION 7+3

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl

MODULE IV VECTOR INTEGRATION 8+2

Line, surface and volume integrals – Green's Theorem, Gauss Divergence Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals.

MODULE V ANALYTIC FUNCTION 8+2

Analytic function - Necessary and Sufficient condition (statement only) – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping ($w = z+a$, az and $1/z$) and

bilinear transformation.

MODULE VI COMPLEX INTEGRATION

7+3

Statement and application of Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics "(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V., "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume 2, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengage learning,UK.

OUTCOMES:

After completing the course, student will be able to

- compute the area and volume using multiple integrals.
- apply special functions to solve integration problems.
- apply differentiation in scalar and vector fields.
- find area and volume of a region using vector integration.
- verify analyticity, conformity and bilinearity of complex functions.
- evaluate complex integrals.

GEC 1211	BASIC ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give on exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

MODULE I VECTOR APPROACH TO MECHANICS 07

Introduction - Units and Dimensions- Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics - Laws of Mechanics – Parallelogram and triangular Law of forces -Lame's theorem, Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle.

MODULE II EQUILIBRIUM OF PARTICLE 06

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 06

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions –Examples

MODULE IV PROPERTIES OF SURFACES 08

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula –

GEC 1212**ENVIRONMENTAL STUDIES**

L	T	P	C
2	0	0	2

OBJECTIVES:

The student will be conversant with the

- various natural resources, availability, utilisation and its current scenario
- different ecosystems, energy transfer, values, threats and conservation of biodiversity
- levels of different pollutants and its impact and the causes and effects of natural disasters
- impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES**8**

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY**8**

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity –biogeographic classification of India - endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER 8

Definition, cause, effects and control measures of (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation**TOTAL HOURS – 30****TEXT BOOKS:**

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersey, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES:

The student will be able to

- predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

GEC 1213	COMPUTER PROGRAMMING II	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To provide knowledge about the benefits of Object Oriented Programming over Procedure oriented programming.
- To learn various File operations
- To expose fundamental concepts of object-oriented programming in classes, invoking methods and functions.
- To prepare students to get full use of code reusability using object oriented programming.
- To implement the basic concepts of object oriented programming using C++concepts.
- To focus on solving problems based on analyzing, designing and implementing programs in C and C++.

MODULE I PROGRAMMING IN C 7

Functions - Storage Classes - Structures and Unions – Pointers -Self Referential Structures and Linked Lists - File Processing.

MODULE II PROGRAMMING IN C++ 8

Programming in C++ - Overview of OOP in C – Inheritance - Polymorphism - Type Casting – Exceptions.

LIST OF EXPERIMENTS:

1. Functions
2. One dimensional arrays, Pointers
3. Recursion
4. Multi dimensional arrays, Linked lists.
5. Operating on Files.
6. Simple C++ program with Control statements.
7. Getting input from user console.
8. Classes, Object and Constructors.
9. Method overloading.
10. Inheritance

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Bjarne Stroustrup, "The C++ Programming Language", Addison Wesley, 4th edition, ISBN-13: 978-0321563842, 2013.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall, ISBN 0-13-110362-8, 2015.
3. Bjarne Stroustrup, "Programming: Principles and Practice Using C++", Addison Wesley, 2nd edition, ISBN-13: 978-0321992789, 2014.
4. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language (Ansi C Version)", Prentice Hall India Learning Private Limited, 2nd edition, ISBN-13: 978-8120305960, 1990.

OUTCOMES:

Students who complete this course will be able to

- Develop efficient algorithms for solving problems
- Handle files in C
- Use simple data structures like arrays and linked lists in solving problems.
- Write simple programs using concepts of object oriented programming.
- Implement algorithms in C++ Language.
- Demonstrate the Object Oriented Programming concepts applied in networking, web development and Database applications.

ECC1201	CIRCUIT AND NETWORK ANALYSIS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To explicate the fundamental laws and theorems of electrical circuit and network.
- To familiarize with the concepts of steady state and transient analysis in RL, RC and RLC circuits.
- To learn the significance of two port networks

PREREQUISITES:

- Basic idea about active and passive elements
- Mathematical knowledge especially in linear algebra and Matrix theory
- Basic knowledge about voltage, current and power.

MODULE I BASICS OF CIRCUITS AND NETWORKS 5+4

Ideal sources – Dependent and Independent sources – Linear relation between voltage and current of Network elements – source Transformation – Types of Networks – Network reduction – voltage division – current division.

Laboratory Practice: Circuit Simulation for Network Reduction

MODULE II ANALYSIS OF CIRCUITS 5+4

Star - delta transformation - Formation of matrix equations and analysis of complex circuits using Mesh current method and nodal method.

Laboratory Practice: Circuit Simulation of Mesh current method and nodal method

MODULE III NETWORK THEOREMS 7+4

Thevenin's Theorem - Norton's Theorem - Superposition theorem - Maximum power transfer theorem, Substitution theorem, Reciprocity theorem.

Laboratory Practice: Circuit Simulation of verification of Thevenin's Theorem-Norton's Theorem - Maximum power transfer theorem.

MODULE IV TRANSIENTS 7+6

Steady state and transient response – DC response of an RL, RC and RLC circuits - Sinusoidal response of an RL, RC and RLC circuits.

Laboratory Practice: Circuit Simulation of DC response of an RL, RC, RLC circuits and Sinusoidal response of RL, RC and RLC circuits.

MODULE V TWO PORT NETWORKS 6+4

Open circuit Impedance (Z) Parameters - short Circuit Admittance(Y) Parameters, Transmission (ABCD) Parameters and Inverse Transmission Parameters-Hybrid (h) Parameters and Inverse Hybrid Parameter- Conversion between parameters- interconnection of two-port networks

Laboratory Practice: Study the network parameters for various types of network connections using simulation

MODULE VI NETWORK TOPOLOGY 4+4

Introduction -Tree and co-tree- Twigs and links-Incidence matrix –properties of Incidence matrix-Tie-set matrix-cut-set-tree branch voltage.

Laboratory Practice: use PSpice simulation to identify tree, co-tree, twigs and branches.

TOTAL HOURS – 60**TEXT BOOKS:**

1. William H.Hayt, Jr, J.E.Kemmerly& Steven M.Durban, "Engineering Circuit Analysis" 6th Edition, Mc Graw Hill, 2013
2. A.Sudhakar &ShyammohanS.Palli "Circuits &Network; Analysis& Synthesis", 4th Edition, Tata Mc Graw Hill, 2010
3. Someshwar C. Gupta, Jon W. Bayless, Behrouz Peikari, "Circuit Analysis - with computer applications to problem-solving", Wiley-Eastern Ltd., 1991.
4. Van Valkenburg, "Network Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2006

REFERENCES:

1. M.L Soni& J.C. Gupta, "Electric Circuit Analysis", Dhanpat Rai& Sons, New Delhi, 1999.
2. Joseph Edminister, "Electric Circuits", Schaum's Outline Series, Mc Graw Hill 5th Edition, 2011
3. Franklin F.Kuo, "Network Analysis and Synthesis", John Wiley, 2nd Edition, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Describe and apply fundamental concepts of network analysis in solving and analyzing different electrical networks.

- Analyze the electrical networks in various network reduction techniques.
- Select appropriate and relevant technique for solving the Electrical network under different conditions.
- Analyze resonant circuits both in time and frequency domains.
- Reconstruct the electrical networks using graph theory
- Learn to use PSpice in the analysis of circuits.

MODULE VI POWER CONTROL DEVICES**6**

Construction, characteristics and applications: UJT, SCR, TRIAC and DIAC - IGBT - Power MOSFET

TOTAL HOURS – 45**TEXT BOOKS:**

1. J.Millman, C.C.Halkias, and Satyabratha Jit, "Electronic Devices and Circuits" Tata McGraw Hill, 2nd Ed., 2007.
2. Thomas L.Floyd , "Electron Devices (Electron Flow Version), 8th edition, Pearson -2008
3. Ben G.Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education 2000.

REFERENCES:

1. Donald A.Neaman, "Semiconductor Physics and Devices" 3 rd Ed., Tata McGraw Hill 2002.
2. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices – Modeling and Technology", Prentice Hall of India, 2004.
3. David A Bell, 'Electronic Devices and Circuits', 5th edition, Oxford University Press, 2008.

OUTCOMES:

On completion of the course, students will be able to

- Infer the charge carrier transport mechanisms of semiconductors.
- Summarize the basic understanding of the static and dynamic behavior of
- P-N junction diodes.
- Identify the applications of different diodes and special diodes.
- Analyze the characteristics of bipolar junction transistor.
- Analyze the characteristics of FET and MOSFET.
- Describe the working of various power control devices

ECC1203	ELECTRON DEVICES LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES

- To analyze the fundamental characteristics of various Semiconductor Devices
- To analyze electronic device characteristics using SPICE simulation software.

PREREQUISITES

- Fundamentals of semiconductor physics
- Basic doping concepts of semiconductor materials and its properties
- Fundamental knowledge in active and passive elements.

EXPERIMENTS

1. Characteristics of P-N diode and Zener diode.
2. Characteristics of BJT
3. Characteristics of UJT
4. Characteristics of FET
5. Characteristics of DIAC
6. Characteristics of SCR
7. Characteristics of LDR
8. Characteristics of Photodiode / Phototransistor
9. Simulation Experiments using SPICE simulation software

MINI PROJECT

1. Implementation of any one application using diodes and sensors
2. Implementation of any one application using transistors and sensors

TOTAL HOURS – 30

REFERENCES:

1. Thomas L. Floyd, David M. Buchla, Steve Wetterling, "Laboratory Exercises for Electronic Devices", 8th edition, Pearson Education, 2008.
2. Millman'S Electron Devices & Circuits, "Electronic apparatus and appliances", Tata McGraw-Hill Education, 2008.
3. Salivahanan, "Electron Devices & Circuits", Tata McGraw-Hill Education, 2008.

OUTCOMES

On completion of the course, students will be able to

- Identify the working condition of any electron device.

- Obtain the characteristics of basic semi-conductor device.
- Analyze the characteristics of BJT, FET, UJT and photo devices
- Model the electronics circuits using SPICE software and analyze their characteristics.
- Apply various electronic devices in circuit design for practical applications.
- Do mini projects using sensors and devices.

SEMESTER III

MAC 2181	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Familiarize in solving partial differential equation of first, second and higher orders.
- Introduce basics and engineering applications of Fourier series, Laplace Transform, Fourier Transform and Z- Transform.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

MODULE II FOURIER SERIES 8+2

Fourier Series and Dirichlet's conditions - General Fourier series - Half range Fourier series - Parseval's identity - Harmonic Analysis.

MODULE III FOURIER TRANSFORMS 7+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS 7+3

Applications of Fourier series and Fourier Transform to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete & point Spectrum and Single pulse.

MODULE V LAPLACE TRANSFORM 8+2

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with unrepeatd complex factors – Damped forced vibrations: repeated complex

factors – Resonance - Solution of differential equations.

MODULE VI Z – TRANSFORM

7+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Kreyszig .E., “Advanced Engineering Mathematics“, 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., “Higher Engineering Mathematics”, 42nd edition, Khanna Publishers, New Delhi, 2012.
3. Ramana, B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

REFERENCES:

1. Veerarajan.T., “Engineering Mathematics“, 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O’Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

- solve the partial differential equations.
- derive a Fourier series of a given periodic function by evaluating Fourier coefficients.
- apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms.
- solve wave equation and heat flow equation.
- solve ordinary differential equations using Laplace transform.
- solve difference equation using Z-transform.

ENC 2181	ORAL COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To expose students to a range of professional contexts through podcasts for learning appropriate expressions.
- To train them in making poster presentations.
- To enable them to make effective business presentations.
- To help them learn persuasive and negotiation skills.
- To train them to debate on issues of current relevance
- To train them to participate in group discussions on current affairs

MODULE I **4**

Orientation to the Importance of Oral Communication -- Verbal and non-verbal communication -Paralinguistic features.

One-minute presentations (using Audacity/Voicethread) – Just a minute (JAM) on random topics

MODULE II **4**

Negotiating and persuading through effective arguments – to arrive at a conclusion (pair-work)

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI**6**

Making full length presentation (through Voicethread) with the focus on one's career plans and prospects (discipline specific)

Listening to interviews for understanding speakers' perception (on industry related issues)

P – 30; Total Hours –30**REFERENCES:**

1. Hancock, Mark (2012). *English Pronunciation in Use*. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). *Study Speaking: A Course in Spoken English for Academic Purposes* (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). *Personality Development*. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). *English and Soft Skills*. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate*. Cambridge University Press, UK.

OUTCOMES:

On completion of the course, students will be able to

- Listen to business conversations and do related tasks.
- Deliver effective poster presentations.
- Make effective business presentations.
- Use persuasive and negotiating skills for justifying arguments.
- Participate effectively in debates.
- Speak English intelligibly, fluently and accurately in group discussions.

ECC2101	ELECTRONIC CIRCUITS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the biasing concepts of BJT, JFET and MOSFET
- To familiarize the design and analysis of BJT and FET amplifiers.
- To study the feedback amplifiers and oscillators.
- To impart knowledge on Tuned amplifiers, Power amplifiers, Multivibrators, blocking oscillators and time based generators.

PREREQUISITES:

- Basic concepts on Network analysis
- Basic knowledge on Electronic devices

MODULE I BIASING CIRCUITS 6+2

DC Load line, operating point, various biasing methods for BJT-Design-Stability-Bias compensation Biasing circuits of BJT, JFET and MOSFET.

**MODULE II SMALL SIGNAL ANALYSIS AND FREQUENCY 9+3
RESPONSE OF AMPLIFIERS**

Small signal models of BJT and MOSFET, Small signal Analysis of Common Emitter, Common Collector and common Base amplifiers. Small signal analysis of FET amplifiers, AC Load line, Voltage swing limitations, Differential amplifiers. Low frequency response of BJT and FET amplifiers-high frequency response of BJT and FET amplifiers, Miller effect capacitance.

MODULE III FEEDBACK AMPLIFIERS AND OSCILLATORS 9+3

Basic feedback concepts - Properties of Negative feedback -Four feedback topologies with amplifier circuit. Examples - Analysis of series - shunt feedback amplifiers.

Oscillators :Barkhausen criteria for oscillator - Analysis of RC oscillators - LC oscillators –Crystal oscillator

MODULE IV POWER AMPLIFIERS AND TUNED AMPLIFIERS 7+3

Classification of large signal amplifiers – Class A amplifier– Class B amplifier – Class AB amplifier– Class C amplifier and Efficiency – Thermal stability and heat sink-Basic principles - Inductor losses - Use of transformers – Single tuned amplifier - Double tuned amplifier - Synchronously tuned amplifiers-impedance matching to improve gain.

MODULE V MULTIVIBRATOR CIRCUITS 7+2

Collector coupled and Emitter coupled Astable multivibrator – Monostable multivibrator- Bistable multivibrators. Triggering methods: Storage delay and calculation of switching times - Speed up capacitors - Schmitt trigger circuit.

**MODULE VI BLOCKING OSCILLATORS AND TIME BASE 7+2
 GENERATORS**

Pulse transformers - Monostable Blocking Oscillators using Emitter and base timing - Astable blocking oscillator - Voltage sweep generators - Current sweep generators

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Boylested and Nashlesky, "Electronic Devices and Circuit theory", 11th edition, Prentice Hall of India, 2015.
2. Donald .A.Neamen, "Electronic Circuit Analysis and Design" 2nd edition, Tata McGraw Hill, 2009.
3. David A. Bell, "Solid State Pulse Circuits", 4th edition, Eastern economic edition, Prentice Hall of India, 2006.
4. D. L. Schilling, C. Belove, Tuvia Apelewicz and Raymond J Saccardi, "Electronic Circuits: Discrete and Integrated", Tata McGraw Hill, 2002.

REFERENCES:

1. Adel.S.Sedra, Kenneth C. Smith, Micro Electronic circuits, 6th Edition, Oxford University Press, 2010.
2. David A. Bell Electronic Devices and Circuits, Oxford Higher Education press, 5th Edition, 2010
3. Millman .J. and Halkias C.C, Integrated Electronics, McGraw Hill, 2001.
4. Millman J. and Taub H., "Pulse Digital and Switching waveform", 3rd Edition McGraw-Hill International, 2000.

OUTCOMES:

On completion of the course, students will be able to

- Calculate the DC voltages and currents of an amplifier.
- Design and analyze the BJT and FET amplifiers
- Classify and construct the feedback amplifiers and oscillators.
- Estimate lower and upper cut off frequencies of an amplifier.
- Explain the concepts of tuned amplifiers and power amplifiers.
- Design and develop circuits to generate non-sinusoidal waveforms.

ECC2102**SIGNALS AND SYSTEMS**

L	T	P	C
3	0	2	4

OBJECTIVES:

- To introduce the concepts of Signals and Linear Time-Invariant Systems
- To illustrate various Transform such as Fourier, Laplace, Z-Transform etc. for signal processing applications
- To interpret the signals and it's processing through computer simulation.

PREREQUISITES:

- Fundamentals of Engineering Mathematics
- Basic knowledge in computer programming

MODULE I INTRODUCTION TO SIGNALS**8+5**

Time-Domain Representation of Discrete and Continuous Signals. Standard elementary signals - and complex signal. Basic Time-Domain operations on signals. Energy, Power and Correlation of signals. Signal Classification and Symmetry. Periodicity of discrete-time signals. Synthesis of simple signals.

Practical Exercises:

1. Generation of standard signals using MATLAB
2. Energy & Power Estimation of signals
3. Even and Odd Components of the signal.

MODULE II INTRODUCTION TO LTI SYSTEMS**7+5**

Continuous-Time and Discrete-Time Systems. Characteristics of Systems. Linear and Time-Invariant (LTI) Systems and its Properties. Impulse Response, convolution sum and convolution integral. Interconnection of LTI Systems. Differential and Difference Equation representation of LTI systems.

Practical Exercises:

4. Correlation of signals
5. Convolution of DT and CT signals
6. Functional Implementation of a given LTI System

MODULE III FOURIER SERIES AND FOURIER TRANSFORM ANALYSIS**6+5**

Fourier Series representation of signals. Properties of Fourier Series. Continuous-Time Fourier Transform and its properties. Frequency Response of CT-LTI

Systems. Discrete-Time Fourier Transform (DTFT) and its properties. Discrete Fourier Transform (DFT) and its properties.

Practical Exercises:

7. DFT of CT and DT signals
8. FFT
9. Power Spectral Density
10. First Order Low-Pass and High Pass-Filters

MODULE IV LAPLACE TRANSFORM ANALYSIS 5+5

Unilateral and Bilateral Laplace Transform. Region of Convergence (ROC), Properties of Laplace Transforms. Poles and Zeros. Inverse Laplace Transformation. The Transfer Function and Frequency Response of CT-LTI Systems.

Practical Exercises:

11. Laplace & Inverse Laplace Transform
12. Plotting of poles and zeros.

MODULE V Z- TRANSFORM ANALYSIS 9+5

Z-Transform. Z-Plane and ROC. Properties of Z-Transform. Poles and Zeros. Methods for Inverse Z-Transform. Transfer Function of DT-LTI Systems. Causality and Stability.

Practical Exercises:

13. Z- Transform of Time limited signals
14. Impulse response of given DT Systems.
15. Plotting of poles and zeros.

MODULE VI APPLICATION OF TRANSFORMS 10+5

Application of Fourier Transform to communication systems - Spectrum of AM, DSB and SSB AM. Computational Structures for Implementing Discrete-Time LTI systems using z-Transform.

Practical Exercises:

16. Generation of AM signal and it's spectrum.
17. Generation of DSB – AM signal and it's spectrum
18. First order and Second order Butterworth Filters

L – 45; P – 30; Total Hours –75

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky , with S. Hamid Nawab, "Signals and Systems", 2nd Edition, Pearson Education, 2015. (ISBN: 9789332550230)
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India Pvt Ltd., 2007. (ISBN: 9788126512652)

REFERENCES:

1. Hwei P. Hsu, "Signals And Systems", 3rdEdition,Schaum's Outlines, McGraw Hill Education, 2017.
2. Won Young Yang, "Signals and Systems with MATLAB", 1st Edition, Springer, 2011.
3. Simon Haykin & Michael Moher, "Communication Systems", 5th Edition, Wiley India Pvt Ltd., 2009.
4. John G. Proakis & Dimitris G Manolakis , "Digital Signal Processing : Principles, Algorithms, and Applications", 4 Edition, Pearson India, 2007.

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

- Mathematically represent and classify the signals
- Evaluate and manipulate signals mathematically.
- Identify, and characterize common LTI Systems.
- Apply the tools such as Fourier Transform, Laplace Transform, and Z-Transform in problem solving.
- Synthesize discrete-time systems from basic component block
- Justify the spectral behavior of communication systems.

ECC2103	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the methods for simplifying Boolean expressions.
- To learn the procedures for the analysis and design of combinational circuits and sequential circuits.
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concepts of HDL

PREREQUISITES:

- Knowledge on Boolean Algebra
- Knowledge on Number System
- Familiarity in Electronics

MODULE I BOOLEAN ALGEBRA AND LOGIC GATES 8

Binary number systems- Binary Arithmetic- Binary codes-Boolean algebra and theorems- Boolean functions- Karnaugh map and Quine- Mc Cluskey Method-Logic gates-Implementations of Logic Functions using gates. Digital IC families -DTL, TTL, ECL, MOS, CMOS.

MODULE II COMBINATIONAL CIRCUITS 8

Analysis and design procedures- Circuits for arithmetic operations - Multiplexer/ Demultiplexer- Encoder / decoder - Parity checker- Code converters.

MODULE III FUNDAMENTALS OF SEQUENTIAL CIRCUITS 10

Edge triggering – Level Triggering, Flip flops- SR, JK, T, D, Master slave– Conversion of flip flops, Counters, Shift registers – Types.

MODULE IV SEQUENTIAL CIRCUITS DESIGN 8

Classification of sequential circuits - Moore and Mealy circuits-Analysis and Design of sequential circuits, Asynchronous sequential circuits-Hazards, Hazards elimination.

MODULE V SEMICONDUCTOR MEMORIES 6

Memory organization, Classification, and characteristics of memories, Sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array, CPLD and FPGA architectures.

MODULE VI INTRODUCTION TO VERILOG HDL 5

Introduction to Verilog HDL, Language Constructs and Conventions, Gate Level Modeling, Modeling at Dataflow Level, Behavioral Modeling, Switch Level Modeling.

Total Hours – 45

TEXT BOOKS:

1. M. Morris Mano ,Michael D. Ciletti "Digital Design With an Introduction to the Verilog HDL",5th Edition, Pearson Education, 2013
2. William Stallings, "Computer Organization and Architecture", 8th Edition, Pearson Education Asia, 2010.

REFERENCES:

1. Charles H. Roth, "Fundamentals of Logic Design", 7th Edition, Global Engineering: Tim Anderson, 2014.
2. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.
3. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 4th Edition. New Delhi, 2010.
4. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education, Inc, New Delhi, 2008
5. Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill Publishing company limited, New Delhi, 2003.

OUTCOMES:

On completion of the course, students will be able to

- Describe concepts and terminology of digital electronics
- Formulate and employ a Karnaugh map to reduce Boolean expressions
- Analyze and design digital combinational circuits and sequential circuits
- Design digital circuits for various applications
- Implement combinational logic circuits using programmable logic devices
- Develop HDL codes for various digital circuits

dielectrics - Propagation in good conductors - Skin effect. Linear, Elliptical and circular polarization - Reflection of Plane Wave from a conductor-normal incidence - Reflection of Plane Waves by a perfect dielectric - normal and oblique incidence. Dependence on Polarization. Brewster angle.

MODULE IV WAVE PROPAGATION IN TRANSMISSION LINES 7+3

Lumped and distributed element models of transmission lines, characteristic impedance, terminated transmission line - reflection coefficient, wavelength and velocities of propagation, Transfer Impedance, Standing waves, Impedance matching, Smith Chart - impedance and admittance chart, scattering matrix.

MODULE V WAVE PROPAGATION IN GUIDED MEDIUM 8+2

Planar waveguides, TE and TM waves - characteristics, velocities of propagation, Rectangular waveguides - dominant mode, cut-off wavelength, phase velocity, group velocity, characteristic impedances,

MODULE VI RADIO WAVE PROPAGATION 4+2

The three basic types of propagation; ground wave, space wave and sky wave propagation. Wave tilt of surface wave, Tropospheric wave, Structure of atmosphere, ionospheric propagation, virtual height, critical frequency, MUF, space wave propagation, ground wave propagation, forward scatter propagation.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. M.N.O.Sadiku: "Elements of Engineering Electromagnetics", 4th Edition, Oxford University Press, 2007.
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall Int., 2009.
3. John D Ryder, "Networks, Lines and Fields", 2nd Edition, Pearson India, 2015.
4. William H.Hayt "Engineering Electromagnetics", 8th Edition, Tata McGraw - Hill, 2014

REFERENCES:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas and Wave Propagation", 3rd Edition, Tata McGraw Hill, 2006.
2. David M.Pozar, "Microwave Engineering", 4th Edition, John Wiley, 2013.
3. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics", 3rd Edition, John Wiley & Sons, 2003

OUTCOMES:

On completion of the course, students will be able to

- Recall the basic laws of Electromagnetic theory
- Solve the static and time varying electric and magnetic fields for practical applications.
- Characterize the EM waves in free space and at different boundaries.
- Analyze the wave propagation in different mediums.
- Explain the basic concepts of Transmission lines and waveguides
- Illustrate the types of wave propagation

ECC2105	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To design the biasing circuits for FET and BJT.
- To obtain the characteristics of common emitter and common collector amplifiers.
- To design multistage amplifiers and oscillators.
- To use modern tools for PCB layouts of electronic circuits.
- To design, simulate and verify the performance of electronic circuits.

PRE-REQUISITES:

- Knowledge on basic concepts of electron Devices and its applications

LIST OF EXPERIMENTS:

1. Design of Biasing networks for BJT & FET and find the operating points & verification using SPICE / Cadence software.
2. Design & Determination of frequency response, input impedance and output impedance of CE amplifier.
3. Design & Determination of frequency response, input impedance and output impedance of CS amplifier.
5. Determination of frequency response, input impedance and output impedance of two stage RC Coupled Amplifier, Darlington amplifier.
6. Determination of CMRR of Differential amplifier.
7. Design and Analysis of Feedback Amplifiers
8. Design of Class C Single Tuned Amplifier
9. Determination of frequency response, input impedance and output impedance of Cascode amplifier
10. Design and Verification of Oscillators
11. Design and fabrication of PCB for basic circuits.

Total Hours –30**REFERENCES:**

1. Paul Horowitz and Thomas C. Hayes, "Learning the Art of Electronics: A Hands-On Lab Course Book", Cambridge university press, first edition, 2016.
2. S.V. Subrahmanyam , "Experiments in Electronics Paperback" New Central Book Agency Pvt Ltd, 2011.

3. Owen Bishop, "Electronics - Circuits and Systems", Elsevier publication, 4th Edition, 2010.

4. John Keown "OrCAD PSpice and Circuit Analysis, Pearson Publication, 4th edition, 2000.

OUTCOMES:

On completion of the course, students will be able to

- Design the biasing circuit for BJT and FET circuits for given operating points and stability factors.
- Design RC coupled amplifier and Darlington amplifiers for better gain values.
- Design RC and LC type oscillators for different frequency.
- Design tuned amplifier for any given frequency.
- Design PCB layout for simple electronics circuits using modern software tools.

ECC2106	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To design and implement the Combinational circuits.
- To verify the functionalities of Flip-flops.
- To design and implement sequential circuits.
- To simulate the Verilog programs using simulators.

PRE-REQUISITES:

- Basic knowledge on digital theory
- Familiarity with logic gates, digital electronic devices and its building blocks

LIST OF EXPERIMENTS:

1. Design and implementation of combinational circuits using logic gates.
2. Design and implementation of 4 bit binary Adder/ subtractor and BCD adder using IC7483.
3. Design and implementation of 2-Bit Magnitude Comparator using logic gates & 8 Bit magnitude Comparator using IC 7485.
4. Design and implementation of 16 bit odd/even parity checker generator using IC 74180.
5. Verification of state tables of R-S flip-flop, J-K flip-flop, T Flip-Flop, D Flip-Flop Using NAND and NOR gates.
6. Design and implementation of asynchronous and synchronous counters.
7. Design and Implementation of shift registers using Flip- flops.
8. Simulation of combinational and sequential circuits using Verilog HDL.
9. Mini project

Total Hours –30**REFERENCES:**

1. M. Morris Mano ,Michael D. Ciletti “Digital Design With an Introduction to the Verilog HDL”,5th Edition, Pearson Education, 2013
2. Charles H. Roth, "Fundamentals of Logic Design", 7th Edition, Global Engineering: Tim Anderson, 2014.
3. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009

4. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 4th Edition. New Delhi, 2010.

OUTCOMES:

On completion of the course, students will be able to

- Analyze and design digital logic circuits applying the knowledge of number systems, codes and Boolean algebra.
- Design simple combinational circuits containing logic gates, multiplexer, encoder and decoder
- Design simple sequential circuits containing latch circuit and flip-flop circuits.
- Identify, formulate and solve engineering problems in the area of digital logic circuit design to meet desired needs within realistic constraints.
- Use the techniques, skills and modern engineering tools such as logic works and Verilog HDL, necessary for engineering practice
- Function on multi-disciplinary teams through digital circuit experiments and projects

SEMESTER IV

ENC 2282	WRITTEN COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To expose them to reading for specific purposes, especially in professional contexts.
- To expose them to the process of different kinds of formal writing.
- To help them learn corporate correspondence for different purposes.
- To train them in preparing effective applications with résumé
- To make them write different types of reports.

MODULE I **4**

Introduction - process of writing – Fundamentals of academic and professional writing – Understanding short, real world notices, messages, etc.

MODULE II **4**

Reading industry related texts (ex. Manufacturing, textile, hospitality sector etc.) for specific information.

Writing Instructions and recommendations

MODULE III **6**

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting.

Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV **6**

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter

Writing Functional résumé and letter of application using Edmodo,

MODULE V **6**

Viewing a Video and reading a case study (industry specific) – collaborative writing using Edmodo –reading and information transfer

Writing reports- Survey, feasibility and progress – exposure to discipline specific

reports

MODULE VI

4

Writing Statement of purpose (Higher Education)-- Justifying and writing about one's preparedness for job (Statement of Purpose highlighting strengths and weaknesses) – Peer evaluation skills through Edmodo.

P – 30; Total Hours –30

REFERENCES:

1. Riordan,D (2013). *Technical Report Writing Today*. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J.(2012). *Writing that Works: Communicating Effectively on the Job* . Bedford/St. Martin's. Eleventh Edition.
3. Garner, B.A. (2013). *HBR Guide to Better Business Writing (HBR Guide Series)*. Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). *Business Correspondence and Report Writing*. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). *Academic and Professional Writing for Teachers*. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate*. Cambridge University Press, UK.

OUTCOMES:

On completion of the course, the students will have the ability to

- Identify content specific vocabulary and also use them in appropriate contexts.
- Demonstrate reading skills with reference to business related texts.
- Draft professional documents by using the three stages of writing.
- Create different types of documents for various corporate correspondences.
- Write effective letter of applications, résumé and statement of purpose.
- Write business related reports efficiently.

ECC2201	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- Implementation of discrete Fourier transform and its applications in digital Filter design.
- Familiarize on design of FIR and IIR Digital filters.
- To understand the concept of quantization noise and its effects in multi-rate signal processing.
- To introduce signal processing concepts in systems having more than one sampling frequency.
- To study the architecture and features of digital signal processor

PRE-REQUISITES:

- Knowledge on Signals and systems

MODULE I DISCRETE FOURIER TRANSFORM 8+3

Introduction to Discrete Fourier Transform, Direct computation of DFT and Inverse DFT, Properties of DFT, Radix-2FFT algorithms -Decimation in Time, Decimation in Frequency algorithms.

MODULE II DESIGN AND IMPLEMENTATION OF IIR FILTERS 8+3

Design of Low Pass Butterworth filters & Chebyshev filters- analog to analog transformation - Analog to digital transformation, Bilinear transformation - prewarping, Impulse invariant transformation.

MODULE III DESIGN AND IMPLEMENTATION OF FIR FILTERS 8+3

Amplitude and phase responses of FIR filters - symmetric and anti-symmetric impulse response, Frequency response of FIR filters, Linear phase filters - Windowing techniques for design of Linear phase FIR filters - Rectangular, Hamming, Hanning windows.

MODULE IV FINITE WORD LENGTH EFFECTS 8+3

Representation of numbers - Fixed point and binary floating point number representation - comparison, errors due to truncation and rounding- off, Quantization noise - derivation for quantization noise power at the input and output of a digital filter, Co-efficient quantization error -product quantization error, Round-off effects in digital filters, Limit cycle oscillation.

MODULE V MULTIRATE DIGITAL SIGNAL PROCESSING 8+3

Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, Sampling rate conversion by a rational factor, Time and frequency domain descriptions - Quadrature Mirror Filter banks - Sub-band Coding.

MODULE VI DIGITAL SIGNAL PROCESSORS 5

Introduction to DSP processor - Harvard and Von Neumann architecture - Pipelining - Architecture of TMS320C5X and C54X, Overview of instruction set of TMS320C5X and C54X.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. John G Proakis, Dimtris G Manolakis, "Digital Signal Processing Principles, Algorithms and Application", 4th Edition, PHI, 2009.
2. B.Venkataramani, M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application", 2nd Edition, TMH 2002.

REFERENCES:

1. Alan V Oppenheim, Ronald W Schafer, John R Back, "Discrete Time Signal Processing", 2nd Edition, PHI, 2000.
2. Avtar Singh, S.Srinivasan, "DSP Implementation using DSP microprocessor with Examples from TMS32C54XX", 3rd Edition, Thomson / Brooks Cole Publishers, 2003.
3. Johny.R.Johnson, "Introduction to Digital Signal Processing", 2nd Edition, Prentice Hall, 2002.
4. S.K.Mitra, "Digital Signal Processing- A Computer based approach", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.

OUTCOMES:

On completion of the course, students will be able to

- Represent discrete-time signals in the frequency domain, using z-transform and discrete Fourier transform (DFT).
- Analyze the basic forms of FIR and IIR filters and, to design filters with desired frequency responses.
- Analyze the effect of finite word length in the DSP systems.
- Implement the multirate processing fundamentals using decimation and interpolation.
- Illustrate the basic architecture of digital signal processors.
- Apply digital signal processing concepts in audio, video signals etc.

ECC2202	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the characteristics and internal circuit of op-amps.
- To Characterize the differential amplifiers and current sources
- To design the various linear and non-linear applications of op-amps.
- To design and characterize the data converters and active filters.
- To explain and characterize the special purpose ICs like PLL, Timer IC, voltage regulators, switched capacitor filters.

PREREQUISITES:

- Comprehensive knowledge in Network Analysis and Synthesis
- Knowledge in Electronic circuits

MODULE I INTRODUCTION AND CIRCUIT CONFIGURATION OF 8
LINEAR ICS

OP-AMP fundamentals, differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics, basic building blocks of OP-AMP.

Feedback Amplifiers: General feedback structure, properties of negative feedback, basic feedback topologies, determination of loop-gain, stability problem.

MODULE II LINEAR APPLICATIONS OF OPERATIONAL 8
AMPLIFIERS

Linear circuits using operational amplifiers and their analysis: virtual ground, Inverting and non-inverting modes; adder, subtractor, difference amplifier; common mode rejection ratio (CMRR), Differentiator, Integrator, V to I converter and I to V converter, Instrumentation Amplifier, sine wave Oscillators, Log and Antilog amplifiers. Designing linear power supply using op amp.

MODULE III NON LINEAR APPLICATIONS OF OPERATIONAL 8
AMPLIFIERS AND ANALOG MULTIPLIER

Precision rectifier, Comparator, Application of comparator, Schmitt trigger, Multivibrators, Triangular wave generator. Analysis of four quadrant (Gilbert cell) and variable trans conductance multiplier, DC analysis of Gilbert multiplier cell, Application of Gilbert cell as complete analog multiplier, modulator and phase detector.

MODULE IV DAC and ADC 7

Analog switches, High speed Sample and Hold circuit. DAC techniques: Weighted Resistor, R-2R ladder, Inverted R-2R ladder, ADC techniques: Flash type, Counter type, Successive approximation, Single slope and Dual slope. DAC and ADC specifications - Linearity, accuracy, Monotonicity, Settling time and stability.

MODULE V TIMER IC AND PLL 8

555 timer IC, Applications: Astable and Monostable operation, Active filters, PLL and Closed loop analysis of PLL, Applications of PLL: Frequency translation, AM, FM and FSK modulators and demodulators.

MODULE VI SPECIAL PURPOSE ICS 6

IC Voltage regulators – General purpose ,variable regulator Switched capacitor filter- IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, fiber optic IC- IC transducers.

Total Hours – 45**TEXT BOOKS:**

1. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 2nd Edition, New Age International Pvt. Ltd., 2011.
2. Gray and Meyer, 'Analysis and Design of Analog Integrated Circuits', 4th Edition, Wiley International, 2009.
3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", TMH. 2007.

REFERENCES:

1. J. Michael Jacob, 'Applications and Design with Analog Integrated Circuits', 4th Edition, Prentice Hall of India, 1996.
2. Ramakant A. Gayakwad, 'OP-AMP and Linear IC's', 3rd Edition, Prentice Hall / Pearson Education
3. Millman.J. and Halkias.C.C. 'Integrated Electronics', 2nd Edition, McGraw-Hill, 1972.
4. William D. Stanely, 'Operational Amplifiers with Linear Integrated Circuits'. 4th Edition, Pearson Education, 2004
5. Sedra & Smith, "Micro Electronic Circuits", 5th Edition, Oxford University Press, 2004.

OUTCOMES:

On completion of the course, students will be able to

- Determine the difference between ideal and practical AC & DC characteristics of an Operational Amplifier.
- Differentiate linear and non-linear applications of operational amplifiers
- Generate waveforms using Op-Amp.
- Identify the special purpose ICs
- Apply IC 555 and PLL for different applications
- Design and analyze a circuit using ICs, based on the requirement.

ECC2203	COMMUNICATION THEORY AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce various continuous wave modulation techniques.
- Differentiate all types of amplitude modulation systems based on transmission bandwidth, transmitted power and system complexity
- Apply the knowledge of vestigial side band modulation in television system.
- Compare amplitude modulation and angle modulation with respect to performance parameters.
- Analyze the noise performance of various analog receivers.
- Distinguish various pulse modulation and Multiplexing techniques.

PREREQUISITES:

- Fundamentals of Electronic circuit design and its function
- Knowledge on Signals and Systems and Random Process

MODULE I AMPLITUDE MODULATION 8

Overview of communication systems-electromagnetic spectrum-ranges and application areas. Need for modulation, Principles of amplitude modulation. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

MODULE II SSB AND VSB MODULATION 8

Single side-band modulation - Phase discrimination method for generating an SSB modulated wave, Demodulation of SSB waves. Vestigial side band modulation - Generation of VSB modulated wave, Envelop detection of VSB wave plus carrier, Frequency translation, Frequency division multiplexing, Application: Radio broadcasting, AM radio.

MODULE III ANGLE MODULATION 8

Angle modulation - Frequency modulation, transmission bandwidth of FM signals, frequency spectrum, phase modulation, relationship between FM&PM, narrow band FM & wide band FM. Generation of FM waves: direct method, indirect method of FM generation. Detection of FM waves: Balanced frequency discriminator, Zero

crossing detectors, Phase locked loop, Fosterseely discriminator, ratio detector.

MODULE IV NOISE THEORY 7

Sources of noise - shot noise, thermal noise, white noise, Noise bandwidth, Noise temperature, Noise figure - Measurement of noise figure, Signal in presence of noise, Narrow band noise. Noise in continuous wave modulation-Noise in SSB and DSB - SC receiver, Noises in AM receiver threshold effect.

MODULE V PULSE MODULATION AND MULTIPLEXING TECHNIQUES 7

Sampling of Signals- Pulse modulation - Generation and detection of PAM, PWM and PPM. Multiplexing- TDM, FDM.

MODULE VI BROADCAST AND TELEPHONE SYSTEMS 7

AM and FM radio broadcast systems, Television systems and scanning principles, TV signal transmission and reception, Telephone systems.

Total Hours – 45

TEXT BOOKS:

1. Simon Haykin, "Communication System", 5th Edition, John Wiley & Sons, 2009.
2. A. Bruce Carlson, Paul B. Crilly, "Communication Systems" McGraw-Hill , 5th Edition, 2011
3. Taub & Schilling, Gautam Sahe, "Principles of Communication Systems", 3rd Edition, TMH, 2008.
4. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", 6th Edition, Pearson Education, 2007.
5. R.R. Gulati "Modern Television Practice: Principles, Technology and Servicing" 2nd edition, New Age International Publications – 2007

REFERENCES:

1. Roddy and Coolen, "Communication Systems", 4th Edition, PHI learning, New Delhi, 2003.
2. George Kennedy and Bernard Davis, "Electronic Communication Systems", 4th Edition, Tata McGraw Hill, 2008.
3. K.N.Hari Bhat & Ganesh Rao, "Analog communications", 2nd Edition, Pearson Publication, 2008.

4. J.G. Proakis and M. Salehi, Communication Systems Engineering, 2nd Edition, Prentice Hall, 2002.
5. A.M.Dhake "TV and Video Engineering" Tata Mcgraw Hill,2001

OUTCOMES:

On completion of the course the students will be able to

- Explain continuous wave modulation techniques.
- Differentiate and analyze the performance of AM, DSB-SC, SSB and VSB systems.
- Compute the performance parameter for noise analysis in various analog receivers
- Design different types of pulse modulation system and its multiplexing techniques.
- Apply suitable analog / pulse modulation techniques for signal transmission.
- Describe the television system and scanning principles.

ECC2204	MICROPROCESSORS & MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate the architecture of 8085 & 8086 microprocessors.
- To introduce the programming and interfacing techniques of 8086 microprocessor.
- To analyze the basic concepts and programming of 8051 microcontroller
- To develop the interfacing circuits for various applications of 8051 microcontroller
- To make use of ARM board for various applications

PREREQUISITES:

- Knowledge on Digital Electronics.

MODULE I ARCHITECTURE OF 8086 MICROPROCESSOR 8

Introduction to the architecture of 8085 Microprocessor, 8086 Microprocessor – Architecture - Register Organization - Memory Organization - Minimum Mode bus cycle - Maximum Mode bus cycle -Timing Diagram - Interrupts & Service Routine.

MODULE II PROGRAMMING OF 8086 6

Addressing modes - Instruction set – Data transfer instructions, Arithmetic Instructions, Logical instructions, String manipulation instructions and control transfer instructions - Assembly language Programming.

MODULE III INTERFACING WITH 8086 MICROPROCESSOR 9

Memory interfacing - Interfacing with peripheral ICs like 8251 - serial I/O, 8255-parallel I/O, 8254-programmable interval timer, 8279-Keybaord display controller, 8257-DMA, LEDs, LCDs, ADCs and DACs.

MODULE IV 8051 MICROCONTROLLER 8

Architecture of 8051 – Special Function Registers (SFRs) – I/O Ports and Memory organization – Instruction set – Addressing modes – Assembly language programming.

MODULE V INTERFACING WITH 8051 MICROCONTROLLER 8

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory

Interface - Stepper Motor interface.

MODULE VI INTRODUCTION TO ARM PROCESSOR 6

ARM architecture - ARM Organization and Implementation - ARM Instruction Set.

Total Hours – 45

TEXT BOOKS:

1. A.K. Ray and K.M.Burchandi, "Advanced Microprocessors and Peripherals (Third Edition)", McGraw Hill International Edition, 2012.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education Asia, New Delhi, 2003.
3. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, University of Manchester, Addison-Wesley Professional, 2001.

REFERENCES:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.
2. Kenneth J Ayala, "The 8051 Microcontroller Architecture Programming and Application", 2nd Edition, Penram International Publishers (India), New Delhi, 1996.
3. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.

OUTCOMES:

On completion of the course, students will be able to

- Illustrate the organization of registers and memory in microprocessors and microcontroller.
- Prioritize interrupts for executing the respective ISR.
- Identify the addressing mode and calculate the number of T-states required for the execution of an instruction
- Develop assembly language programs suitable for real time applications using microprocessors / microcontroller.
- Explain the different interfacing devices.
- Design and develop applications using ARM boards.

ECC2205	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To introduce the concept of Assembly Language Programming (ALP).
- To develop skills in assembly language programming to interface 8086 with various modules.
- To familiarize students on programming and interfacing of 8051 Microcontroller.
- To introduce applications using ARM board.

PREREQUISITES:

- Knowledge on Digital Electronics.
- Comprehensive knowledge on the instruction set of 8086 Microprocessor & 8051 Microcontroller.

LIST OF EXPERIMENTS:**8086 Microprocessor basic programs**

1. 16 bit Arithmetic operation
2. Sorting of an array

8086 Microprocessor interfacing programs

3. Stepper motor interface
4. Generate an interrupt using 8253 timer.
5. Program to display a string of characters using Keyboard display (8279).
6. Interfacing PPI (8255).

8051 Microcontroller basic and interfacing programs

7. 16 bit Arithmetic operation
8. Interfacing ADC
9. Interfacing DAC
10. Communication between 8051 kit and PC using USART (8251)
11. Interfacing Traffic Light Control
12. Study on ARM Processor

Total Hours – 30**REFERENCES:**

1. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.
2. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design", Second Edition, Prentice

Hall of India, 2007.

3. A.K. Ray and K.M.Burchandi, "Intel Microprocessors Architecture Programming and Interfacing", 2nd Edition, McGraw Hill International Edition, 2000.
4. William Hohl and Christopher Hinds "ARM Assembly Language: Fundamentals and Techniques", Second Edition, CRC Press is an imprint of Taylor & Francis Group, 2015.

OUTCOMES:

On completion of the course, students will be able to

- Develop the assembly language program for the basic arithmetic and logical operations of 8086 Microprocessor and 8051 Microcontroller.
- Interface different peripheral devices with Microprocessor/Microcontroller.
- Analyze the errors during the execution of program.
- Develop applications using Microprocessor/Microcontroller based systems.
- Interface Microcontroller and PC.
- Design and develop programs for various applications using Microprocessor/ Microcontroller.

ECC2206**DIGITAL SIGNAL PROCESSING
LABORATORY****L T P C
0 0 2 1****OBJECTIVES:**

- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

PREREQUISITES:

- Basic concepts of Signals and systems
- Fundamentals of various transforms.

LIST OF EXPERIMENTS USING SIMULATION TOOL

1. Frequency response of LTI system.
2. Linear convolution/Circular convolution
3. Discrete Fourier Transform & Fast Fourier Transform
4. Design of IIR filter using Impulse invariant and Bilinear transformation
5. Design of FIR filter using windows
6. Sampling and reconstruction of a signal
7. Sampling rate conversion-interpolation & decimation.

LIST OF EXPERIMENTS USING DSP PROCESSOR

8. Linear convolution using TMS320C54X
9. Circular convolution using TMS320C54X
10. Discrete Fourier Transform using TMS320C54X
11. Inverse Discrete Fourier Transform using TMS320C54X
12. Mini project

Total Hours – 30**REFERENCES:**

1. S.K.Mitra, "Digital Signal Processing- A Computer based approach", 4th Edition Tata McGraw-Hill, New Delhi, 2013.
2. Nasser kehtarnavaz and Namjin Kim, "Digital Signal processing system-level design using LabVIEW", Newnes- Elsevier, 2005.
3. B.Venkataramani, M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application", 2nd Edition, TMH 2002.

OUTCOMES:

On completion of the course, students will be able to

- Use DSP tools to analyze discrete time signals and systems
- Analyze the properties of discrete time signals and systems and identify its implication for practical systems.
- Evaluate and plot the frequency, magnitude and phase response of linear time-invariant systems using simulation tools.
- Evaluate the discrete Fourier transform (DFT) of a sequence, use the FFT to compute DFT and implement using DSP processor.
- Implement convolution using DSP processor.
- Design digital IIR and FIR filter.

ECC2207**LINEAR INTEGRATED CIRCUITS
LABORATORY****L T P C****0 0 2 1****OBJECTIVES:**

- To understand the characteristics of operational amplifier
- To categorize the linear integrated circuits and available ICs with its basic functionalities
- To apply operational amplifiers in linear and nonlinear applications
- To acquire the basic knowledge of special function ICs like PLL, regulators
- To use Elvis board and SPICE, Netlist software for circuit design
- To become skilled with the functions of linear integrated circuits

PREREQUISITES:

- Basic knowledge on circuits and circuit theory
- Knowledge on dual power supply connections.

LIST OF EXPERIMENTS:**DESIGN AND TESTING OF**

1. Inverting and Non-Inverting Amplifiers and Voltage follower – Application as Buffer/Isolator.
2. Adder, Subtractor, Difference amplifier, Integrator, Differentiator – Application of Analog computation.
3. Instrumentation Amplifier – Signal extraction from sensor and measurement of CMRR
4. Active Butterworth Filters – As distortion eliminators in Audio amplifiers
5. Multivibrators and Schmitt Trigger using operational amplifier – Function generator
6. Phase shift and Wien bridge oscillators using operational amplifier – Variable low frequency generator.
7. Design of Multivibrators using 555 timer – Clock Pulse generator.
8. PLL characteristics and its application as Frequency Multiplier.
9. DC power supply using LM317 and LM723.
10. Study of SMPS
11. Simulation using PSpice, Netlist of above experiments
12. Mini project using above experiments

Total Hours – 30

REFERENCES:

1. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 2nd Edition, New Age International Pvt. Ltd., 2011.
2. Gray and Meyer, 'Analysis and Design of Analog Integrated Circuits', 4th Edition, Wiley International, 2009.
3. William D.Stanely, 'Operational Amplifiers with Linear Integrated Circuits'.4th Edition, Pearson Education, 2004.
4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2002.

OUTCOMES:

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

- Estimate the DC and AC Analysis of operational amplifiers.
- Design and implement circuits using Op amp to perform various mathematical operations.
- Design and demonstrate the sinusoidal and non-sinusoidal oscillators using Op-AMP
- Design filters using Opamp and perform experiment on frequency response
- Develop and analyze various multivibrator circuits using OP amp and 555 Timer IC
- Analyze the working of PLL and use PLL as frequency multiplier

SEMESTER V

MSC 3181	LEADERSHIP & CEO TRAINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 08

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetter Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 08

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder-

empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader’s role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 09

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer-Yahoo.Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 08

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO’s. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

L – 45; Total Hours – 45

REFERENCES:

1. Andrew J DuBrin. “Leadership: Research Findings, Practice, and Skills”, 8th Edition, South-Western College Pub, 2015.
2. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft, “Leadership”, 5th Edition, South Western Cengage Learning 2012.

4. Stephen P. Robbins and Timothy A. Judge. "Organizational Behaviour", 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, "Organizational Behavior, An Evidence Based Approach", 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press

Recommended Readings:

1. Jim Collins, (2001). "Good To Great: Why Some Companies Make the Leap...And Others Don't", Random House Publishers India Pvt.Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press.
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one's own leadership style, their strength and weakness
- Gain self confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

ENC 3181**SOFT SKILLS FOR CAREER**

L	T	P	C
0	0	2	1

OBJECTIVES:

- To enable students to gain knowledge about industries, work culture and ethics.
- To develop students' critical reading and writing skills.
- To develop students' problem solving, analytical and leadership skills.
- To train them in presentation, group discussion and team building skills.

MODULE I**6**

Brief about industries- Analyzing work culture and ethics of multinational companies and SME(Small and Medium Enterprises) - Knowledge about etiquette (different types)

MODULE II**6**

Visiting industries and writing reports based on their visit.

MODULE III**4**

Analysing industry related problems-case studies.

MODULE IV**6**

Developing Leadership skills-- various aspects of leadership - time management - people skills.

MODULE V**8**

Team building skills-- group discussions -- preparing for interviews- interpersonal skills

Total Hours – 30**REFERENCES:**

1. Covey,S.R., "The 7Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK, 2004.
2. Fine, P.M.& Alice Olins, "Step up: Confidence, Success and Your Stellar

Career in 10 Minutes a Day, Vermilion, UK, 2016

3. Pai, A., "How to Develop Self-Confidence. Soma Books Ltd., 1993
4. Wentz, F.H., Soft skills training: A Workbook to Develop Skills for Employment. Createspace Independent Pub; Large Print edition, 2012

OUTCOMES:

After the completion of the course, students would be able to

- Demonstrate knowledge about industries/workplace.
- Write reports in simple and clear language.
- Exhibit problem solving and leadership skills.
- Make presentations and take part in discussions.

ECC3101	DIGITAL COMMUNICATION	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the building blocks of digital communication systems.
- To give an overview of the design of digital communication systems.
- To introduce the basic concepts of digital modulation of baseband and passband signals.
- To give an exposure to information theory, source coding and error control coding.
- To discuss about the spread spectrum modulation schemes.

PREREQUISITES:

- Basic knowledge on Probability and random process.
- Fundamentals of Analog Communication.

MODULE I SAMPLING AND QUANTIZATION 12

Digital communication systems – Functional description, Channel classification, Mathematical Models of Communication Channel, Sampling theory, Sampling theorem- Impulse sampling , flat top sampling, Sampling and quantization.

MODULE II WAVEFORM CODING TECHNIQUES AND BASEBAND 10
SIGNALING

Pulse Code Modulation, Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Line Codes & their properties - Matched filter – ISI, Signal Design for zero ISI and Ideal Nyquist's Pulse for distortion less baseband data transmission - Correlative coding - Eye pattern, Adaptive Equalization.

MODULE III BAND PASS SIGNALING 11

Geometric Representation of signals, Conversion of the continuous AWGN Channel into a Vector Channel, Optimum receivers using coherent detection - Generation, detection, PDF and BER of Coherent BPSK, BFSK, and QPSK - Principles of MSK and QAM - Non-Coherent Modulation Techniques –BFSK- Principle of DPSK.

MODULE IV INFORMATION THEORY 9

Entropy –Source coding theorem - Lossless data Compression Algorithms- Prefix coding, Huffman and Shannon-Fano codes. - Mutual information - Channel capacity - Channel coding theorem.

MODULE V ERROR CONTROL CODING 9

Error control using forward error correction, Discrete memoryless channels, - Linear Block codes –Syndrome and properties- Hamming codes - Cyclic codes- Convolution codes - Viterbi Decoder - Trellis Coded Modulation.

MODULE VI SPREAD SPECTRUM TECHNIQUES 9

Spread Spectrum Codes - PN sequence - Auto correlation and Cross correlation properties - M Sequences - Direct Sequence Spread Spectrum - Code synchronization, Processing Gain - Jamming Resistance - CDMA - Frequency Hop Spread Spectrum.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Simon Haykin, "Digital Communication System", John Wiley & Sons 2014.
2. John G. Proakis, "Digital Communication", 4th Edition, McGraw Hill Higher Education, 2000.

REFERENCES:

1. Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Prentice Hall, 2009.
2. B. P. Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Leon W. Couch, "Modern Communication Systems: Principles and Applications", BS Publication, 2017.
3. Roger L. Peterson, David E. Borth and Rodger E. Ziemer, "Introduction to Spread Spectrum Communications", Prentice Hall Inc, 2013.

OUTCOMES:

On Completion of the course, students will be able to

- Explain the fundamental concepts of sampling and quantization.
- To describe the baseband and pass band digital communication.
- Choose different modulation techniques based on the application.
- Apply the suitable source coding and channel coding techniques.
- Develop secure communication using spread spectrum techniques.
- Design and evaluate a digital communication system on need basis.

ECC3102**COMPUTER NETWORKS****L T P C****3 0 0 3****OBJECTIVES:**

- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- To know about the concepts of data communication and networks.
- To discuss on ISO-OSI model and different protocols.
- To distinguish different protocols of network layer, transport layer and application layer.
- To discuss cloud computing technology
- To provide students with contemporary knowledge in Cryptography and Security.

PRE-REQUISITES:

- Basic Knowledge in Computer terminologies.

MODULE I DATA COMMUNICATIONS 7

Introduction to data communication - Topologies-Protocols and Standards - ISO/OSI model - TCP/IP Protocol Suite- Modems - RS232 Interfacing sequences.

MODULE II DATA LINK LAYER 10

Error - detection and correction - Parity - LRC - CRC - Hamming code - Flow Control and Error control: stop and wait - go back N ARQ - selective repeat ARQ-sliding window techniques LAN: Ethernet IEEE 802.3, IEEE 802.4, IEEE 802.5 and IEEE 802.11.

MODULE III NETWORK LAYER 9

Packet Switching and Datagram approach –IP protocol suite- IP addressing methods - Routing - Distance Vector Routing - Link State Routing-Cloud computing-an overview

MODULE IV TRANSPORT LAYER 7

Duties of transport layer - Multiplexing - Demultiplexing - Sockets – User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) – Congestion Control - Quality of services (QOS).

MODULE V APPLICATION LAYER 6

Domain Name Space (DNS)-SMTP, FTP,HTTP & WWW

MODULE VI CRYPTOGRAPHY**6**

Basics of cryptography, classical encryption techniques, Data Encryption Standard and RSA algorithm, Role of firewalls and types of firewalls.

L-45; TOTAL HOURS-45**TEXT BOOKS**

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw-Hill, 2017.
2. Larry L. Peterson & Bruce Davie, "Computer Networks': A system Approach", 5th Edition, Morgan Kaufmann Publishers, 2011.
3. William Stallings, "Cryptography and network Security", 6th Edition, Pearson Education, March 2013
4. Thomas Erl, Zaigham Mahmood and Richardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, May 2013

REFERENCES

1. James.F. Kurose, Keith W.Ross, "Computer Networking: A Top-down Approach Featuring the Internet", Sixth Edition, Pearson Education, 2012.
2. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2011.

OUTCOMES:

On completion of the course, students will be able to

1. Identify the data communication systems and its components.
2. Enumerate the layers of OSI model and TCP/IP.
3. Implement the error detection and correction techniques in computer networks
4. Apply cloud computing technology
5. Build the sub-netting and routing mechanisms.
6. Compare the operation and features of application layer protocol.
7. Use cryptography & encryption techniques.

ECC3103	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss fundamentals of MOS and CMOS digital circuits
- To describe the fundamental principles of MOS and CMOS process technology and to examine the basic building blocks of large-scale digital integrated circuits.
- To apply the concepts of modeling in digital system using Hardware Description Language.
- To analyze the design of complex digital VLSI circuits.

PREREQUISITES:

- Fundamentals and applications of Digital Electronics, Electronic Devices and Circuits

MODULE I	MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER	8
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MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, Process Variations, Technology Scaling, CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

MODULE II	COMBINATIONAL LOGIC CIRCUITS	7
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Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

MODULE III	SEQUENTIAL LOGIC CIRCUITS	7
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Static Latches and Registers, Dynamic Latches and Registers, Timing Issues, Pipelines, Pulse and sense amplifier based Registers, Nonbistable Sequential Circuits.

MODULE IV	ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES	7
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Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel

Shifters, Speed and Area Tradeoffs, Memory Architectures, and Memory control circuits.

MODULE V IMPLEMENTATION STRATEGIES 8

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

MODULE VI DESIGN OF VLSI SYSTEMS 8

Basic concepts- identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow and RTL, structural, gate level, switch level modeling, Design hierarchies, Behavioral and RTL modeling, Test benches models, Structural gate level description with examples.

L – 45;Total Hours –45

TEXT BOOKS:

1. Introduction To VLSI Circuits And Systems, John P. Uyemura, John,2009, Wiley & Sons
2. Jan Rabaey, AnanthaChandrakasan, B Nikolic, "Digital Integrated Circuits: A Design Perspective". Second Edition, Feb 2003, Prentice Hall of India
3. N.Weste, K. Eshraghian, "Principles of CMOS VLSI Design". Second Edition, 1993 Addison Wesley,
4. Verilog HDL, A guide to digital design and synthesis, Samir Palnitkar, 2010, PHI

REFERENCES:

1. CMOS Digital Integrated Circuits Analysis, Sung-Mo (Steve) Kang, 2011, TMH
2. Introduction to VLSI Systems: A Logic, Circuit, and System Perspective, Ming Lo Bin, 2011, CRC Press, ISBN 9781439868591
3. Principles Of CMOS VLSI Design, Neil H.E, Weste, 2010, Pearson
4. CMOS Logic Circuit Design, John P Uyemura, 2009, Springer
5. Verilog for Digital Design, Frank Vahid, Roman Lysecky, Wiely, 2007
6. Digital VLSI Design with Verilog, A Textbook from Silicon Valley Polytechnic Institute, Williams, John Michael, 2014 Springer
7. Digital Design and Verilog HDL fundamentals, Joseph Cavanagh, 2007, CRC Press, ISBN

OUTCOMES:

On completion of the course, students will be able to

- Analyze the characterization of MOS and CMOS circuits.
- Analyze the resistance and capacitance effects of transistors and interconnects to further calculate transistor delay.
- Design combinational and sequential digital logic circuits.
- Design data path and arithmetic circuits for processor design
- Design and analyze FPGA interconnect routing procedures
- Write program using verilog HDL for VLSI digital systems.

ECC3104**VLSI LABORATORY****L T P C****0 0 2 1****OBJECTIVES:**

- To test the function of combinational and sequential circuits using Verilog HDL
- To apply the simulation and synthesis tools for FPGAs.
- To estimate power and delay of logic circuits in FPGAs.

PRE-REQUISITES:

- Principles of Digital Electronics and its systems
- VLSI Design

LIST OF EXPERIMENTS

1. Study of Simulation & Synthesis tools.
2. Design and simulation of basic logic gates.
3. Design, simulate and synthesis of adders and subtractors using HDL.
4. Design, simulate and synthesis of Multiplexers & demultiplexers using HDL.
5. Design, simulate and synthesis of Encoders & Decoders using HDL.
6. Design, simulation and synthesis of multipliers using HDL.
7. Design, simulation and synthesis of flip flops using HDL.
8. Design, simulation and synthesis of Shift registers and Counters using HDL.
9. Verification of on board LEDs and switches of FPGA using HDL codes.
10. Design of traffic light controller using HDL.
11. Design of Real Time clock (2 digits, 7 segment LED displays each for Hour, Minute and Sec) and verification in the FPGA board.
12. Design of CMOS inverter in Cadence.
13. Design of FIR filter using MATLAB and its implementation in FPGA.

P – 30; Total Hours –30**REFERENCES:**

1. Digital Design: With an Introduction to the Verilog HDL, 5th Edition by M

- Morris Mano and Michael Ciletti, Pearson publications, 2013.
2. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition By Samir Palnitkar, Prentice Hall PTR, 2003
 3. Fundamentals of Digital Logic with Verilog Design, Third Edition, Stephen Brown, Mc, Graw Hill, 2014

OUTCOMES:

On completion of the course, students will be able to

- Write Verilog code for combinational circuits and sequential circuits
- Simulate the combinational circuits and sequential circuits using Xilinx ISE
- Synthesize the designed digital circuits using Spartan FPGA kits.
- Implement the designed circuits in FPGA and verify the operation physically
- Estimate the power and delay of the digital circuit from device utilization summary
- Develop a real time application using Xilinx ISE and FPGA kit

ECC3105	COMPUTER NETWORKS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To explain about basic network components and devices in a network
- To find out performance of different wired LAN protocols
- To analyze wireless LAN protocol
- To use different algorithms for finding out shortest path between any nodes
- To study network simulator tools and network protocol analyzer.

PREREQUISITES:

- Knowledge of basics of network and its protocols
- Basics of C language.

LIST OF EXPERIMENTS

1. Demonstration of network devices and crimping of Ethernet cable.
2. Performance analysis of CSMA / CSMA – CD protocol for data communication between nodes in a network.
3. Performance analysis of Token Bus/ Token ring access method in a bus network.
4. Performance analysis of Stop-and-Wait and Go-back N protocol for data transfer between two nodes in a network.
5. Establishment of wired LAN.
6. Study of network simulator. Create a network scenario with 'n' nodes and analyze the packet drop due to congestion using network simulator.
7. Simulation of shortest path between any two nodes with Distance Vector Routing Protocol and Link State Routing Protocol using network simulator
8. Packet Capture & Traffic Analysis with Packet analyzer.
9. Establishment of Wireless LAN. Realization and throughput measurement of Wireless LAN.

P – 30; Total Hours –30

REFERENCES:

1. Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw-Hill, 2011.

2. J.F. Kurose and K.W. Ross, "Computer Networking: A Top-Down Approach" , Seventh Edition, Addison-Wesley/Pearson, 2016
3. Larry L. Peterson & Bruce Davie, "Computer Networks': A system Approach", 5th Edition, Morgan Kaufmann Publishers, 2011.
4. William Stallings, "Cryptography and network Security",6th Edition, Pearson Education, March 2013.

OUTCOMES:

On completion of the course, students will be able to

- Understand fundamental underlying principles of computer networking devices
- Implement basic wired LAN protocol such as ALOHA in a network and find its performance
- Implement IEEE standard protocols for wired LAN such as IEEE 802.3,802.4 and 802.5 and find its performance
- Implement wireless LAN protocol in a network and find its performance
- Understand the algorithm for finding shortest path between any two nodes in a network.
- Use industry standard simulation tools for real time applications.

ECC3106	COMMUNICATION SYSTEM LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To implement Analog modulation systems
- To analyse the Spectral characteristics of AM and FM signal
- To construct and analyse different converters and mixer circuits.
- To implement the modulation techniques using software simulation.
- To develop an application using various analog modulation techniques.

PREREQUISITES:

- Basics of Electronic circuit design
- Fundamentals of analog modulation
- Software skills in MatLab, LabVIEW, and NI MultiSIM.

LIST OF EXPERIMENTS:

1. Design, Testing, Time-domain and Frequency Domain Analysis of AM/FM system.
2. Design and performance of IF amplifier.
3. Design of Mixer circuit / Frequency converters
4. Design of 100 MHz FM audio transmitter circuit.
5. Design and Testing of pulse modulation techniques (PAM, PWM, and PPM)
6. Design and Testing of ASK / FSK system.
7. Noise analysis of AM and FM.
8. Noise analysis of FSK and QPSK.
9. Bandwidth Analysis of FDMA / TDMA / DSSS

P – 30; Total Hours –30**REFERENCES:**

1. John.G. Proakis and Masoud Salehi, "Communication Systems Engineering", Edition, Pearson, 2015.
2. John.G. Proakis and Masoud Salehi, "Digital Communications", 5th Edition, McGraw Hill Education, 2014
3. Simon Haykin, "Communication System", 5th Edition, Wiley India Pvt Ltd, 2009
4. A. Bruce Carlson, Paul B. Crilly, "Communication Systems", 5th Edition, McGraw Hill Education, 2015

Hill Int., 2017.

OUTCOMES:

On completion of the course the students will be able to

- Design and Implement the modulation techniques for the analysis of signal communication circuits.
- Analyze and design simple modulators & demodulators using diode, transistors and integrated circuits
- Identify, formulate and Perform spectral estimation in the area of communication engineering to meet desired needs within realistic constraints.
- Apply the techniques, skills and modern engineering tools such as NI-LABVIEW necessary for engineering practice.
- Analyze and design the multiplexer and demultiplexer circuits.
- Justify and incorporate the modulator and demodulator circuits for various applications.

SEMESTER VI

MSC3182	SOCIAL ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fit between individual and their entrepreneurial ambitions.
- To identify the customers and find a problem worth solving.
- To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas
- To develop a solution for customers' problem and analyze the problem solution fit & product market fit.
- To build and demonstrate a Minimum Viable Product (MVP) for startup.
- To analyze and understand the impact of social entrepreneurship on society and cases.

MODULE I SELF & OPPORTUNITY DISCOVERY 9

Finding the flow, Effectuation, Entrepreneurial Style, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study.

MODULE II CUSTOMER , SOLUTION AND BUSINESS MODEL 9

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas, Basics of Business Model and Lean Canvas, Risk and Assumptions.

MODULE III VALIDATION AND MONEY 9

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV TEAM BUILDING AND MARKETING 7

Shared Leadership, Hiring, Fitment , Team Role and Responsibilities , Collaboration Tools and Techniques, Positioning and Branding, Channels

MODULE V SALES & SUPPORT 6

Sales Planning, Selling Skills, Project Management, Project Tracking, Basic of Business Regulation, Startup.

MODULE VI IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETIES AND CASES 5

Impact of Social Entrepreneurship, NGO vs For-Profit Companies vs. Social Entrepreneurship. Procedures for registration of small scale industry, Overview of venture capital and angel investment, Social entrepreneurship report preparation by students. Case Study of Social Entrepreneurs.

Total Hours - 45

TEXT BOOKS

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. Learn wise platform - Wadhvani Foundation, 2018
3. "Social Entrepreneurship and Social Business" Christine K Volkmann, Springer Gabler 2012.
4. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.

REFERENCES

1. Social Entrepreneurship" Manuel London, Routledge, 2012.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. "Anatomy of Business Plan" – Linda Pinson, OMIM publication , Seventh Edition, 2008.
4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

OUTCOMES:

On completion of the course, students will be able to

- Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process
- Craft solution to the problem through value proposition canvas and develop a business model using lean canvas
- Provide product solution demo and deliver a minimum viable product
- Work as a team and create brand strategy marketing for product/service
- Prepare, make an outstanding sale pitch for startup.
- Showcase the impact of Social Entrepreneurship on society and cases.

ENC 3281	ENGLISH FOR WORKPLACE	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop students' proficiency in English at CEFR B2 level (Business Vantage).
- To develop students' receptive skills (Listening and Reading) in a wide range of situations.
- To develop students' productive skills (Speaking and Writing) in a wide range of situations.
- To expose students to the nuances of the English language, grammar and usage

MODULE I	6
SPEAKING	

Taking part in interview sessions by assuming roles of an interviewer and interviewee- exchanging information in question answer format-use of question tags, direct questions-all in real life contexts, Pronunciation.

READING

Reading short passages and answering matching tasks and error identification

LISTENING

Listening to audio recordings of short extracts of business-related texts and making note completion tasks.

WRITING

Writing intra office communication like a note, message for about 40-50 words.

MODULE II	6
SPEAKING	

Role play, participating in short talks relating to business topics-Discussion on a business related topic.

READING

Reading longer texts and answering questions.

LISTENING

Listening to audio recordings of telephone calls, face to face conversations and attempting exercises on gap filling involving information in words on numerical data and completing the task.

WRITING

Writing a memo or email to a colleague or colleagues within a company-Writing letter of application with resume, Writing reports on conference, seminars etc.

MODULE III **6**

SPEAKING

Giving presentations on business related topics involving decision making for one minute.

READING

Reading texts related to business topics and answering multiple-choice questions.

LISTENING

Listening to audio recordings of interviews and answering multiple-choice questions.

WRITING

Writing a short report, proposal from the notes given in about 120-140 words, writing replies to customers.

MODULE IV **8**

SPEAKING

Group Discussion-Taking part in discussions-Exchanging information.

READING

Reading excerpts taken from newspapers, magazines and answering questions.

LISTENING

Listening to a range of business related conversations, interviews, telephone calls, face to face conversations and attempting questions based on them.

WRITING

Writing a letter of enquiry, letter of complaint, sales letter.

MODULE V **4**

GRAMMAR & VOCABULARY

Use of sequence words, collocations, linking words and phrases, coherence and cohesion, Business Vocabulary

Total Hours – 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree MaitreyPrintechPvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.

3. Simon Sweeney, 'Communicating in Business' Teacher's Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, 'Communicating in Business' Student's Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. 'Business Vocabulary in Use'. Advanced. Cambridge University Press, Cambridge, 2004.

OUTCOMES:

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

- Use the LSRW skills effectively in business and in general situations.
- Demonstrate receptive skills effectively in various formal and informal communication situations.
- Demonstrate productive skills effectively in various formal and informal communication situations.
- Use appropriate grammar and vocabulary in any context.

ECC3201	MICROWAVE AND ANTENNA THEORY	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce various microwave sources, devices and components.
- To study the characteristics of microwave devices and components.
- To demonstrate the theory of wire antennas and aperture antennas.
- To familiarize with array antennas. Samuel Y Liao, "Microwave Devices
- To study about planar transmission lines and microwave integrated circuits

PRE-REQUISITES:

- Electromagnetic Fields & Electromagnetic Wave Propagation.

MODULE I MICROWAVE SOURCES 7

Microwave tubes-High frequency limitations- Principle of operation of Two cavity klystron, Multicavity Klystron, Reflex Klystron, TWT and Magnetron.

MODULE II MICROWAVE SOLID STATE DEVICES 8

Transferred Electron Devices: Introduction- Gunn-Effect Diodes-GaAs Diode, RidleyWatkins-Hilsum(RWH) Theory, Modes of Operation, LSA Diodes, InP Diodes, CdTe Diodes, Microwave Generation and Amplification. Avalanche Transit-Time Devices: Introduction, Read Diode, IMPATT Diodes, TRAPATT Diodes.

MODULE III MICROWAVE PASSIVE COMPONENTS 7

Microwave junctions- Tee junctions- Magic Tee – Rat race-Corners- bends and twists-Directional couplers- Two hole directional couplers-Isolator-Circulator–S Matrix for microwave components

MODULE IV FUNDAMENTALS OF ANTENNA 8

Vector Potential, Radiation from a infinitesimal alternating current element, Half-wave dipole antenna - power radiated, Mono-pole antenna. Antenna Parameters, radiation resistance, radiation intensity, radiation pattern, directivity, gain, effective height and effective aperture. Reciprocity theorem, Self and Mutual impedance

MODULE V ANTENNA ARRAYS& APERTURE ANTENNAS 8

Linear Arrays - Broadside and End-fire arrays, pattern multiplication, parasitic array elements, log-periodic and Yagi-Uda antenna. Loop antenna, Travelling

wave antenna concepts. Horn Antennas and its types – Reflector antennas and its types.

MODULE VI STRIPLINES & MMICs

7

Monolithic Microwave Integrated Circuits: Introduction - Materials: Substrate Introduction to Microstrip Lines - Characteristic Impedance, Attenuation Losses – Parallel Strip Lines - Distributed Lines - Coplanar Strip Lines - Shielded Strip Lines. Materials, Conductor Materials, Dielectric Materials, Resistive Materials - Monolithic Microwave Integrated- Circuit Growth - MMIC Fabrication Techniques.

TOTAL HOURS 45

TEXT BOOKS

1. & Circuits”, Prentice Hall of India, 2006.
2. Clive Poole, Izzat Darwazeh, "Microwave Active Circuit Analysis and Design", Elsevier, 2016
3. Spartak Gevorgian, "Ferroelectrics in Microwave Devices, Circuits and Systems: Physics, Modeling, Fabrication and Measurements, Springer-verlag London Limited, 2009.
4. Robert.E.Collin-Foundations of Microwave Engg–McGraw Hill, 2002.
5. Constantine A. Ballanis , "Antenna Theory ", 2nd Edition, John Wiley & Sons, 2003.

REFERENCES

1. D.M.Pozar, “Microwave Engineering”, John Wiley & sons, Inc., 2006.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas and Wave Propagation", 3rd Edition, Tata McGraw Hill, 2006.
3. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

OUTCOMES

On completion of the course, students will be able to

- Select a microwave source, device and strip lines for a particular application.
- Determine the S-Matrix of various passive devices.
- Analyze the various microwave devices and components.
- Analyze the characteristics of different strip lines, antennas and antenna arrays.
- Solve the problems related to microwave devices.
- Design various types of antennas and micro strip line for a specific application.

ECC3202**EMBEDDED SYSTEMS****L T P C****3 0 0 3****OBJECTIVES:**

- To expose the concepts of embedded systems
- To equip students with the software development skills necessary for practitioners in the embedded systems field
- To learn entire software development lifecycle and examine the various issues involved in developing software for embedded systems

PREREQUISITES:

- Knowledge in Microprocessor and Microcontrollers
- Basic Programming Skills in C language.

MODULE I EMBEDDED COMPUTING PLATFORM 8

Embedded computing – classification, characteristics and challenges –embedded system design process- overview of processors and hardware units in an embedded system- Embedded application.

MODULE II EMBEDDED SOFTWARE DEVELOPMENT TOOLS 8

Development and debugging - Host and target machines- Debugging Techniques- Debugging Challenges- System-Level Performance Analysis- Model of programs- Assembly, Linking and Loading - Basic compilation techniques.

MODULE III PROGRAM OPTIMIZATION AND ANALYSIS 7

Program optimization-software performance optimization-Analysis and optimization of program size - Program validation and testing.

MODULE IV EMBEDDED C 8

Programming embedded systems in C- Introducing the 8/16 bit microcontroller family- simulation and debugging in IDE-I/O port programming- Reading Switch- Adding structure to your code- meeting real-time constraints- Creating an embedded operating system- Serial interface.

MODULE V EMBEDDED NETWORKING 7

Multiprocessor systems-distributed embedded system-I2C bus-CAN bus- Ethernet- Overview of IoT – IoT supported hardware platforms.

MODULE VI REAL TIME OPERATING SYSTEMS (RTOS)**7**

Overview of Operating Systems (OS) concepts – Real time systems –Types -Need for RTOS in Embedded Systems -Compare OS and RTOS- Multiple Tasks and Multiple Processes-Priority-Based Scheduling- Real time scheduling algorithm – Inter process Communication Mechanisms- Case study.

TOTAL HOURS 45**TEXT BOOKS:**

1. Marilyn Wolf, "Computers as components", Elsevier 2012.
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003.
3. Michael J Pont, "Embedded C", Pearson Education Ltd, 2011.

REFERENCES :

1. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003.
2. Rajkamal, "Embedded Systems Architecture, Programming and Design", 1st Reprint, Tata McGraw-Hill, 2003.
3. Steve Heath, "Embedded System Design", 2nd Edition, Elsevier, 2004.
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
5. Qing Li and Caroline , "Real Time Concepts for Embedded Systems", CRC PRESS, 2017.

OUTCOMES:

On completion of the course, students will be able to

- Describe the software and hardware components in embedded system.
- Apply code optimization and debugging techniques for host & target based embedded system
- Design real time embedded application.
- Study the basics of microcontroller Architecture and programming the peripherals with C Language
- Illustrate the communication in distributed embedded system.
- Discuss the application development using RTOS

ECC3203**MICROWAVE AND ANTENNA
LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES:

- To study the characteristics of various microwave sources.
- To determine S - matrices of various passive microwave components.
- To find the gain and radiation pattern of various microwave antennas.
- To measure various microwave parameters using network analyzer.

PRE-REQUISITES:

- Electromagnetic Fields & Electromagnetic Wave Propagation

LIST OF EXPERIMENTS:

1. Characteristics of Gunn diode Oscillator.
2. Characteristics of Reflex Klystron.
3. Microwave Power Measurement.
4. Characteristics of Directional Coupler and Magic Tee.
5. Determination of guide wavelength, frequency measurement.
6. VSWR measurements.
7. Determination of impedance of microwave components.
8. Radiation Patten of Horns, parabolic antenna.
9. Measurement of Dielectric constants of a solid.
10. Simulation of Microwave components/Antennas using numerical simulation software/HFSS.
11. Characteristics of microwave components/Antennas using Vector Network Analyzer.

Total Hours - 30**TEXT BOOKS**

1. Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.
2. Clive Poole, Izzat Darwazeh, "Microwave Active Circuit Analysis and Design", Elsevier, 2016
3. Robert.E.Collin-Foundations of Microwave Engg–McGraw Hill, 2002.
4. Constantine A. Ballanis, "Antenna Theory ", 2nd Edition, John Wiley & Sons, 2003.

OUTCOMES:

On completion of the course the students will be able to

- Identify the antenna based on the characteristics of radiation pattern.
- Determine the s parameters of microwave devices
- Find the dielectric constant of any material
- Apply the theoretical principles underlying microwave devices and network.
- Use the techniques, skills and modern engineering tools such as network analyzer and HFSS, for solving problems in microwave systems
- Design a microwave system, components or process to meet desired needs within realistic constraints.

ECC3204**EMBEDDED SYSTEM DESIGN
LABORATORY****L T P C****0 0 2 1****OBJECTIVES:**

- To learn the concepts of programming on software tools for Microcontrollers
- To develop a program, simulate and debug 8/16 bit and ARM Microcontrollers
- To program serial ports and displays device with Microcontrollers
- To program on chip peripherals of ARM Controllers
- To familiarize a real time operating system
- To know the concepts of IOT

PRE-REQUISITES:

- Micro-processor and Micro-controller architecture and its interfacing mechanism.
- Basics of C language.

LIST OF EXPERIMENTS:

1. Design with 8/16 bit Microcontrollers - I/O Programming, Timer programming - Assembly and C Programming.
2. Serial port programming with 8/16 bit Microcontrollers – Assembly and Embedded C language.
3. Program LCD and keypad interface with 8/16 bit Microcontrollers – Embedded C Programming.
4. I/O port programming using ARM Processor.
5. Serial communication programming using ARM Processor.
6. Program for Analog to Digital conversion (with on chip ADC) of ARM Processor.
7. Multitasking implementation using RTX-tiny Real Time Operating Systems.
8. Study and implementation of Embedded application.

TOTAL HOURS - 30**REFERENCES:**

1. Steve Furbe , “ARM System-on-Chip Architecture” , Pearson education, 2009.
2. Qing Li and Caroline, “Real Time Concepts for Embedded Systems”, CRC PRESS, 2017.

3. Dr. K.V.K.K PRASAD, "Embedded Real Time Systems : Concepts , Design & Programming", Dream Tach press, 2003.
4. Michael J Pont, "Embedded C", Pearson Education, 2007
5. Mohamammad Ali Mazidi & Mazidi, "8051 Microcontroller and Embedded Systems" , Pearson Education, 2006.
6. Marilyn Wolf, "Computers as components", Elsevier 2012.

OUTCOMES:

On completion of the course, students will be able to

- Develop and debug the programs using Keil μ vision IDE.
- Design projects for I/O ports, timers, serial ports using 8/16 bit Microcontrollers.
- Demonstrate Keypad and LCD interfacing with microcontroller.
- Develop the application based on on- chip peripherals of ARM processor.
- Develop a real time embedded application.
- Design IOT based application using SOC.

SEMESTER VII

ECC4101	INTRODUCTION TO WIRELESS COMMUNICATION	L T P C
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		3 0 0 3
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OBJECTIVES:

- To introduce the aspects, needs and standards of modern wireless communications.
- To elaborate techniques for wireless channel modeling, and their performance over digital modulation.
- To describe the multiple access techniques used in the mobile communication
- To explain various wireless network systems and standards.
- To learn the recent trends of wireless communication.

PRE-REQUISITES:

- Basics of communication theory and system.

MODULE I INTRODUCTION TO WIRELESS COMMUNICATION 8

Overview of Wireless Communication, Types of wireless communication systems, Cellular concepts- Frequency reuse, Channel assignment, hand-off strategies, Improving coverage & capacity in cellular system.

MODULE II RADIO WAVE PROPAGATION 7

Path Loss and Shadowing – Free space Path loss – Ray tracing models, Empirical Path loss Models, shadow fading, combined loss, outage probability, coverage area.

MODULE III STATISTICAL MULTIPATH CHANNEL MODELS 8

Impulse response of channel, Narrow-band fading model and wide-band fading model, Discrete-time model, Space-Time channel models, Capacity of wireless AWGN channels, Flat-fading channels, and Frequency-selective fading channels.

MODULE IV MULTIPLE ACCESS TECHNIQUES 6

Introduction, Comparisons of multiple access strategies - TDMA, CDMA, FDMA, OFDM, CSMA protocols.

MODULE V WIRELESS SYSTEMS AND STANDARDS 8

Second Generation, Third Generation and Fourth generation Wireless Networks and Standards - AMPS, GSM, IS-95, LTE.

MODULE VI RECENT TRENDS 8

Introduction to Wi-fi, WiMAX, Zigbee networks, Software defined Radio, Wireless Adhoc networks & mobile portability.

TOTAL HOURS 45**TEXT BOOKS**

1. Andrea Goldsmith, "Wireless Communications", 1st Edition, Cambridge University Press, 2005.
2. Andreas F. Molisch, "Wireless Communications", 2nd Edition, Wiley IEEE, 2011.

REFERENCES

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson India, 2010.
2. Simon Haykin, Michael Moher, "Modern Wireless Communication", 1st Edition, Pearson India, 2011.
3. Kamilo Feher, "Wireless Digital Communications: Modulation and Spread Spectrum Applications", 1st Edition, PHI Learning, 2009.

OUTCOMES:

On completion of the course, students will be able to

- Describe and apply the fundamental concepts of Mobile Communication.
- Recognize various wireless communication services and modulation techniques.
- Classify channel models and signal models.
- Analyze the various multiple access techniques
- Identify various Wireless systems and standards.
- Summarize the recent trends of wireless communication.

ECC4102	OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply the principle and techniques of fiber optical communication.
- To distinguish various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- To integrate optical source, optical detectors, Network Topologies and their application in optical Communication system.

PREREQUISITES:

- Basic knowledge in physics, analog communication and digital communication.

MODULE I INTRODUCTION TO OPTICAL FIBERS 7

Element of an Optical Fiber Transmission link - Ray Optics - Optical Fiber Modes and Configurations - Mode theory of Circular Wave guides - Overview of Modes - Linearly Polarized Modes – Single Mode and Multimode mode Fibers - Graded Index fiber structure.

MODULE II SIGNAL DEGRADATION IN OPTICAL FIBERS 8

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides - Information Capacity determination - Group Delay - Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers - Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers - Mode Coupling - Design Optimization of SM fibers.

MODULE III FIBER OPTICAL SOURCES 8

Direct and indirect Band gap materials - Light source materials - LED structures, Quantum efficiency and LED power, Modulation of a LED, Laser Diodes - Modes and Threshold condition - Rate equations - External Quantum efficiency, Resonant frequencies - Laser Diodes structures and radiation patterns.

MODULE IV FIBER OPTICAL RECEIVERS 7

PIN and APD diodes - Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise - Comparison of Photo detectors – Fundamental Receiver Operation - Equalization techniques.

MODULE V DIGITAL TRANSMISSION SYSTEM 7

Point-to-Point links - System considerations - Fiber Splicing and connectors - Link Power budget - Rise-time budget - Noise Effects on System Performance

MODULE VI OPTICAL NETWORKS 8

Introduction to optical networking components-Basic networks-Network Topologies, Performance of passive linear Buses, Performance of star Architectures- Operational Principles of WDM, Erbium-doped fiber, Solitons, Basic concepts of SONET/SDH-Optical CDMA- Measurements- optical power meter-optical time domain reflectometer (OTDR).

Total Hours –45

TEXT BOOKS:

1. Gerd Keiser, "Optical Fiber Communication", 3rd Edition, McGraw-Hill International, Singapore, 2013.
2. J. Gowar, "Optical Communication System", Prentice Hall of India, 2001.
3. J. Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2010

REFERENCES :

1. D. C. Agrawal, "Fiber Optic Communication", S.Chand & Co Ltd., 2005.
2. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks: A practical perspective", 2nd Edition, Morgan Kaufmann, 2001.

OUTCOMES:

On completion of the course, students will be able to

- Describe the basic elements in optical communication system.
- Identify and analyze the characteristics of optical fibers.
- Quantify and understand the significance of dispersion and attenuation in optical fiber communications.
- Classify the characteristics of Optical sources and detectors.
- Design a real time fiber optic system based on link power and rise time budget.
- Analyze the optical network based on network topologies.

ECC4103	OPTICAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To align light waves into small optical components with high precision.
- To Estimate the attenuation and signal degradation due to coupling & Bending.
- To compute and simulate the modes in step index fiber and graded index fiber.

PRE-REQUISITES:

- Analog & digital Communication system.

LIST OF EXPERIMENTS:

1. To measure the numerical aperture (NA) of the different optical fiber.
2. Measurement of Mode field diameter of optical fiber.
3. Analysis of various parameters for step index fiber and graded index fibers using MATLAB.
4. Measuring optical power attenuation in plastic optical fiber.
5. Measuring optical power bending loss and coupling loss in plastic optical fiber.
6. To check the VI characteristic of LED.
7. Characteristics of LASER Diode.
8. Characteristics of APD
9. Describe the operational characteristics and parameters of Photodiode used as photo detector in fiber optic system.
10. Analysis of fiber optic power budget using MATLAB
11. Power budget analysis of LASER and LED bases optical Link.
12. Measurement of Link Characteristics using OTDR.

TOTAL HOURS - 30**REFERENCES**

1. John M. Senior , "Optical Fiber Communication", 3rd Edition, Pearson Education, 2010.
2. Gerd Keiser, "Optical Fiber Communication", 5th Edition, Mcgraw Higher Education, 2013.

OUTCOMES:

On completion of the course, students will be able to

- Couple light in and out of fibers and connect them.

- Measure loss and dispersion in fibers.
- Write mat lab code for different types of optical fibers.
- Explain the fundamental analogies between electrical and optical communication systems.
- Measure the performance of digital and analog fiber links.
- Estimate the power and study the characteristics of different sources and detectors

ECC4104	WIRELESS COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To familiarize mathematical modeling of wireless communication systems and channels.
- To evaluate the performance of wireless communication systems using software tools.
- To implement Filters and Equalizer for wireless digital communication.
- To observe the performance of modulation techniques using modern radio communication system, Software Defined Radio.

PRE-REQUISITES:

- Basics of communication theory and system

LIST OF EXPERIMENTS:

1. Modeling Digital Baseband Communication with noise.
2. Implementation of Matched Filter using Simulation tools.
3. Study of EYE-Pattern variation with SNR & Bandwidth.
4. Spectral Analysis of BPSK, QPSK, 16-PSK, FSK and QAM.
5. Simulation of Digital Communication Receiver with Hard Decision.
6. Decoding of BER vs SNR for BPSK, QPSK and FSK and observe the scatter plot.
7. Direct Sequence Spread Spectrum communication
8. Modeling of Fading wireless channels.
9. Implementation of Equalization techniques.
10. Implementation of modulation techniques in SDR platform

30**TOTAL HOURS -****REFERENCES**

1. Andrea Goldsmith, "Wireless Communications", 1st Edition, Cambridge University Press, 2005.
2. Andreas F. Molisch, "Wireless Communications", 2nd Edition, Wiley IEEE, 2011.
3. Apurba Das, "Digital Communication - Principles & System Modelling", Springer, 2010.
4. Agam Kumar Tyagi, "Matlab and Simulink for Engineers", Oxford

University Press, 2012.

OUTCOMES:

On completion of the course, students will be able to

- Classify the modulation schemes based on the applications.
- Model wireless communication Systems and channels.
- Implement suitable filters and Equalizers based on the system.
- Analyze the BER performance of various modulation schemes under AWGN and ISI.
- Evaluate the performance of different Spread Spectrum techniques.
- Assess the performance of modulation techniques using SDR.

ECC4105	INTERNSHIP/ INDUSTRY TRAINING/ MINI PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To improve the professional competency and research aptitude of students
- To help the students to develop the work practice to apply the design skills for solving real life problems.

GUIDELINES:**Mini Project**

- To be an experimental project on any of the topics in electronics and communication engineering.
- Assigned as individual mini project work on different topics.
- The students shall be encouraged to do their project in the parent institute or through core industries.
- Department will constitute an Evaluation Committee to review the project periodically.

Internship

- The students shall be encouraged to do their internship in core industries to develop an experimental project on any of the topics in electronics and communication engineering.
- Assigned to individuals on different topics for a period not less than 30 hours.
- Department will constitute an Evaluation Committee to review the project periodically.

Industry Training

- The students shall be encouraged to do their industry training in core industries, to have industry exposure and to improve work skill set on any of the topics in electronics and communication engineering.
- Assigned to individuals on different topics for a period not less than 15 days.
- Department will constitute an Evaluation Committee to review the project periodically.

Total Hours –30

OUTCOMES:

At the end of the project the student will be able to

- Design and analyze an electronic system
- Fabricate an electronic system/device in their area of interest
- Improve their presentation skills
- Improve the documentation skills
- Improve their fabrication skills
- Develop proto type working model and its demonstration.

SEMESTER VIII

ECC4201	PROJECT WORK	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To develop the work practice of students
- To apply theoretical and practical tools/techniques
- To solve real life problems related to industry and current research
- To improve the skills on prototype development
- To improve the skills towards report/documentation preparation

GUIDELINES:

Project work can be a design project/experimental project and/or computer simulation project on any of the topics of Electronics and communication Engineering. The project work is allotted individually or a group of students not more than 3 on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute.

Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of internal guide and experts in the specified area of the project. Project work consists of thesis work, two reviews of the work and the submission of project report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, draft of the project report and demo of the prototype model.

OUTCOMES:

At the end of the project the student will be able to

- Learn the tool required for the design, analysis of their preliminary work.
- Select the specific devices for different application along with justification.
- Apply the practical knowledge while solving real time problems
- Incorporate cost effective and efficient project models.
- Conclude the subject knowledge through proto type models.
- Prepare an appropriate documentation.

PROFESSIONAL ELECTIVES

ECCX 01	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the principles involved in the design of asynchronous sequential circuits to match industry standards.
- To gain knowledge in the design of asynchronous sequential circuits, fault modelling and simulation.
- Students will gain knowledge in designing memory devices.
- Students will be able to design circuits using PLDs.
- The students will gain knowledge in system verilog programming.

MODULE I ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 7

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Designing vending Machine Controller – Mixed Operating Mode Asynchronous Circuits

MODULE II STATE MACHINE CHARTS 6

SM Chart - derivation of SM Chart- SM chart for Binary Multiplier, Realization of SM Chart.

MODULE III NEW GENERATION PROGRAMMABLE LOGIC DEVICES 8

ROM- Internal ROM structure – Implementation of Boolean functions using ROM- Design of Sequential circuits using ROM, PROM – Realization State machine using PLD, PAL, PLA, Programmable Gate Arrays, Programmable Logic sequencer, Field Programmable Gate Array Families.

MODULE IV FAULT MODELING 7

Logical fault model, Fault detection & Redundancy in combinational, sequential circuits, Fault Equivalence and Fault location in Combinational & sequential Circuits. Single stuck fault model, Multiple stuck fault model.

MODULE V FAULT TESTING 8

Basic issues, Automatic test generator for single stuck fault in combinational circuits,D

Algorithm, Path oriented Decision Making Algorithm, ATG systems, Test set compaction

MODULE VI SYSTEM DESIGN USING VERILOG HDL 9

Hardware Modelling with Verilog, Realization of combinational and sequential circuits using Verilog – Registers – counters – sequential machine – serial adder – Multiplier-Divider – Design of simple microprocessor, Synthesis of Finite State Machines.

Total Hours –45

TEXT BOOKS:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill, 2002.
2. Stephen Brown and ZvonkVranesic, "Fundamentals of Digital Logic with Verilog Design", Tata McGraw Hill, 2002.
3. Parag K Lala, "Digital System design using PLD", BS Publications, 2003.
4. John M Yarbrough, "Digital Logic applications and Design", Thomson Learning, 2001.

REFERENCES:

1. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001.
2. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
3. Digital Logic Design, IV edition, Brian Holdsworth, Clive Woods, Elsevier, 2008.
4. Michael D Ciletti, "Advanced Digital Design with the Verilog HDL", PHI, 2008.

OUTCOMES:

- Analyze asynchronous sequential circuits and design simple asynchronous digital system for the given specifications.
- Make use of state machines and ASM charts for the given design requirements.
- Select and use appropriate PLDs to realize digital systems based on the requirements.
- Test the faults in the digital circuits using stuck at fault models.
- Generate test vectors using ATPG algorithms and analyze its performance.
- Apply digital system design principles and make projects based on the requirements using verilog HDL.

ECCX 02	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquaint students with the basic hardware components and performance measure of computers
- To study the algorithms & implementation of arithmetic for Computer
- To understand the concepts of pipelining and the hierarchy of memory system
- To impart knowledge on Parallel Processors and networking

MODULE I COMPUTER ABSTRACTIONS AND TECHNOLOGY 9

Introduction - Eight Great Ideas in Computer Architecture - Below Your Program - Technologies for Building Processors and Memory – Performance - The Power Wall - Switch from Uniprocessors to Multiprocessors - Fallacies and Pitfalls

MODULE II LANGUAGE OF THE COMPUTER 9

Operations and Operands of computer hardware – Signed and Unsigned Numbers - Representing Instructions in the Computer – Instruction and instruction sequencing - Addressing modes - Stacks and queues - A translation hierarchy for C.

MODULE III ARITHMETIC ALGORITHMS FOR COMPUTERS 8

Algorithms : Addition and Subtraction – Multiplication – Division - Floating Point operations

MODULE IV PROCESSING UNIT AND PIPELINING CONCEPTS 7

Fundamental concepts - Hardwired control - Microprogrammed control- Nano Programming - Pipelining - Basic concepts - Data hazards - Instruction hazards - Superscalar operation

MODULE V EXPLOITING MEMORY HIERARCHY 7

Basic concepts - Semiconductor RAMs, ROMs ,Speed, size and cost - Associative memory - Cache memories - Virtual memory - Memory Management requirements - Secondary storage.

MODULE VI PARALLEL PROCESSORS FROM CLIENT TO CLOUD 5

Introduction - Categorization of parallel hardware - Introduction to Multiprocessor Network Topologies - Communicating to the Outside World: Cluster Networking.

Total Hours – 45

TEXT BOOKS:

1. D A Patterson & J L Hennessy, Computer Organization and Design: The hardware/software interface, Morgan-Kaufmann (Fifth edition) 2013.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization" 5th Edition, McGraw Hill, 2002.
3. Morris Mano, "Computer System Architecture", 3rd Edition, PHI, 2001.

REFERENCES:

1. William Stallings, "Computer Organization & Architecture - Designing for Performance", 6th Edition, Pearson Education, 2003 reprint.
2. David A.Patterson and John L.Hennessy, "Computer Organization & Design, the hardware / software interface", 2nd Edition, Morgan Kaufmann, 2002 reprint.
3. John P.Hayes, "Computer Architecture & Organization", 3rd Edition, McGraw-Hill, 1998.

OUTCOMES:

On completion of the course the students will be able to

- Analyze and evaluate the performance of a system.
- Identify addressing modes and describe the language of a computer.
- Demonstrate how to add and multiply integers and floating-point numbers using two's complement.
- Design and emulate a single cycle or pipelined CPU and handle different types of hazards.
- Explain the wide variety of memory technologies and learn partitioning of memory.
- Use different techniques to create and use parallelism.

ECCX 03**CONTROL SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the modeling of control systems.
- To analyze the properties of control system in time domain & frequency domain.
- To design feedback controllers and compensators
- To analyze the stability of the control system.
- To introduce state variable representation of physical systems and study the effect of state feedback
- To introduce the modern tool such MATLAB for analyzing the system.

MODULE I CONTROL SYSTEM MODELING 8

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

MODULE II TIME RESPONSE ANALYSIS 8

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB

MODULE III FREQUENCY RESPONSE ANALYSIS 8

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol"s Chart - Use of Nichol"s Chart in Control System Analysis

MODULE IV STABILITY ANALYSIS 7

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability, Analysis using MATLAB

MODULE V STATE VARIABLE ANALYSIS 7

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state

equations - Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem – Sampler & Hold – Open loop & Closed loop sampled data systems.

MODULE VI DESIGN OF COMPENSATORS

7

Series, Parallel, series-parallel Compensators - Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB.

Total Hours –45

TEXT BOOKS:

1. Farid Golnaraghi, Benjamin C. Kuo, " Automatic Control Systems", McGraw Hill Professional, Tenth Edition , 2017.
2. Katsuhiko Ogata, " Modern Control Engineering" Prentice Hall, 5e, 2010.
3. J. Nagrath, M. Gopal Control Systems Engineering, Anshan, 5e, 2008.

REFERENCES:

1. William S. Levine, "The Control Handbook, Second Edition: Control System Fundamentals "CRC Press, 2010.
2. Jesus C. De Sosa, "Control Systems: Analysis and Realization ", iUniverse, 2010

OUTCOMES:

On completion of the course the students will be able to

- develop mathematical models of control components and systems
- design controllers for systems
- analyze the system in time and frequency domain
- use the Root Locus method, Routh Hurwitz array and Nyquist stability criterion to find stability of a system
- obtain and manipulate state space representation of systems
- use techniques and skills of system control using modern tool such as matlab

ECCX 04	BIO MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the application of biomedical sensors.
- To analyze different instruments to measure bio signals like EEG, ECG, and EMG.
- To explain the working of different medical instruments, Therapeutic Instruments and their use in physiological measurements.

MODULE I SOURCES OF BIOELECTRIC POTENTIALS 8

Introduction to bio potentials-Resting & Action potentials, propagation of active potential, The Bioelectric potentials – ECG, EEG, EMG and Evoked responses

MODULE II TRANSDUCERS & ELECTRODES 8

Transducers & Transduction principles-Active transducers- Passive Transducers- Biochemical Transducers- Transducer for Biomedical Applications.

Electrode theory- Bio potential Electrodes – Microelectrodes- Body surface electrodes- Needle Electrodes- Reference electrodes- PH electrodes- Blood gas electrodes.

MODULE III MONITORS AND RECORDERS 5

Bio potential amplifiers, recorders, monitors, Galvanometric, potentiometric, ultra violet, electrostatic, ink jet recorder video monitors, color printers, Electro Physiological recorders

MODULE IV BIO SIGNAL MEASUREMENTS 8

Neuronal communication, EPSP & IPSP, Neuronal firing measurements, EEG-block diagram, various Rythms, EEG in diagnostics, EMG -principles and applications. ECG-principles and clinical applications.

MODULE V OPHTHALMOLOGY INSTRUMENTS 8

Electro retinogram, Electrooculogram, Ophthalmoscope, Tonometer for eye pressure measurement.

MODULE VI THERAPEUTIC INSTRUMENTS 8

Diathermy, Defibrillator, cardiac pacemaker, stimulators, Laser applications in

machine, X-Rays production & use, Radiographic Diagnostic and Therapeutic, Film construction and processing, Interaction with body. Fundamentals of radiation therapy.

Total Hours –45

TEXT BOOKS:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
2. Willis J.Tompkins,"Biomedical digital signal processing", Prentice Hall of India, New Delhi, 2000
3. Leislle Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2013.

REFERENCES:

1. W.F. Ganong / Review of Medical Physiology / 25th Asian Ed. / Medical Publishers, 2015
2. J. G. Webster / Medical Instrumentation / Houghton Mifflin, Fourth edition,2010
3. A. M. Cook and J. G. Webster, eds / Therapeutic Medical Devices / PHI, 2009

OUTCOMES:

On completion of the course the students will be able to

- Characterize various sources of bio signals.
- Identify the transducers and electrodes used for brain, heart, muscles diagnosis.
- Discuss the various recorders in clinical applications.
- Analyze EEG,ECG & EMG signal.
- Describe the Ophthalmology Instruments for eye pressure measurements
- Apply modern therapeutic Instruments for diagnosis and treatments

ECCX 05**IMAGE PROCESSING****L T P C****2 0 2 3****OBJECTIVES:**

- Describe basic principles of digital image processing and its performance parameters
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Use appropriate algorithm for different image processing applications

MODULE I DIGITAL IMAGE FUNDAMENTALS 5

Difference between Analog and Digital image, Components of Image Processing System, Elements of Visual Perception, Image Sampling & Quantization, Spatial and Gray Level Resolution, Basic Relationships between Pixels. Performance parameters- Measures and their significance- Mean, variance, PSNR, correlation. Fundamentals of color image processing: color models- RGB, CMY, HIS.

MODULE II IMAGE ENHANCEMENT 5

Image Enhancement techniques overview- Histogram of an image-Histogram equalization-Spatial and frequency domain-Low pass and High pass filters.

MODULE III IMAGE TRANSFORMS 5

Significance of image transforms – Classifications-2D DFT,DCT, Hadamard and Haar transform

MODULE IV IMAGE SEGMENTATION AND RESTORATION 6

Morphological Image Processing: Dilation, Erosion, Opening, Closing on Binary Images, Segmentation: Point, line edge detection, boundary and thresholding, Segmentation types, Restoration: Image Degradation Model, Unconstrained and constrained restoration

MODULE V IMAGE COMPRESSION 4

Need for image compression-Compression ratio-Compression types-Lossless and lossy compression techniques.

MODULE VI IMAGE PROCESSING APPLICATIONS 5

Applications using different Imaging modalities such as Satellite Imaging, Medical imaging etc. Applications in Biometrics and security.

Practicals :**30Hrs**

1. Read, write and displaying images
2. Image sampling and quantization
3. Extraction of basic color components from an image
4. Histogram of a low contrast, high contrast and good contrast image
5. Histogram equalization
6. Image filtering using LPF and HPF
7. DFT of an image
8. Haar transform of an image
9. Dilation, Erosion, opening and closing of binary image
10. Point, line and edge detection of an image
11. Image compression using lossless technique and find its compression ratio
12. Image compression using lossy technique and find its compression ratio
13. Extracting Agricultural fields from satellite images
14. Enhancing X-ray images
15. Fingerprint recognition

L – 30; P– 30; Total Hours – 60**TEXT BOOKS:**

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007
3. Gonzalez, Woods and Eddins, "Digital Image Processing using MATLAB", Tata McGraw Hill Education, 2nd edition, 2017

REFERENCES:

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Jayaraman, S.Essakirajan and T.Veerakumar "Digital Image Processing", Tata McGraw Hill Education, 5th edition, 2015
3. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course the students will be able to

- Explain the fundamental concepts and performance parameters of digital image processing.
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing

- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques
- Apply suitable image processing techniques in different applications

ECCX 06	ADVANCED MICROPROCESSOR AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about Pentium Processor and its programming
- To learn about the functioning of PIC Microcontroller.
- To learn about the interfacing of PIC Microcontroller.
- To study the ARM RISC architecture and its programming.

MODULE I HIGH PERFORMANCE ARCHITECTURE – PENTIUM 8

CPU Architecture- Bus Operations – Pipelining – Branch predication – floating point unit- Pentium memory management.

MODULE II INTRODUCTION TO MULTICORE ARCHITECTURE 7

State of computing – Multiprocessor and Multicomputer – Multivector and SIMD Computer –Performance Metrics and Measures- Speedup Performance Laws

MODULE III PIC MICROCONTROLLER CPU 8

CPU Architecture - Instruction set - interrupts - Assembly language programming and introduction to C-Compilers.

MODULE IV PIC COMMUNICATION INTERFACE 7

Timers- I2C Interfacing - UART- A/D Converter -PWM and Introduction to C-Compilers.

MODULE V ARM ARCHITECTURE 7

Organization of CPU - Bus architecture -Memory management unit - ARM instruction sets - addressing modes - Programming the ARM processor

MODULE VI HIGH PERFORMANCE RISC ARCHITECTURE ARM 8

Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Application of ARM Processor.

Total Hours –45**TEXT BOOKS:**

1. James L. Antonakos, “An Introduction to the Intel family of Microprocessors ” Pearson Education 1999.

2. B P Singh, "Advanced Microprocessors and Microcontrollers", Paperback, 2008.
3. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014
4. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 2011.
5. D.A.Godse A.P.Godse, "Advanced Microprocessors and Microcontroller", Technical Publications, 2008
6. James L. Antonakos, "The Pentium Microprocessor" Pearson Education , 1997.
7. Steve Furber, " ARM System –On –Chip architecture "Addison Wesley, 2000.
8. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer's Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.

REFERENCES:

1. Gene .H.Miller." Micro Computer Engineering," Pearson Education, 2003.
2. John .B.Peatman, "Design with PIC Microcontroller, Prentice hall, 1997.
3. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001.
4. Barry.B.Breg," The Intel Microprocessors Architecture, Programming and Interfacing", PHI, 2002.

OUTCOMES:

On completion of the course the students will be able to

- Categorize the CISC and identify the addressing modes for various instructions of advanced microprocessors
- Develop an algorithm and write programs for PENTIUM.
- Develop an algorithm and write programs for PIC.
- Interface peripheral devices with PIC microcontroller.
- Explain the architecture and programming of ARM processor.
- Design a ARM development board.

ECCX 07	PCB DESIGN	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To familiarize with basics of PCB components.
- To study about Pspice for circuit analyze
- To learn about schematic design.
- To evaluate Design rule check and prepare footprint.
- To design layout and generate art files.
- To Fabricate the PCB, assemble the components and test the PCB.

MODULE I BASICS OF PCB AND SCHEMATIC DESIGN 7+10

PCB components – SMD and through hole components, Circuit analysis – Pspice, Schematic design - Design rule check. Footprint design, Net list generation

1. Schematic circuit design
2. New symbol creation.
3. Pspice Simulation
4. Foot print creation
5. Design rule check and Net list generation

MODULE II PCB LAYOUT DESIGN AND MANUFACTURING 6+10
PROCESS

Classification of PCB, Layer design, General layout - rules and parameters - PCB design rules for digital and analog circuits, Art file Generation.

1. Layout design constrains
2. Components placement
3. Board routing
4. Design rule check
5. Art file generation.

MODULE III PCB FABRICATION USING MILLING MACHINE AND 2+10
ASSEMBLY

Fabrication and testing of five Volt power supply board, Fabrication and testing of half adder and full adder circuit, Fabrication and testing of Half wave rectifier circuit, Fabrication and testing of amplifier circuit.

L – 15; P-30 ; Total Hours – 45

TEXT BOOKS:

1. Walter C Bosshart , “ Printed Circuit Boards, Design and Technology ” McGraw Hill.Inc., 2009
2. Khandpur R.S, “ Printed Circuit Boards, Design, Fabrication and Assembly” McGraw Hill.Inc., 2011

REFERENCES:

1. Clyde F.Coombs,Jr., and Happy T.Holden,“Printed Circuits Handbook”Tata Mc.Graw Hill Education, Seventh Edition.
2. Kraig Mitzner “Complete PCB Design Using OrCAD Capture and PCB Editor” Newnes, 2009
3. IPC 2221 standards, Generic standard on printed board design, Association Connecting Electronics Industries (IPC) publishers, 2012.
4. Pspice.com for component models and libraries

OUTCOMES:

On completion of the course the students will be able to

- Categorize the SMD components and PTH components with different packages
- Understand circuit design process and different machines used for designing.
- Design pads and footprint for new symbols.
- Design, place components and trouble shoot the errors.
- Etch the traces for final PCB and Produce art files for fabrication.
- Fabricate the board and test the circuit by assembling the components

5. Write a C program to demonstrate the working of queue, of size N using Array. The program should check the queue status for empty and full.
6. Write a C program to convert the given expression from infix to postfix.
7. Write a C program to search for an element in an array using binary search.
8. Write a C program to sort a list of n elements using bubble sort.
9. Write a C program to sort a list of n elements using quick sort.

L – 15; P – 30; Total Hours –45

TEXT BOOKS:

1. Horowitz, Sahni, Anderson- Freed , “Fundamentals of Data Structures in C” , , 2nd edition, Universities Press, 2008.
2. A.M.Tennenbaum, Y.Langsam and M.J.Augenstein , “Data Structures using C”, PHI, Pearson education 1991.

REFERENCES:

1. Rajesh K. Shukla , “Data Structures Using C & C++”, Wiley- India,1st edition 2009.
2. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill, First reprint 2007.
3. Balagurusamy, “Data Structure Using C” , McGraw Hill Education; First edition, July 2017
4. C & Data Structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, Dreamtech press.

OUTCOMES:

On completion of the course the students will be able to

- Describe common applications for arrays.
- Compare between different data structures. Pick an appropriate data structure for a design situation.
- Apply linear and non-linear data structures like stacks, queues, linked list etc.
- Analyse, evaluate and choose appropriate abstract data types and algorithms to solve particular problems.
- Analyze and evaluate the efficiency of various sorting algorithms including exchange sort, bubble sort and quicksort.
- Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures.

ECCX 09	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the jvm and java environment
- To apply the Concepts of Object Oriented Programming
- To familiarize the core Java concepts.
- To get an overview of java libraries.

MODULE I OVERVIEW OF JAVA 4

The Java Virtual Machine, Java Byte code, Paradigms of OOPS, Lexical Issues and Java keywords, Compilation and Execution.

MODULE II FUNDAMENTALS OF JAVA LANGUAGE 7

Data Types, Variables and arrays, Operators, Control statements.

MODULE III OBJECTS AND CLASSES 9

Introduction to Classes, objects and methods, Inheritance, method overloading and overriding, Packages and Interfaces.

MODULE IV EXCEPTION HANDLING 8

Using try and catch, Exception types, throw, throws and finally, Java's built-in Exceptions.

MODULE V MULTITHREADING 8

Creating and executing Threads, Priorities, and thread synchronization, Interthread Communication, Deadlock.

MODULE VI JAVA LIBRARIES 9

Java IO, Java Collections Framework, Networking, Introduction to AWT, Event Handling.

Total Hours 45**TEXT BOOKS**

1. Herbert Schildt, "Java - The Complete Reference", 10th Edition, McGraw Hill Higher Education, 2017.

REFERENCES

1. Cay S. Horstmann, "Core Java Volume I - Fundamentals" 10th Edition, Pearson, 2016

2. Herbert Schildt, "Java - A Beginner's Guide", 1st Edition, McGraw Hill Higher Education, 2017
3. Paul Deitel, Harvey Deitel, "Java SE 8 for Programmers", 3rd Edition, Pearson 2014.
4. Rogers Cadenhead, "Sams Teach Yourself Java in 21 Days", Pearson Education, 2013.

OUTCOMES:

On completion of the course the students will be able to

- Compose, compile, execute and debug simple java programs.
- Use control statements for programming complex and iterative tasks.
- Distinguish between Class and Objects.
- Apply the OOP principles using java language.
- Justify the issues in multi threaded programming.
- Create custom java libraries.

ECCX 10	MATLAB PROGRAMMING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To practice the MATLAB environment and learn programming fundamentals
- To develop skill to write Programs using commands and functions
- To use MATLAB in engineering applications

MODULE I AN OVERVIEW OF MATLAB 7

MATLAB environment - Command Window- History- Workspace-Current Directory- Figure window- Edit window-Shortcuts-Help files-Data types-Constants and Variables- Character constants- operators- Assignment statements-Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.

MODULE II OPERATIONS IN MATLAB 8

Input Output functions-Reading and Storing Data-Vectors and Matrices- Matrix Manipulations- Arithmetic operations on Matrices, Relational operations on Matrices, and Logical operations on Matrices- Polynomial Evaluation- Roots of Polynomial-Arithmetic operations on Polynomials- Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart- Applications of MATLAB in engineering.

Total Hours –15**TEXT BOOKS:**

1. Bansal R.K, Goel A.K, Sharma M.K, "MATLAB and its Applications in Engineering", Pearson Education, 2012
2. MATLAB for Electrical and Computer Engineering Students and Professionals, with Simulink, R. Priemer, SciTech Pub, 2013, ISBN: 978-1-61353-188-4.

REFERENCES:

1. Amos Gilat, "MATLAB-An Introduction with Applications", Wiley India, 2009.
2. Stephen J Chapman, "Programming in MATLAB for Engineers", Cengage Learning, 2011.

OUTCOMES:

On completion of the course the students will be able to

- Write simple program modules to implement algorithms
- Calculate solutions to engineering problems
- Test program output for accuracy using hand calculations and debugging techniques
- Synthesize multiple program modules into larger program packages

ECCX 11	PYTHON PROGRAMMING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in python, including defining classes, invoking methods, using class libraries, etc
- Have the ability to write a program to solve specified problems

MODULE I PYTHON CONCEPTS 5

Introduction to python, Installation, Python Interpreter, Interpreter and its environment, running a program, first python programme , Basic Operators, Data types- String ,List, tuple, set, Dictionary, Control statements – Decision making, loop, numbers ,Date and time.

MODULE II FUNCTIONS AND MODULES 5

Defining a Function- Calling a Function-Passing by Reference Versus Passing by Value -Function Arguments-The return Statement-scope of variables – global and local variables-Modules-import statements.

MODULE III FILES I/O EXCEPTIONS AND CLASSES & OBJECTS 5

Reading Keyboard Input-Opening and Closing Files-Reading and Writing Files-Renaming and Deleting Files -Directories in Python-file and Directory Related methods-Exception handling, creating Classes and Objects, accessing the attributes, class inheritance, Over riding, Over loading methods.

Total Hours – 15**TEXT BOOKS:**

1. Mark Lutz , “Learning Python” , Fifth Edition, O,Reilly, 2013
2. Allen Downey, “Think Python”, second edition, Green Tea Press,2015

REFERENCES:

1. Jason Cannon, “Python Programming for Beginners” O,Reilly, 2012
2. David Beazley , Brain K Jones “Python CookBook” Third edition,2013
3. CHUN, WESLEY J ”Core Python Programming”, Pearson Education 2012
4. GUTTAG, JOHN V ”Introduction to Computation and Programming Using Python”, PHI Learning Private,2014

OUTCOMES:

On completion of the course the students will be able to

- Implement user defined python functions.
- Create programs using various collection data types
- Develop basic programs using fundamental structures
- Apply appropriate Python control flow structure
- Design classes and use them
- know how Python can be used for application development

dispersal – Coordination

MODULE V SATELLITE DIGITAL AUDIO RADIO SERVICE AND VSAT 7
NETWORKS FOR INTERACTIVE APPLICATION

Satellite radio broad cast Concept- World space- Sirius satellite radio- XM satellite Radio – Interactive data networks- VSAT star networks – VSAT in business TV.

MODULE VI FIXED TELEPHONY SATELLITE NETWORKS AND 8
MOBILE SATELLITE SERVICE

Role of satellite in telephone services – Demand assignment SCPC Network Architecture – Preassigned point to point link – Application of FTS- Foundation of Mobile Satellite services – GEO MSS system – Handheld terminals – Non- GEO MSS systems – Intelligent MSS services- Multiple access in MSS – Digital speech compression – Ground Segment Architecture in MSS- Subscriber access and connectivity – Network security - DTH- Satellite Applications- Satellite Navigation.

TOTAL HOURS 45

TEXT BOOKS

1. Timothy Pratt, Charles Bostian, Jeremy Allmuti, "Satellite Communications", John Wiley & Sons (Asia) Pvt. Ltd. 2004.
2. Dennis Roddy, "Satellite Communications", 4th Edition, McGraw-Hill Publication, 2006.

REFERENCES

1. Kenneth Y. Jo, "Satellite Communications Network Design and Analysis", Artech House, 2011.
2. Bruce R. Elbert, "The Satellite Communication Applications Handbook", 2nd edition Artech House, 2004.
3. Bruce R. Elbert, "Introduction to Satellite Communication", 3rd edition Artech House, 2008.
4. Wilbur L. Pritchard, Henri G. Suyder, Hond Robert A. Nelson, "Satellite Communication Systems Engineering", 2nd Edition, Pearson Education Ltd., 2003.
5. M. Richharia, "Satellite Communication Systems (Design Principles)", 2nd Edition, Macmillan Press Ltd, 2003.

OUTCOMES:

On completion of the course, students will be able to

- Identify satellite orbits and launching mechanisms
- Describe the space segment and earth segment
- Identify different antennas used in satellite communication
- Design uplink and downlink of a satellite systems
- Explain about satellite digital services for interactive application
- Describe satellite service like FSS, DBS, MSS and VSS.

ECCX 13	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the methods of recording various bio-potentials.
- To introduce the processing techniques of biomedical signals and parameter detection
- To discuss recent techniques in bio medical signal processing
- To introduce modern industrial biomedical applications

PREREQUISITES:

- Basic knowledge about signals and systems
- Fundamentals of signal processing

MODULE I INTRODUCTION TO BIOMEDICAL SIGNALS 6

The origin of Bio-potentials-I -ECG, EEG, ENG, EMG, PCG, EOG- - Typical waveforms and signal characteristics.

MODULE II PROCESSING OF BIOMEDICAL SIGNAL 9

Processing of Random & Stochastic signals - spectral estimation - Properties and effects of noise in biomedical signals - Filtering of biomedical signals- Detection of biomedical signals in noise.

MODULE III ANALYSIS OF ELECTROCARDIOGRAM 10

High-frequency noise in the ECG. Motion artifact in the ECG -.Power-line interference in ECG signals - Maternal interference in fetal ECG- ECG parameters estimation -Direct data compression techniques- Direct ECG data compression techniques- Transformation compression techniques-MATLAB Simulation of analyzing ECG.

MODULE IV ANALYSIS OF ELECTROENCEPHALOGRAM 10

EEG rhythms & waveform - EEG applications - Epilepsy-sleep disorders-brain computer interface - Modeling EEG- linear, stochastic models - Non linear modeling of EEG - artifacts in EEG & their characteristics and processing - Model based spectral analysis - EEG segmentation - Joint Time - Frequency analysis - correlation analysis of EEG channels - coherence analysis of EEG channels.

MODULE V BIO-TELEMETRY 5

Telemetry principles- Frequency selection- Bio-telemetry- Radio-pill and Tele-stimulation

MODULE VI BIOMEDICAL APPLICATIONS 5

Case Study HL7 Protocol- Patient Monitoring System - Wearable Devices- Nano medicine and application.

TOTAL HOURS 45

TEXT BOOKS

1. Rangaraj M. Rangayyan, "Bio medical signal analysis. A case study approach", Wiley-IEEE Press June 2015
2. D.C.Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005.

REFERENCES

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2014.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 2001.
3. Leslie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2013.
4. Willis J.Tompkins,"Biomedical digital signal processing", Prentice Hall of India, New Delhi, 2000

OUTCOMES:

On completion of the course, students will be able to

- Describe the characteristics of various Bio medical signals.
- Discuss the properties and effects of noise in biomedical signals
- Design filters for biomedical signals
- Analyze the ECG signals and its compression techniques.
- Analyze the EEG signals
- Summarize the biotelemetry and modern technologies in hospital applications.

MODULE V RADAR TRACKING 7

Tracking Radar: Different types of tracking techniques, Tracking in range, Tracking in Doppler, Search Acquisition radar, Comparison of Trackers.

MODULE VI RADAR APPLICATIONS 7

Introduction to Pulse Compression Radar: Height finding radars, Air traffic control Radars and data handling, Atmospheric effects of radar, Electromagnetic compatibility aspects, Airborne Radars, Synthetic Aperture Radar, Secondary surveillance Radars.

Total Hours 45

TEXT BOOKS

1. Merrill Skolnik, "Introduction to Radar Systems", 3rd Edition, McGraw Hill Higher Education, 2001.
2. Peyton Z. Peebles, "Radar Principles", 1st Edition, Wiley, 2007.

REFERENCES

1. Jian Li, Robert Hummel, Petre Stoica, Edmund G. Zelnio, "Radar Signal Processing and Its Applications", Springer, 21-Dec-2013
2. Vyacheslav Tuzlukov, "Processing in Radar Systems", CRC Press, 19-Dec-2017
3. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw Hill Professional, 15-Jul-2005
4. G. S. N. Raju, Radar Engineering, I. K. International Pvt Ltd, 04-Oct-2008
5. J.C. Toomay, Paul J. Hannen, "Principles of Radar", 3rd Edition, PHI Learning, 2010.

OUTCOMES:

On completion of the course the students will be able to

- Reproduce the radar equation and its derivation.
- Demonstrate Radar detection and ranging techniques.
- Demonstrate the principles of SAR
- Justify the effects of the Doppler shift.
- Apply knowledge of Radar to analyze MTI and PDR.
- Comprehend common applications of radar.

ECCX 15	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about various wireless applications like WLAN and WAN.
- To have a good understanding of wireless internet and adhoc networks.
- To learn the advanced wireless network standards and technologies like LTE and 4G.
- To have a clear understanding about the wireless IP architecture, Packet Data Protocol and LTE network architecture.

PREREQUISITES:

- Basics of wireless communication and Computer Networks.

MODULE I WIRELESS LAN 8

Introduction – WLAN technologies: Infrared, UHF narrowband, spread spectrum
IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer
802.11a/b/g/c/n – Hiper LAN1, HiperLAN2, WATM, BRAN - IEEE802.16
WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX.

MODULE II MOBILE NETWORK LAYER 7

Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-
Network layer in the internet- Mobile IP session initiation protocol – mobile Adhoc
network - Issues in Adhoc networks - Routing Protocols, Wireless Sensor Networks
– Architecture.

MODULE III MOBILE TRANSPORT LAYER 7

TCP enhancements for wireless protocols – Traditional TCP: Congestion control,
fast retransmit/fast recovery, Implications of mobility – Classical TCP
improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing,
Selective retransmission, Transaction oriented TCP – TCP over 3G wireless
networks.

MODULE IV WIRELESS WIDE AREA NETWORK 7

Overview of 2G & 2.5G Networks - UTM S Terrestrial Radio access network-UMTS
Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-
IWMSC, Firewall, DNS/DHCP-High Speed Packet Access (HSPA).

MODULE V 4G NETWORK 8

Introduction – 4G vision – 4G features and challenges – Applications of 4G – 4G

Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

MODULE VI WIRELESS IP NETWORK ARCHITECTURE 8

3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context -Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain – LTE network Architecture - Roaming Architecture- Protocol Architecture- Bearer Establishment Procedure -Inter-Working with other RATs.

Total Hours –45

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2012.
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier, 2007.
3. KavehPahlavan, PrashantKrishnamoorthy, "Principles of Wireless Networks,-A unified approach", PHI, New Delhi, 2009.
4. C.Siva Ram Murthy, B S Manoj, "Ad hoc Wireless Networks, Architectures and Protocols", Pearson, 2004.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. AymanEINashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.
4. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks", Wiley Publication, 2005.
5. StefaniaSesia, IssamToufik and Matthew Baker, "LTE – The UMTS Long Term Evolution from Theory to Practice", John Wiley & Sons, Inc. Publication, Second Edition, 2011.
6. SavoGlisic," advanced wireless networks-technology and business models", Third Edition, John Wiley & Sons, Ltd, 2016.

OUTCOMES:

On completion of the course the students will be able to

- Describe the working principle of wireless LAN network and protocols involved in physical layer & MAC layer.
- Explain the importance of various TCP Protocols.
- Classify the various wireless networks.
- Demonstrate the mechanism of Ad Hoc Networks and Sensor Networks.
- Familiarize with the latest 4G networks and LTE.
- Illustratethearchitecture of wireless IP and LTE network.

ECCX 16	MULTIMEDIA COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the components of Multimedia Communication.
- To describe the different compression techniques for text, image, audio and video signal.
- To familiarize real time applications of multimedia.

PREREQUISITES:

- Fundamentals of Signal theory
- Basics of Signal and Image Processing

MODULE I MULTIMEDIA COMPONENTS 4

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

MODULE II TEXT COMPRESSION 9

Need for Compression, types, Huffman coding-Adaptive Huffmancoding - arithmetic coding - Shannon-Fano coding - LZW algorithms

MODULE III IMAGE COMPRESSION 8

Analogue black and white picture signal. Colour picture and RGB signal, Y;Cr,Cb. Resolution of the picture. Structure of the picture signal information, luminescence and chromatic components .Transform coding - DCT – JPEG

MODULE IV AUDIO AND VIDEO COMPRESSION 9

A law and μ law companding - Basic sub-band coding - Application to speech coding - G.722.H.261 - H.263 - MPEG 1, 2, 4.

MODULE V REQUIREMENT AND PERFORMANCE ISSUES 7

Network performance parameters for multimedia, characteristics of multimedia traffic sources, factors that affect network performance, multimedia traffic requirement for networks, Quality of Service.

MODULE VI MULTIMEDIA APPLICATIONS 8

Video conferencing, DVI technology-Packet Video, DVB-T and DVB-C, Digital television, TV monitor as Multimedia terminal, VOIP Technology.

Total Hours –45**TEXT BOOKS:**

1. K.R. Rao, Z S Bojkovic, D A Milovanovic, "Multimedia Communication System", Standards, and Networks", Pearson Education, 2007.
2. Khalid Sayood, "Introduction to Data Compression", Morgan Kauffman Harcourt India, 2nd Edition, 2000.
3. Yun Q. Shi, Huifang Sun, "Image and video compression for Multimedia Engineering", CRC Press, 1999.

REFERENCES:

1. Fred Halshall "Multimedia communication - applications, networks, protocols and standards", Pearson education, 2007.
2. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 2002.
3. Ranjan Parekh, "Principles of Multimedia", TMH 2006.
4. Marcus goncalves "Voice over IP Networks", McGraw Hill, 1998.

OUTCOMES:

On completion of the course the students will be able to

- Distinguish and describe the various components of multimedia communication.
- Describe various compression techniques and apply them for text compression.
- Explain various compression techniques and apply them for image compression.
- Describe various compression techniques and apply them for sound and video compression
- Analyze the performance issues of multimedia on networks.
- Apply multimedia in real time scenarios.

ECCX 17	INTRODUCTION TO NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of computer security.
- Identify the encryption techniques used in real time applications.
- Interpret the various network intrusion such as computer viruses, network worms etc.,

PREREQUISITES:

- Fundamentals of networking concepts.
- Basic knowledge on Computer network and data communication.

MODULE I COMPUTER SECURITY AND CRYPTOGRAPHY 7

Computer Security : Introduction, Need for security, Principles of Security, Types of Attacks

Cryptography : Plain text and Cipher Text, Substitution techniques, Caesar Cipher, Mono-alphabetic Cipher, Polygram, Polyalphabetic Substitution, Playfair, Hill Cipher, Transposition techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks

MODULE II SYMMETRIC KEY ALGORITHMS AND AES 7

Algorithms types and modes, Overview of Symmetric key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish, Advanced Encryption Standard (AES)

MODULE III ASYMMETRIC KEY ALGORITHMS, DIGITAL 8
SIGNATURES AND RSA

Brief history of Asymmetric Key Cryptography, Overview of Asymmetric Key Cryptography, RSA algorithm, Symmetric and Asymmetric key cryptography together, Digital Signatures, Knapsack Algorithm.

MODULE IV DIGITAL CERTIFICATES AND PUBLIC KEY 8
INFRASTRUCTURE (PKI)

Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML, PKI and Security, Hash functions, Key Predistribution, Blom's Scheme, Diffie-Hellman Key Predistribution, Kerberos,

Diffie-Hellman Key Exchange, The Station-to-station Protocol

MODULE V INTERNET SECURITY PROTOCOLS 8

Basic concepts, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Hyper Text Transfer Protocol (SHTTP), Time Stamping Protocol (TSP), Secure Electronic Transaction (SET), SSL vs SET, 3-D Secure Protocol, Electronic Money, E-mail Security, Wireless Application Protocol (WAP) Security, Security in GSM, Security in 3G

MODULE VI USER AUTHENTICATION AND KERBEROS 7

Authentication basics, Passwords, Authentication Tokens, Certificate-based Authentication, Biometric Authentication, Kerberos, Key Distribution Center (KDC) , Security Handshake Pitfalls, Single Sign On (SSO) Approaches. Basics of Cryptanalysis

Total Hours –45

TEXT BOOKS:

1. AtulKahate, "Cryptography and Network Security ", 3rd Edition, Tata McGrawHill, 2017.
2. William Stallings, 'Cryptography and Network Security', Pearson, 6th edition, 2013
3. V KPachghare, 'Cryptography and Information Security', PHE Publications, 2013.

REFERENCES:

1. Neal Krawetz ,'Introduction to Network Security', published by CENGAGE Learning, 2006
2. Charlie Kaufman, Radia Perlman and Mike Spenciner, "Network Security– Private Communication in a Public World" by, Pearson/PHI, 2002.

OUTCOMES:

On successful completion of this course, student will be able to:

- Analyze basic cryptographic algorithms, web authentication and security issues.
- Analyze the vulnerabilities in any computing system and able to design a security solution.
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical.
- Describe about electronic mail security.
- Discuss the current legal issues towards information security.

ECCX 18	INFORMATION CODING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts of information theory.
- To study about data compaction, data compression and data transmission.
- To learn about various error detection and correction techniques.
- To Identify the encryption techniques used in real time applications.

PRE-REQUISITES:

- Basic knowledge on Probability and Random Processes
- Basics of Digital Communications

MODULE I INFORMATION ENTROPY FUNDAMENTALS 7

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding – Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

MODULE II DATA AND VOICE CODING 8

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

MODULE III ERROR CONTROL CODING 8

Introduction to rings, fields, Galois fields, linear block codes – error detecting and correcting capabilities – generator and parity check matrices – Standard array and syndrome decoding – Hamming codes, cyclic codes – polynomial and matrix descriptions – generation of cyclic codes, decoding of cyclic codes, Reed – Solomon Codes, Convolutional Codes – encoding –, State Tree & Trellis diagrams, Maximum likelihood decoding of convolutional codes – The Viterbi Algorithm. Sequential decoding.

MODULE IV COMPRESSION TECHNIQUES 7

Introduction to Lossless coding. Low probability of compression. Basic compression schemes – Arithmetic Coding, Runlength encoding, Differential compression, Lossless Coding - Shannon's Noiseless Coding Theorem, Shannon-Fano Codes, dynamic Huffman Codes, Image Compression – Introduction

to JPEG standards.

MODULE V AUDIO AND VIDEO CODING 8

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

MODULE VI CRYPTOGRAPHY 7

Overview of encryption techniques - symmetric cryptography - Data Encryption Standard (DES) - International Data Encryption Algorithm (IDEA) - RC Ciphers - Public-key algorithm - RSA algorithm - Pretty Good Privacy - One-way Hashing

TOTAL HOURS 45

TEXT BOOKS

- 1 Simon Haykin, "Communication Systems", John Wiley and Sons, 5th Edition, 2010.
- 2 Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2004; Chapters: 3, 4, 5.

REFERENCES

- 1 Mark Nelson, "Data Compression Book", BPB Publication, 2008.
- 2 Irina Bocharova, "Compression for Multimedia" Cambridge University Press, 2010

OUTCOMES:

On completion of the course, students will be able to

- Distinguish the various source encoding and decoding techniques.
- Compare the performance of various compression techniques.
- Analyze the multimedia communication for various source coding and channel coding techniques.
- Apply error-control coding techniques.
- Understand the cryptographic techniques.
- Develop new compression algorithm for future communication.

ECCX 19**RF MEMS CIRCUIT DESIGN****L T P C****3 0 0 3****OBJECTIVES:**

- To explain the technologies of RF MEMS.
- To intro the types of RF MEMS switches.
- To discuss RF MEMS based filters and phase shifters.
- To apply MEMS concept in transmission lines and antennas.
- To analyze reliability of RF MEMS in wireless communication.

PREREQUISITES:

- Basic knowledge on RF and microwave components.
- Fundamentals of antennas and transmission lines

MODULE I INTRODUCTION**9**

Introduction to RF MEMS technologies: Need for RF MEMS components in communications, space and defense applications, Materials and fabrication technologies, Actuation methods in MEMS, Special considerations in RF MEMS design.

MODULE II RF MEMS SWITCHES**9**

Introduction -Switch parameter- Basics of switching - Switches for RF and microwave applications .Electrostatic switching Approaches for low actuation voltage switches thermal switching MEMS switch design, modeling and evaluation MEMS switch design considerations.MEMS Inductors and Capacitors-Introduction

MODULE III RF FILTERS AND PHASE SHIFTERS**9**

Modeling of mechanical filters, micro machined filters, surface acoustic wave filters, micro machined filters for millimeter wave frequencies; Various types of MEMS phase shifters; Ferroelectric phase shifters.

MODULE IV MICROMACHINED TRANSMISSION LINES AND ANTENNAS**8**

Micro machined transmission lines, losses in transmission lines, coplanar transmission lines, micro machined waveguide components; Micro machined antennas: Micromachining techniques to improve antenna performance,

reconfigurable antennas.

MODULE V RF MEMS ANTENNAS FOR WIRELESS APPLICATIONS 5

Introduction-RF MEMS antennas-Reconfigurable feeding networks-Reconfigurable antennas- Design considerations- Conclusion and future trends-Sources of further information and advice.

MODULE VI RELIABILITY OF RF MEMS 5

Introduction-Overview of failure mechanisms in RF MEMS-Charging in RF MEMS-Analytical modeling-Electrostatic discharge-Reliability issues of MEMS packages

TOTAL HOURS 45

TEXT BOOKS

1. Vijay K Varadan, Vinoy KJ and Jose K A, "RF MEMS and Their Applications", John Wiley & Sons Ltd, England, 2003.
2. Gabriel M Rebeiz, "RF MEMS Theory, Design and Technology ", John Wiley & Sons Ltd, New Jersey, 2004
- 3 Deepak uttanchandhani, "Handbook of MEMS for wireless and mobile applications", 1 st edition, Woodhead Publishing, 2013.

REFERENCES

1. G. Rebeiz, RF MEMS: Theory, Design, and Technology, Wiley/IEEE Press, 2003
2. H.J. De Los Santos, Introduction to Microelectromechanical (MEM) Microwave Systems, Artech house, 1999.
3. J. De Los Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2003.

OUTCOMES:

On completion of the course, students will be able to

- Describe the technologies of RF MEMS.
- Discuss the types of RF MEMS switches.
- Illustrate the RF MEMS based filters and phase shifters.
- Analyze the MEMS concept in transmission lines and antennas.
- Acquire knowledge in RF MEMS in wireless communication.
- Analyze the RF MEMS reliability.

ECCX 20**DISPLAY TECHNOLOGIES****L T P C****2 0 0 2****OBJECTIVES:**

- To discuss and apply the fundamentals TFT technology
- To describe the fundamental principles of Photolithography.
- To analyze about 2D and 3D displays
- To apply the micro display technologies

PREREQUISITE :

Knowledge on Properties of Light, Geometric Optics, Digital Electronics, Electron Devices and Circuits

MODULE I THIN FILM TRANSISTOR TECHNOLOGY**8**

Fundamentals of Optics for Displays- TFT Technology- classification- fabrication techniques- Flexible Displays, Applications

MODULE II LED AND LCD DISPLAY TECHNOLOGY**8**

Evolution of Display technology- LED, OLED, LCD technologies for display and applications.

MODULE III LOW POWER DISPLAY TECHNOLOGIES**7**

Paper like and Low Power Displays: Colorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Auto stereoscopic 3- D Technology, Volumetric and 3-D Volumetric Display Technology, Holographic 3-D Technology; Mobile Displays: Trans-reflective Displays for Mobile Devices, Liquid Crystal Optics for Mobile Displays, Energy Aspects of Mobile Display Technology.

MODULE IV MICRO DISPLAY TECHNOLOGIES**7**

Liquid Crystals on Silicon Reflective Micro display, Transmissive Liquid Crystal Micro display, MEMs Micro display, DLP Projection Technology; Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multifocal Displays, Occlusion Displays, Cognitive Engineering and Information Displays; Display Metrology, Standard Measurement and Advanced Measurement Procedures.

TOTAL HOURS 30

TEXT BOOKS

1. Janglin Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology", 2nd Edition, Springer Publication, 2016.

REFERENCES

1. A. Castellano, Handbook of Display Technology, Gulf Professional Publishing, 1992.

OUTCOMES:

On completion of the course, students will be able to

- Analyze the principles of various display technologies
- Illustrate the TFT and photolithography.
- Analyze the operation of LED, LCD displays
- Discuss the 3-D display technologies
- Describe the concepts of Micro display technologies.
- Apply the concept of display technologies in various filed like advertisement, cinema etc.,

ECCX 21	SIMULATION OF RF CIRCUITS AND COMPONENTS	L	T	P	C
		0	0	2	1

OBJECTIVES:

To simulate the RF components and devices using 3D Electromagnetic Software.

PREREQUISITES:

- Knowledge on electromagnetic fields and waves
- Characteristics of strip lines, waveguides, antennas

LIST OF EXPERIMENTS

1. Simulation of Rectangular and circular waveguides.
2. Simulation of wave guide Tee junction.
3. Simulation of microstripline
4. Simulation of strip line
5. Simulation of RF Low Pass & High Pass Filters
6. Simulation of RF Band pass and Band stop Filters
7. Simulation of coupled filters.
8. Simulation of Impedance matching networks
9. Simulation of RF amplifier
10. Simulation and Fabrication of Microstrip patch antenna
11. Simulation of Oscillator and Mixers

Total Hours –30**REFERENCES:**

1. David. M.Pozar,"Microwave Engineering", 3rd Edition, John Wiley and Sons, 2005.
2. S.Y.Liao, "Microwave Amplifiers and Oscillators Design", Prentice Hall, New Jersey, 1999.

OUTCOMES:

On completion of the course the students will be able to

- Theoretical modeling of a RF component.
- Numerical Analysis of the RF component.
- Analyze any RF component or circuit using a simulation tool
- Design a RF component or circuit for a specific application.
- Fabricate the RF component.
- Measure the results of fabricated circuits.

ECCX 22**RF TEST AND MEASUREMENT****L T P C****0 0 2 1****OBJECTIVES:**

- To study the measurements using network analyzers and spectrum analyzers.

PRE-REQUISITES:

- Knowledge in Electromagnetics
- Knowledge in Microwave Systems.

LAB EXPERIMENTS:

1. Vector Network analyzer Basics – S parameter Measurement.
2. S-Parameter, VSWR, Impedance measurement of Antenna.
3. S-Parameters and Impedance measurement of Passive circuits.
4. Measurements of Transmission lines.
5. Extraction of S-parameters of active devices.
6. Design, Fabrication and Measurement of 1GHZ amplifier/1090 MHz Oscillator.
7. Basics of spectrum analyzer.
8. Analysis of a spectrum of various Modulation schemes.

TOTAL HOURS 30**REFERENCES:**

1. D.M.Pozar, "Microwave Engineering", John Wiley & sons, Inc., 4th Edition, 2006.
2. User Manual of NI Vector Network Analyzer.
3. User Manual of Agilent's Spectrum Analyzer.

OUTCOMES:

On completion of the course, students will be able to

- Determine 'S' parameters for any microwave circuits or components.
- Analyze the microwave networks using VNA & Spectrum Analyser.

ECCX 23**DATA SCIENCE****L T P C****3 0 0 3****OBJECTIVES:**

- To describe and explain basic principles of Data Science
- To discuss Data Manipulation
- To identify the types of regression
- To analyze Natural Language Processing and Parallel computing

PREREQUISITE :

- Basic knowledge in data and its types
- Knowledge in programming algorithms

MODULE I DATA SCIENCE AND IDE 7

Introduction to Data Science- Toolboxes for Data Scientists- Fundamentals-IDE-Get Started with Python for Data Scientists- Reading - Selecting Data- Filtering Data- Filtering Missing Values- Manipulating Data- Sorting- Grouping Data- Rearranging Data- Ranking Data- Plotting.

MODULE II DESCRIPTIVE STATISTICS 8

Introduction - Descriptive Statistics- Data Preparation- Example- Exploratory Data Analysis- Summarizing the Data- Data Distributions- Outlier Treatment- Measuring Asymmetry- Continuous Distribution- Kernel Density- Estimation.

MODULE III SUPERVISED LEARNING 8

Introduction- Learning- Training, Validation and Test- Learning Models- Generalities Concerning Learning Models- Support Vector Machines- Random Forest- Ending the Learning Process-use cases.

MODULE IV REGRESSION ANALYSIS 7

Linear regression- Simple Linear Regression- Multiple Linear Regression and Polynomial Regression- Sparse Model- Logistic Regression- overview Unsupervised Learning.

MODULE V NETWORK ANALYSIS 8

Introduction- Basic Definitions in Graphs- Social Network Analysis - Basics in NetworkX-2 Practical Case: Facebook Dataset- Centrality- Drawing Centrality in Graphs- PageRank- Ego-Networks- Community Detection.

MODULE VI STATISTICAL NATURAL LANGUAGE PROCESSING AND PARALLEL COMPUTING 7

Introduction- Statistical Natural Language Processing -Data Cleaning- Text Representation- Bi-Grams and n-Grams - Parallel Computing- Architecture- Multicore Programming.

TOTAL HOURS 45**TEXT BOOKS**

1. Laura Igual, Santi Seguí, "Introduction to Data Science" Springer International Publishing Switzerland 2017.
2. Yunus Emrah Bulut, Zacharias Voulgaris, AI for Data Science: Artificial Intelligence Frameworks and Functionality for Deep Learning, Optimization, and Beyond, Publisher: Technics Publications, 2018.
3. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media, 1st Edition, ISBN: 9781491912058, 2016.

REFERENCES

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 1st Edition, ISBN: 9781491901427, 2015
2. Jake vander plas, "Python data science hand book", O'reilly media, 2016
3. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 1st Edition, ISBN: B009NLMB8Q, 2012.

OUTCOMES:

On completion of the course, students will be able to

- Apply the tool box to validate the data consistency.
- Explore and summarize the data
- Analyze the appropriate learning model
- Perform regression Analysis to estimate the relationship between variables
- Describe the characteristics of dataset, network and its community detection
- Evaluate the unique benefits of data representation and computation.

ECCX 24**MACHINE LEARNING****L T P C****2 0 2 3****OBJECTIVES:**

- To describe and explain basic principles of Machine learning
- To discuss about machine learning techniques
- To analyze the deep learning techniques
- To identify suitable machine learning technique for various problems

PREREQUISITE :

- Basic knowledge in Linear Algebra and Calculus
- Knowledge in Statistics and Probability

MODULE I INTRODUCTION**5**

Introduction to Artificial Intelligence- Overview of machine learning-Mathematical basics for machine learning- Linear algebra, Matrix operations, Calculus and linear regression

MODULE II MACHINE LEARNING TECHNIQUES**5**

Machine learning techniques- Supervised learning-Bayesian models-Support vector machine-K-nearest neighbour, Unsupervised learning-clustering and types of clustering and Semi-supervised learning-Expected maximisation and pseudo labelling.

MODULE III DEEP LEARNING TECHNIQUES**5**

Deep learning techniques-Convolutional neural network, Recurrent neural network-Deep belief network-Deep auto encoders.

MODULE IV DIMENSIONALITY REDUCTION**5**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms.

MODULE V MACHINE LEARNING APPLICATIONS**5**

Biomedical application - Email spam and malware filtering-Text mining, Video surveillance

MODULE VI CASE STUDY 5

Machine learning in self driving cars- Application of machine learning as Virtual personal assistant-Face recognition in social media

LAB EXPERIMENTS: 30

1. Implement anyone Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
2. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set
3. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
4. Use Principal component analysis to fit a linear regression.
5. Alzheimer's classification for brain images using Machine learning
6. Handwritten digits recognition using Machine learning

L:30 Hrs, P: 30 Hrs, Total Hours 60

TEXT BOOKS

1. Peter Wlodarczak, "Machine learning and its applications", Taylor & Francis Group, 2019.
2. Pradeep Kumar & Arvind Tiwari, "Ubiquitous Machine learning and its applications", IGI Global, 2017.
3. Bishop, C., "Pattern Recognition and Machine Learning", Berlin: Springer-Verlag, 2006.

REFERENCES

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
3. Ethem Alpaydin, "Introduction to Machine Learning" (Adaptive Computation and Machine Learning Series II), Third Edition, MIT Press, 2014.

OUTCOMES:

On completion of the course, students will be able to

- Acquire the knowledge of fundamental concepts of a machine learning
- Identify suitable mathematical technique for machine learning problems
- Describe various techniques for machine learning
- Analyze various algorithms for deep learning
- Use suitable dimensionality reduction technique
- Recognize and apply suitable techniques for machine learning applications

ECCX 25**ROBOTICS AND ITS APPLICATIONS****L T P C****3 0 0 3****OBJECTIVES:**

- To describe the terminology of robotics and their specifications.
- To compare the different types of control mechanism used in robotics.
- To demonstrate the robot transformation and sensors.
- To explain micro/nano robotic working principle and their overall system.
- To present a problem oriented in depth knowledge of Artificial Intelligence and Robotics. .
- To address the underlying concepts, methods and application of different Artificial Intelligence and Robotics.

PREREQUISITE :

Basics of electronic circuits, sensors and Kinematics of Machine

MODULE I INTRODUCTION**8**

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems.

MODULE II END EFFECTORS AND ROBOT CONTROLS**7**

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT Motion Interpolations-Adaptive control.

MODULE III ROBOT TRANSFORMATIONS AND SENSORS**7**

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation-Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

MODULE IV ROBOT CELL DESIGN AND NAVIGATION**8**

Robot work cell design and control-Sequence control, Operator interface, Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control

architectures - Cartesian control, Force control and hybrid position/force control, Behavior based control.

MODULE V MICRO/NANO ROBOTICS SYSTEM 8

Micro/ Nano robotics system overview-Scaling effect-Top down and bottom up approach Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biometric robot-Swarm robot-Nano robot in targeted drug delivery system.

MODULE VI ROBOT CONTROL, PROGRAMMING AND APPLICATIONS 7

Application of Neural network, fuzzy logic, optimization algorithms for navigation problems. Robotic Programming, On-line and off-line programming. Robot applications- Manufacturing industries, Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting, robots in surgery, space and underwater.

TOTAL HOURS 45

TEXT BOOKS

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
- 3 Robert J Schilling, Fundamentals of Robotics Analysis and Control, PHI.

REFERENCES

1. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.
2. Craig. J. J. "Introduction to Robotics mechanics and control", Addison-Wesley, 1999
3. K.S. Fu, R. C. Gonzalez and C.S.G. Lee, Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 2008.
4. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw Hill, Int. 2008.
5. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book co, 1987.

6. Ghosal, Robotics Fundamental Concepts and Analysis, Oxford University Press India, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Acquire basic knowledge on Robots.
- Ability to process end effectors and robotic controls.
- Analyze robot Transformations and Sensors.
- Describe the robot cell design and applications
- Develop skills in deploying various sensors, robot peripherals and their use in a manufacturing system
- Develop skills in identifying areas of robotics can be deployed for enhancing productivity.

ECCX 26	DSP ARCHITECTURE AND PROGRAMMING	L T P C
		3 0 0 3

OBJECTIVES:

- To describe the architecture of programmable digital signal processor.
- To implement basic DSP functions in processor TMS320C5XX
- To apply TMS320C5XX for real time applications.

PREREQUISITE :

- Basics of signals and systems
- Knowledge in microcontrollers and microprocessors

MODULE I FUNDAMENTALS OF DSP PROCESSORS 7

Multiplier and Multiplier accumulator, Modified Bus Structures and Memory access in PDSPs, Multiple access memory, Multi-ported memory, VLIW architecture, Pipelining, Special Addressing modes in P-DSPs, on chip Peripherals.

MODULE II COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATION 7

Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementation, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors.

MODULE III ARCHITECTURES OF DIGITAL SIGNAL PROCESSOR 9

Basic Architectural features, DSP computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed issues Features for External interfacing.

MODULE IV PROGRAMMABLE DIGITAL SIGNAL PROCESSORS 10

Commercial Digital signal-processing Devices, TMS320C54XX DSP: Data Addressing mode, Memory space, Program Control, Instructions and Programming, On-Chip peripherals, Interrupts, Pipeline Operation, Introduction to code composer studio.

MODULE V TMS320C6XDSPs 6

Introduction, features of TMS320C6X processor, internal architecture, functional

units and its operations, addressing modes in C6x, memory architecture, peripherals.

MODULE VI IMPLEMENTATION OF BASIC DSP ALGORITHMS 6

The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, Adaptive Filters, 2-D signal processing, An FFT Algorithm for DFT Computation, Computation of signal spectrum.

TOTAL HOURS 45

TEXT BOOKS:

1. Sen-Maw Kuo, Woon-Seng Gan, "Digital signal processors architectures, implementations, and applications", Pearson Prentice Hall, 2005
2. Avtar Singh, S. Srinivasan, "DSP Implementation using DSP microprocessor with Examples from TMS32C54XX" - Thomson 2004
3. B. Venkataramani, M. Bhaskar "Digital Signal Processors: Architecture, Programming and Applications", Tata McGraw-Hill Education, 2002

REFERENCES:

1. Alan V. Oppenheim, "Discrete-Time Signal Processing", Pearson Education India, 2006.
2. Jonathan Stein, "Digital signal processing" John Wiley 2005.
3. Phil Lapsley, Jeff Bier, Amit Shohan, Edward A Lee, "DSP Processor Fundamentals, Architectures & Features". S. Chand & Co, 2000
4. S. K. Mitra, "Digital Signal Processing", Tata McGraw-Hill Publication, 2001.

OUTCOMES:

On completion of the course, students will be able to

- Recognize the fundamentals of fixed and floating point architectures of various DSPs.
- Estimate DSP computational errors.
- Describe the architectural features of DSP processors
- Select appropriate DSP processors for signal processing applications.
- Make use of TMS3206X processors in real time applications
- Implement various DSP algorithms.

ECCX 27**DEEP LEARNING****L T P C****3 0 0 3****OBJECTIVES:**

- To analyze the basics of deep networks.
- To describe the deep learning algorithms.
- To apply the deep learning algorithms for various applications.
- To use deep learning in research

PREREQUISITE :

- Basics of cognitive science and artificial learning

MODULE I DEEP FEEDFORWARD NETWORKS**6**

Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms.

MODULE II REGULARIZATION FOR DEEP LEARNING**9**

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop, and Manifold Tangent Classifier.

MODULE III OPTIMIZATION FOR TRAINING DEEP MODELS**8**

Differentiation of learning from pure optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

MODULE IV CONVOLUTIONAL NETWORKS**9**

The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuro scientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning.

MODULE V SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS 8

Recurrent Neural Networks - Bidirectional RNNs - Encoder-Decoder Sequence-to-Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks.

MODULE VI DEEP LEARNING APPLICATIONS 5

Large scale Deep Learning, Computer Vision, Speech Recognition,

TOTAL HOURS 45**TEXT BOOKS**

1. Good fellow I., Bengio Y., and Courville A., Deep Learning, MIT Press, 2016.
2. Bishop C.M, Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCES

1. Yegnanarayana B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub G. H., and Van Loan C., Matrix Computations, JHU Press, 2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
4. A. Ravindran, K. M. Ragsdell, and G. V. Reklaitis, Engineering Optimization: Methods and Applications, John Wiley & Sons, Inc., 2016.
5. A. Antoniou, W. S. Lu, Practical Optimization Algorithms and Engineering Applications, Springer, 2007.

OUTCOMES:

On completion of the course, students will be able to

- Apply the fundamentals of deep networks.
- Analyze the techniques of deep learning.
- Investigate the functions and algorithms used for Convolutional networks.
- Elaborate the associate rules and various clustering
- Use the appropriate deep learning algorithm in problem solving
- Evaluate the effect of deep learning

ECCX 28	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the human machine interface.
- To introduce the methods and tools in Augmented reality
- To learn about the physiological considerations in virtual reality.
- To introduce the concept of synthetic environment system.

PREREQUISITES:

- Basic knowledge about systems and controls.
- Basic knowledge about coordinate systems and transforms

MODULE I HUMAN SYSTEM INTERFACE 8

Introduction - Design, Control, and Evaluation of a Hyper-redundant Haptic Device-Man-Machine Interface Systems for operation and Interaction - Acquisition, Processing and Display for robotic Applications

MODULE II AUGMENTED REALITY 7

Introduction- Definition-components of augmented reality-Differences between Augmented reality and virtual reality- Augmented reality methods- Augmented reality display technology- Augmented reality tools.

MODULE III AUGMENTED REALITY DEVELOPMENT ENVIRONMENT 8

Abstraction and implementation- design activities for AR-real time 3D design and modeling-Interface Design and Evaluation of Augmented Reality Applications

MODULE IV VIRTUAL REALITY 8

Virtual reality: Overview – Physiological considerations-visual channel-Auditory channel-Haptic interfaces-Position tracking and mapping

MODULE V VIRTUAL REALITY HARDWARE 7

Motion Interfaces - Speech, Physiology and other interfaces - computer hardware and software for generation of virtual environment.

MODULE VI APPLICATIONS OF AUGMENTED REALITY AND VIRTUAL REALITY 7

Augmented reality in education, sports, gaming, entertainment and medicine.-

Synthetic Environment system –Virtual reality techniques in flight simulation-using virtual reality techniques in animation process.

TOTAL HOURS 45

TEXT BOOKS

1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human factors for Augmented reality and Virtual reality", Pearson Education, 2017.
2. Greg Kipper, Joseph Rampolla, "Augmented Reality An Emerging Technologies Guide to AR", Elseiver, 2012
3. R.A. Earnshaw, M.A.Gigante, H.Jones,"Virtual reality systems", Academic Press, 2014

REFERENCES

1. Nathaniel I. Durlach and Anne.S, "Virtual Reality: Scientific and Technological Challenges", Academic Press,1995
2. Manuel Ferre, Martin Buss, Rafael Aracil, Claudio Melchiorri and Carlos Balaguer", Advances in Telerobotics", Springer.2007.
3. Jason Jerald ", The VR Book: Human-Centered Design for Virtual Reality", ACM Books, 2015.
4. Bruno Siciliano, Oussama Khatib," Springer Handbook of Robotics", springer, 2016.

OUTCOMES:

On completion of the course, students will be able to

- Describe the human machine interface systems.
- Enumerate the components and methods for Augmented reality.
- Illustrate the applications of Augmented reality systems
- Compare the physiological considerations of visual and auditory channels in virtual reality systems.
- Explain the hardware and software interfaces in virtual reality.
- Discuss about applications of virtual reality.

L – 45; Total Hours –45**TEXT BOOKS:**

1. Dr.R.P.Das, L.Sreedhar, "Neural Networks and Fuzzy Logic", S.K. Kataria & Sons; 2012
2. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall, New Delhi, 2004.
3. Chennakesava R. Alavala, "Fuzzy logic & Neural Networks", New Age International, 2008
4. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, West Sussex, England, 2005.
5. B.Yegnanarayana," Artificial neural networks ", Prentice Hall of India P Ltd 2005.

REFERENCES:

1. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002.
2. Klir G.J. & Folger T.A., "Fuzzy sets, Uncertainty and Information", Prentice – Hall of India Pvt. Ltd., New Delhi, 2008.
3. Zimmerman H.J., "Fuzzy set theory and its Applications", Kluwer Academic Publishers Dordrecht, 2001.
4. Laurance Fausett, Englewood cliffs, N.J., "Fundamentals of Neural Networks", Pearson Education, New Delhi, 2008.

OUTCOMES:

On completion of the course, students will be able to

- Analyze the concepts of feed forward neural networks
- Discuss about feedback networks.
- Apply the concept of fuzziness involved in various systems.
- Evaluate the fuzzy set theory.
- Design the fuzzy control system with appropriate algorithms.
- Apply the fuzzy logic control to recognize the various image pattern, symbols and characters

ECCX 30**ARTIFICIAL INTELLIGENCE****L T P C****2 0 2 3****COURSE OBJECTIVES:**

- To become familiar with AI and machine learning concepts.
- To explain the mathematical background for carrying out the optimization.
- To familiarize with genetic algorithms and other random search procedures.

PREREQUISITES:

- Basic knowledge in mathematics and algorithms.
- Fundamentals of digital electronics

MODULE I INTRODUCTION TO AI 10

History of Artificial Intelligence, AI problems, AI technique, philosophy and development of Artificial intelligence. Introduction to Bayes' Rule.

Practicals:

- Introduction and installation of open source software(Python/R/etc)
- Write a program to implementation of basic logic operations.
- Write a program to show concept of list, data types and keywords.
- Write a program to solve the problem through prediction using Baye's rules

MODULE II PROBLEM SPACES AND SEARCH 10

Search process and AI, Brute force, Depth first, Breadth first search techniques, Hill climbing, Best first search, AND/OR graphs, A* algorithm, Constraint satisfaction.

Practicals:

- Solve any problem using depth first / Breath first search.
- Solve the salesman routing problem using A* algorithm
- Solve the given tree using AND /OR graph

MODULE III AI AND GAME PLAYING 10

Major components of a game playing program, plausible move generator, static evaluation, function generator, Minimal strategy, Alpha and Beta techniques, problems in computer game playing programs.

Practicals:

- Write a program to solve 8 queens problem.
- Write a Program to demonstrate family relationship.
- Solve the given problem using mini-max algorithm

MODULE IV KNOWLEDGE REPRESENTATION 10

Logic, Propositional logic, Tautology, Contradiction, Normal forms, Predicate logic - Rules of inference, Resolution, Unification algorithm, Production rules - Semantic networks. Frames – Scripts - Conceptual dependency.

Practicals:

- Implement a Boe-Bot navigation with Infrared Headlights and Phototransistors
- Formulate a propositional logic to identify a particular disease based on symptoms.

MODULE V KNOWLEDGE ENGINEERING 10

Design and architecture of expert systems, Expert system life cycle, Knowledge acquisition, difficulties, strategies, major applications areas, Qualitative study of expert systems.

Practicals:

- Solve Robot (traversal) problem using means End Analysis.
- Solve Wireless Sensor Node traversing using means End Analysis.
- Acquire the real time EEG signal using “brain sensor” and differentiate different states (eye open and eye closed conditions).

MODULE VI MACHINE LEARNING 10

Frame work for learning- Linear algebra – Inductive learning –Supervised, Unsupervised learning – Parallel distributed processing – Genetic Algorithms.

Practicals:

- Extract statistical feature from given data set (use any open data source ex., Gaggle, BONN , Physionet etc.,)
- Cluster the given data set as two groups using KNN clustering/Fuzzy clustering methods
- Classify the real time EEG signal (eye open state \ eye closed state) using any two supervised machine learning algorithm and compare its accuracy value of classification. (Use “Brain sensor” for acquiring real time EEG data)

L: 30 Hrs, P:30 Hrs - Total Hours 60

TEXT BOOKS:

1. Stuart J. Russel, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3rd Edition, Pearson Education India, 2015.
2. Wolfgang Ertel, & quot; Introduction to Artificial Intelligence & quot;; 2nd Edition, Springer, 2018.

REFERENCES

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", 3 rd Edition, McGraw Hill, Education, 2017.
2. Waymond Rodgers, & quot; Artificial Intelligence in a Throughput Model & quot;, CRC Press, 2020.
3. Patrick Henry Winston, "Artificial Intelligence", 3 rd Edition, Pearson Education, 2002.
4. George F. Luger, William A. Stubblefield, & quot; AI Algorithms, Data Structures, and Idioms in Prolog, Lisp and Java & quot;, Pearson Education, 2009.
5. George F. Luger and William A. Stubblefield, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson Education, 2002.

OUTCOMES:

On completion of the course the students will be able to

- Demonstrate fundamentals of artificial intelligence and its functions.
- Apply basic principles of AI for problem solving, inference, perception, knowledge representation, and learning.
- Apply AI techniques in intelligent agents, and other machine learning models.
- Provide solutions for various applications using AI tools.
- Apply knowledge representation, reasoning, and machine learning techniques to societal problems.
- Compare various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms).

ECCX 31	INTRODUCTION TO RECONFIGURABLE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basic concepts of Reconfigurable computing
- Various FPGA designs
- Modeling and programming various reconfigurable systems
- Mapping algorithms for reconfigurable architectures
- Design and development of Various Reconfigurable architectures.
- Applications development of reconfigurable systems

PRE-REQUISITES:

- Basics of VLSI Design
- Fundamental knowledge of FPGA architecture

MODULE I RECONFIGURABLE COMPUTING HARDWARE 8

Device Architecture- The Computational Fabric- Array and Interconnect-Extending Logic, Configuration, Reconfigurable Processing Fabric Architectures, RPF Integration into Traditional Computing Systems

MODULE II PROGRAMMING RECONFIGURABLE SYSTEMS 8

Computer Models and System Architectures, Hardware Compilation Flow, VHDL Programming, Hardware Compilation Flow.

MODULE III MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 8

Structural Mapping Algorithms- Integrated Mapping Algorithms Mapping Algorithms for Heterogeneous Resources- FPGA Placement Problem.

MODULE IV RETIMING AND FAST COMPILATION 7

Retiming: Concepts, Algorithm, and Restrictions- Re-pipelining and C-slow Retiming Implementations of Retiming- Retiming on Fixed-frequency FPGAs-C-slowing as Multithreading.

MODULE V CASE STUDIES OF FPGA APPLICATIONS 7

SPIHT Image Compression- Multi- FPGA Systems: Logic Emulation.

MODULE VI APPLICATION DEVELOPMENT**7**

Strengths and Weaknesses of FPGAs-Application Characteristics and Performance-
General Implementation Strategies for FPGA-based Systems- Implementing
Arithmetic in FPGAs

Total Hours: 45**TEXT BOOKS:**

1. Scott Hauck and Andre DeHon, "Reconfigurable Computing: The Theory and Practice of FPGA-Based computation". Morgan Kaufmann Publishers, 2008.

REFERENCES:

1. M.Gokhale and P.Graham, "Reconfigurable Computing: Accelerating Computation with Field Programmable Gate Arrays", Springer Publications, 2005.
2. C.Bobda," Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications", Springer Publications, 2007.

OUTCOMES:

On completion of the course, students will be able to

- Analyze various reconfigurable architectures.
- Apply various methodologies to reconfigure FPGA.
- Implement fast compilation techniques in architecture design.
- Develop modules and applications using high level languages and tools.
- Design and build an SOPC for a specific application.
- Design FPGA and programming reconfigurable systems.

ECCX 32	INTRODUCTION TO SYSTEM VERILOG FOR VERIFICATION	L T P C
		3 0 0 3

OBJECTIVES:

- To know the Fundamentals of system verilog, Design, verification and testing methodologies.
- To make productive RTL design
- To Build a complete verification environment function coverage

PRE-REQUISITES:

- Basic VLSI design.

MODULE I VERIFICATION GUIDELINES 6

Verification Process, Verification Plan, Verification Methodology Manual, Basic Test bench functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Test bench Components, Layered Test bench, Building a Layered Test bench, Simulation Environment Phases, Maximum Code Reuse, Test bench Performance.

MODULE II DATA TYPES 8

Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width, Net Types.

MODULE III PROCEDURAL STATEMENTS AND ROUTINES 8

Procedural Statements, Tasks, Function Overview, Task functions and Void functions, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

MODULE IV BASIC OOP 8

Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Static Variables Vs. Global Variables, Class Routines, Defining Routines Outside of the Class, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public Vs. Private, Straying Off Course, Building a Testbench.

MODULE V CONNECTING THE TESTBENCH AND DESIGN 8

Separating the Testbench and Design, The Interface Construct, Stimulus Timing, Interface Driving and Sampling, Top-Level Scope, Program – Module Interactions, System Verilog Assertions, The Four-Port ATM Router.

MODULE VI RANDOMIZATION 7

Randomization in System Verilog, Constraint Details, Solution Probabilities, Controlling Multiple Constraint Blocks, Valid Constraints, In-line Constraints, The pre-randomize and post-randomize Functions, Constraints Tips and Techniques, Common Randomization Problems, Iterative and Array Constraints, Atomic Stimulus Generation Vs Scenario Generation, Random Control, Random Generators, Random Device Configuration.

Total Hours –45

TEXT BOOKS:

1. Chris Spear, "SystemVerilog for Verification A Guide to Learning the Test bench Language Features", Springer, 1st edition, 2006, ISBN-10: 0-387-27036-1.
2. Stuart Sutherland, Simon David Mann, Peter Flake, "System Verilog For Design", Springer, 2nd edition, ISBN-10: 0-387-33399-1, 2006.

REFERENCES

1. Mark Zwolinski, "Digital system design using FPGA", McGraw Hill Professional ,1st edition, 2017

OUTCOMES:

On completion of the course, students will be able to

- Understand Fundamental syntax of system verilog.
- Create a verification environment.
- Run high level synthesis.
- Learn the fundamentals of OOPS.
- Employ various verification techniques.
- Evaluation of concepts of OOPS.

Nanoparticles-Catalysis by Gold Nano particles-Quantum devices – nano mechanics-Carbon nano tube emitters-Energy applications of nanomaterials-environmental applications of nano materials

TOTAL HOURS 45

TEXT BOOKS

1. Guozhong Cao, Ying Wang “Nanostructures and Nano materials” world scientific series in nanoscience and nanotechnology 2nd edition 2016
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press, 2011.
3. M.S. Ramachandra Rao, Shubra Singh, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

REFERENCES

1. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
2. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st Edition, Overseas Press, New Delhi, 2005
3. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.

OUTCOMES:

On completion of the course, students will be able to

- Discuss about the synthesis of Nano materials
- Describe various fabrication techniques of Nano structures
- Compare different characterization techniques
- Explain about Nano devices
- Apply the knowledge of different types of Nanomaterial for various Engineering applications

ECCX 34	EMBEDDED PROCESSOR FOR DIGITAL SIGNAL PROCESSING	L T P C
		3 0 0 3

OBJECTIVES:

- To study the architecture of embedded processor.
- To introduce the number formats and quantization in real time processing..
- To learn the memory systems and data transfer in Blackfin Processor.
- To introduce the concept of code optimization and power management.

PRE-REQUISITES:

- Knowledge in electronic circuits, DSP, microprocessors

MODULE I INTRODUCTION TO EMBEDDED PROCESSOR 4

Embedded Processor: Micro Signal Architecture -Real-Time Embedded Signal Processing

MODULE III BLACKFIN PROCESSOR 6

The Blackfin Processor: An Architecture for Embedded Media Processing-
Introduction to Micro Signal Architecture-Overview of the Blackfin Processor-
Architecture: Hardware Processing Units and Register Files-Bus Architecture and
Memory-Basic Peripherals

MODULE III REAL-TIME DSP FUNDAMENTALS AND IMPLEMENTATION CONSIDERATIONS 9

Number Formats Used in the Blackfin Processor-Fixed-Point Formats -Fixed-Point
Extended Format -Fixed-Point Data Types -Emulation of Floating-Point Format -
Block Floating-Point Format-Dynamic Range, Precision, and Quantization Errors -
Incoming Analog Signal and Quantization -Dynamic Range, Signal-to-Quantization
Noise Ratio, and Precision -Sources of Quantization Errors in Digital Systems-
Overview of Real-Time Processing

MODULE IV MEMORY SYSTEM AND DATA TRANSFER 10

Overview of Signal Acquisition and Transfer to Memory-DMA Operations and
Programming-Using Cache in the Blackfin Processor-Comparing and Choosing
Between Cache and Memory DMA- Scratchpad Memory of Blackfin Processor

MODULE V CODE OPTIMIZATION AND POWER MANAGEMENT 10

Using Assembly Code for Efficient Programming - Using Hardware Loops - Using Dual MACs -Using Parallel Instructions -Special Addressing Modes: Separate Data Sections - Using Software Pipelining- Power Consumption and Management in the Blackfin Processor

MODULE VI DSP APPLICATIONS 6

Overview of Audio Compression -Audio Encoding -Audio Decoding- Digital Image Processing- Overview of Image Representation- Color Conversion- Image Enhancement

TOTAL HOURS 45**TEXT BOOKS**

1. Woon-Seng Gan, Sen M. Kuo, "Embedded Signal Processing with the Micro Signal Architecture", Wiley-IEEE Press, January 2007.

REFERENCES

1. Proakis and Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications, Pearson, July 2013
2. S.K. Mitra, "Digital Signal Processing", Mc-Graw Hill, 3rd Edition, 2006.
3. Sinha, Priyabrata, "Speech Processing in Embedded Systems", Springer 2010.
4. Phil Lapsley, Jeff Bier, Amit Shoham, Edward A. Lee, "DSP Processor Fundamentals: Architectures and Features", Wiley-IEEE Press, 2017.
5. Edward Ashford Lee and Sanjit Arunkumar Seshia, "INTRODUCTION TO EMBEDDED SYSTEMS", Second Edition, 2017

OUTCOMES:

On completion of the course, students will be able to

- Describe the architecture of embedded processor.
- Differentiate the Number Formats Used in Blackfin processor.
- Analyze the Quantization Errors in Digital Systems
- Compare DMA Operations and Cache in Blackfin Processor
- Optimize the codes and Power Consumption in Blackfin Processor.
- Acquire knowledge about applications of DSP.

ECCX 35	GPU ARCHITECTURE AND PROGRAMMING	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the basics of programming for heterogeneous architectures
- To analyze the basic concepts and programming for massively parallel processors
- To find out the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

PREREQUISITE :

Knowledge on Microprocessor & Microcontroller and Computer Architecture

MODULE I GPU ARCHITECTURE 9

Introduction to Graphics Processing Units (GPU) - GPU architecture - Parallelism with GPU- Traditional Serial code, Serial/Parallel Problems, Types of Parallelism- Task-based parallelism, Data-based parallelism- PC Architecture, GPU Hardware – Threads- Threading on GPUs, Blocks arrangement, Grids-Stride and offset, Warps-Branching, GPU utilization, Block Scheduling - Memory Handling with CUDA- Shared Memory, Constant Memory, Global Memory and Texture Memory.

MODULE II GPU PROGRAMMING 8

GPU Programming using CUDA –Serial and Parallel code, Processing Datasets, Multi GPU systems - Multi GPU systems – Algorithm on Multiple GPUs, Single – Node Systems, Multiple-Node Systems and Optimizing CUDA Applications.

MODULE III ERROR HANDLING 7

CUDA Error Handling, Kernel launching and bounds checking, Parallel Programming Issues- Race hazards, Synchronization, Algorithmic Issues- Back-to-back testing, Memory leaks, Finding and Avoiding Errors.

MODULE IV ALGORITHMS ON GPU 8

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster - CUDA Dynamic Parallelism.

MODULE V GPU PROGRAMMING MODELS 7

Introducing OpenGL- Background, Data Parallelism Model, Device Architecture, Kernel Functions, Device Management and Kernel Launch, Electrostatic Potential

Map in OpenGL, Open ACC, Thrust.

MODULE VI GPU APPLICATIONS

6

Non Cartesian Magnetic Resonance Imaging, Molecular Visualization and Analysis, Machine Learning, Parallel Programming and computational thinking, Programming a Heterogeneous computing cluster.

TOTAL HOURS 45

TEXT BOOKS

1. Shane Cook, CUDA Programming: "A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors - A Hands-on Approach", Second Edition, Morgan Kaufmann, 2012.

REFERENCES

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison - Wesley, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison - Wesley, 2010.

OUTCOMES:

On completion of the course, students will be able to

- Describe the basics of programming for heterogeneous architectures
- Analyze the various programming for massively parallel processors
- Classify the Parallel Programming Issues during execution of program
- Describe the CUDA Dynamic Parallelism
- Realize the issues in mapping algorithms for GPUs
- Summarize the different GPU programming models

ECCX 36	PROGRAMMING IN EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the design of embedded computing systems with its hardware and software architectures
- To describe entire software development lifecycle and examine the various issues involved in developing software for embedded systems.
- To analyze the I/O programming and Embedded C coding techniques
- To equip students with the software development skills necessary for Practitioners in the field of embedded systems.

PRE-REQUISITES:

- Embedded System Concepts and C Language

MODULE I DATA REPRESENTATION IN EMBEDDED SYSTEMS 6

Introduction to embedded system-Fixed-Precision binary numbers-Binary representation of integers-Binary representation of Real numbers-integer data types-mixed data types-manipulating bits in memory, I/O ports- Accessing memory mapped I/O Devices-Structures

MODULE II C PROGRAMMING CONCEPTS 8

Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization.

MODULE III EMBEDDED C 9

Programming Embedded System In C-Introducing 8051 Microcontroller-Keil Software-Reading Switches- Adding Structure To C Code- Meeting Real Time Constraints-Creating An Embedded Operating System-Multistate Systems And Function Sequences- Serial Interface.

MODULE IV INPUT/OUTPUT PROGRAMMING 6

Mixing c and assembly-I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Direct memory access.

MODULE V MEMORY MANAGEMENT 7

Scheduling-Objects In C-Automatic Allocation-Static Allocation-Object Creation, Initialization and Destruction-Dynamic Allocation-Automatic Allocation With Variable Size-Recursive Function –Shared Memory.

MODULE VI PYTHON PROGRAMMING 9

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

Total Hours: 45

TEXT BOOKS:

1. Michael J Pont, "Embedded C", Pearson Education, 2008.
2. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education
3. Allen Downey, "Think Python", second edition, Green Tea Press,2015

REFERENCES:

1. Mohamammad Ali Mazidi & Mazidi, "8051 Microcontroller and Embedded Systems", Pearson Education,2006
2. Jason Cannon, "Python Programming for Beginners" O,Reilly, 2012
3. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Write, compile and debug programs in C language.
- Develop program using embedded C
- Analyze the Real-time constraints in embedded systems
- Describe memory management in embedded systems
- Program using python language
- Design projects using embedded C and python language

ECCX 37	MULTI-CORE ARCHITECTURE AND PARALLEL PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study multicore architecture and their design issues.
- To Program distributed and shared memory architecture.
- To know various types of multicore architecture and application.

MODULE I INTRODUCTION TO MULTI-CORE ARCHITECTURE 8

Motivation for concurrency in software-Parallel computing Platforms-Parallel computing in Microprocessors-Differentiating Multi-core architectures from Hyper-threading technology-Multithreading on Single-Core versus Multi-core platforms-understanding performance-Amdahl's law-Gustafson's law-Homogeneous multi-core-Heterogeneous multi-core

MODULE II PARALLEL HARDWARE 7

The basics of caching- Cache mappings- Virtual memory- Instruction-level parallelism- Hardware multithreading- SIMD systems- MIMD systems - Interconnection networks- Cache coherence- Shared-memory versus distributed-memory

MODULE III PARALLEL SOFTWARE 7

Coordinating the processes/threads- Programming hybrid systems- Input and Output- Scalability- Parallel Program Design

MODULE IV DISTRIBUTED-MEMORY PROGRAMMING WITH MPI 8

Getting Started- Compilation and execution- MPI programs- Communicators- SPMD programs- Communication- Message matching- The Trapezoidal Rule in MPI- Dealing with I/O- Collective Communication- MPI Derived Datatypes- Performance Evaluation of MPI Programs

MODULE V SHARED-MEMORY PROGRAMMING WITH OPENMP 8

Compiling and running OpenMP programs- The Trapezoidal Rule- The Reduction Clause- The parallel for Directive- Loops in OpenMP- Scheduling Loops- Producer-Consumer Synchronization - Caches, Cache Coherence, and False Sharing- Thread-Safety.

MODULE VI CASE STUDIES**7**

Intel Core Duo, Intel i7, AMD Dual Core Opteron, SUN UltraSPARC Multicore, Freescale Embedded Multicore, IBM cell.

L – 45; Total Hours - 45**TEXT BOOKS:**

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Elsevier, 1st edition, 2011
2. Shameem Akhtar and Jason Roberts, "Multi-core Programming", 2nd Edition, Intel Press, 2006.
3. Richard Y. Kain, "Advanced Computer Architecture a Systems Design Approach", Prentice Hall, 1st edition, 2011.

REFERENCES:

1. Kai Hwang and Zhi Wei Xu, "Scalable Parallel Computing", Tata McGraw Hill, New Delhi, second edition, 2003.
2. Kai Hwang and Faye Briggs, "Computer Architecture And Parallel Processing", Mc Graw-Hill International Edition, second edition, 2000.
3. David E. Culler, Jaswinder Pal Singh, "Parallel computing architecture: A hardware/software approach", Morgan Kaufmann Elsevier Publishers, 1st edition, 1999.

OUTCOMES:

On completion of the course the students will be able to

- Analyze the functions of multicore architecture
- Compare various multicore processor architectures
- Discuss the architecture of Vector, SIMD and GPU architecture
- Develop parallel programming using MPI for DSM
- Develop programme for shared memory architecture using OpenMP
- Describe the existing multicore architecture

ECCX 38	ADVANCED COMPUTER ARCHITECTURE	L T P C
		3 0 0 3

OBJECTIVES:

- To know the architectural design of a processor
- To understand Pipelining techniques.
- To know the Memory and IO concepts
- To Design a custom made processor.
- To know the techniques to improve performance and save power

PRE-REQUISITES:

- Basics of Computer architecture.

MODULE I FUNDAMENTALS OF COMPUTER DESIGN 6

Review of Fundamentals of CPU, Memory and IO – Trends in technology, power, energy and cost, Dependability - Performance Evaluation.

MODULE II INSTRUCTION LEVEL PARALLELISM 8

ILP concepts – Pipelining overview - Compiler Techniques for Exposing ILP – Dynamic Branch Prediction.

MODULE III SCHEDULING 8

Dynamic Scheduling – Multiple instruction Issue – Hardware Based Speculation – Static scheduling - Multi-threading - Limitations of ILP

MODULE IV DATA-LEVEL PARALLELISM 8

Vector architecture – SIMD extensions – Graphics Processing units – Loop level parallelism.

MODULE V THREAD LEVEL PARALLELISM 8

Symmetric and Distributed Shared Memory Architectures – Performance Issues – Synchronization – Models of Memory Consistency.

MODULE VI MEMORY AND I/O 7

Cache Performance – Reducing Cache Miss Penalty and Miss Rate – Reducing Hit Time – Main Memory and Performance – Memory Technology. Types of Storage Devices – Buses.

Total Hours – 45

TEXT BOOK

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012

REFERENCES

1. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 1st edition, 2000.
2. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 1st edition, 2000.

OUTCOMES:

On completion of the course, students will be able to

- Analyze the performance of a processor.
- Compare different pipelining techniques.
- Efficiently draw time space diagram.
- Resolve the bottle necks for efficient processor design
- Evaluate memory related issues
- Apply and Performance the performamnce of memory technology

ECCX 39	ROBOTICS AND AUTONOMOUS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basics of autonomous systems.
- To know about the issues and challenges in autonomous systems
- To learn locomotion, perception measurement techniques, localization, path planning and navigation.

PREREQUISITES :

- Basic knowledge in Engineering Mathematics
- Basic concepts in designing, prototyping, analysis, coding algorithms, electronics circuitry, control systems etc.

MODULE I INTRODUCTION 7

Tele-operated Robot – Master and slave - Autonomous Robot - Components of autonomous robotic system – challenges in autonomous robot – redundant manipulator – types of autonomous robotic system.

MODULE II LOCOMOTION AND KINEMATICS OF WHEELED MOBILE ROBOT 8

Types of locomotion – Key issues in locomotion –Wheeled mobile robot – types of wheel – wheel stability – wheel configurations - biomimetic locomotion, Hilare mobile robot – car-link mobile robot – Degree of mobility- Instantaneous Center of Rotation

MODULE III PERCEPTION 7

Dead Reckoning- Heading Sensors- Vehicular Radar - Ground-Based RF Beacons and GPS, Sensors for Map-Based Positioning- Odometry- Active Beacon Navigation Systems- Landmark, Sizing and Torque Calculations.

MODULE IV LOCALIZATION 8

Self-localizations and mapping - Challenges in localizations – IR based localizations – vision based localizations – Ultrasonic based localizations -Map representation and Map building- Map based localization scheme – other localization systems.

MODULE V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 8

Introduction – Competences for Navigation, Planning and Reacting, Path planning, Road map, 40 Cell decomposition, Potential field – Obstacle avoidance, Bug algorithm – A*algorithm - Vector field histogram – Dynamic window approach - Navigation Architectures.

MODULE VI MULTI ROBOTS AND ITS APPLICATION 7

Leader based multi robot system – leader less mobile robot system - task allocation – fault tolerance – swarm robotics. Applications - Military mobile robots – Underwater robots – Service robot – Surveillance robots – Nano robots – Case study.

Total Hours 45**TEXT BOOKS**

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza: Introduction to Autonomous Mobile Robots, The MIT Press, 2011.
2. Bruno Siciliano, Oussama Khatib, Handbook of Robotics 2nd edition, Springer, 2016.

REFERENCE BOOKS

1. Farbod Fahimi, Autonomous Robots Modeling, Path Planning and control, Springer, 2009.
2. Shuzhi Sam Ge, Autonomous Mobile Robots: Sensing, Control, Decision making and Applications, CRC Press, Taylor and Francis Group, 2006.
3. Jitendra R. Rao, Ajith K. Gopal, Mobile Intelligent Autonomous Systems, CRC Press, Taylor and Francis Group, 2012.
4. Krzysztof Kozłowski, Robot Motion and Control, Springer, 2012.

OUTCOMES :

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

- Differentiate between various types of mobile and autonomous robots
- Prove solution to the key challenges of various autonomous robots
- Apply the knowledge about locomotion and perception for mobile robotic system
- Apply the knowledge about localization and path planning for mobile robotic system
- Create the navigation system
- Ability to understand the characteristics of multi-robotic system

ECCX 40**IC TECHNOLOGY****L T P C****3 0 0 3****OBJECTIVES:**

- To discuss and apply the fundamentals of IC growth techniques.
- To describe the fundamental principles of CMOS Fabrication.
- To analyse the semiconductor measurements, packaging and testing
- To discuss physical mechanism in novel devices.

PREREQUISITE :

Knowledge on Digital Electronics, Electron Devices and Circuits

MODULE I ENVIRONMENT AND CRYSTAL GROWTH FOR IC TECHNOLOGY 8

Introduction to CMOS, Semiconductor technology trends, Clean rooms, Wafer cleaning, Semiconductor Substrate, Crystal structure, Crystal defects, Czochralski growth, Float Zone growth, Wafer Preparation and specifications

MODULE II FABRICATION OF CMOS INTEGRATED CIRCUITS 7

An overview of silicon semiconductor technology, Wafer processing, Oxidation, Epitaxial deposition, ion-implantation and diffusion , Silicon gate process Basic CMOS Technology, Basic n-well CMOS process, P-well process, Twin-Tub process, Silicon-on-Insulator process

MODULE III INTERCONNECTIONS AND CONTACTS, PACKAGING AND YIELD 7

Metal Interconnections and Contact Technology, Diffused Interconnections, Polysilicon Interconnections and Buried Contacts, Silicides and Multilayer-Contact Technology, Copper Interconnects and Damascene Processes, Wafer Thinning and Die Separation, Die Attachment, Wire Bonding, Packages, Yield.

MODULE IV CMOS PROCESS ENHANCEMENTS AND LAYOUT DESIGN RULES 8

Circuit elements, Layer representations, CMOS n-well rules, Latch-up, Technology-related CAD issues.

MODULE V INTRODUCTION TO MEMS & NEMS 8

Introduction to Design of MEMS and NEMS, Overview of Nano and

Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

MODULE VI NANO DEVICES

7

Multigate Device- Various multigate device configurations-device structure and important features, Nanowire: Fabrication and applications, Graphene Device: Carbon nanotube transistor fabrication, CNT applications

TOTAL HOURS 45

TEXT BOOKS

1. J. Plummer, Michael D. Deal and Peter B. Griffin, "Silicon VLSI Technology, fundamentals, practice and modeling", Pearson Education, 2009.
2. Richard C. Jaeger, "Introduction to Microelectronic Fabrication", Second Edition, 2010.
3. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001

REFERENCES

1. J. P. Uyemura, Physical Design of CMOS Integrated Circuits Using L-Edit, PWS Publishers, Boston, 1995.
2. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design A Circuits and Systems Perspective" 4th edition, Pearson Publication, 2010.
3. Jan M. Rabaey Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits, 2nd edition, 2012.
4. Sergey Edward Lyshevski, —MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002

OUTCOMES:

On completion of the course, students will be able to

- Analyze the principles of CMOS transistors.
- Describe the lithography techniques and concepts of wafer exposure system, types of resists etc.
- Describe the concepts of thermal oxidation and Si/SiO₂ interface and its quality measurements.
- Discuss the back-end technology to define contacts, interconnects, gates, source and drain
- Describe the concepts of MEMS and NEMS
- Apply the concept of fabrication to develop nano devices.

ECCX 41**DESIGN USING EDA TOOLS****L T P C**
0 0 2 1**OBJECTIVES:**

- To introduce the basic functionality of CAE/CAD tools for integrated circuits CADENCE
- To become familiar with the main structure and basic modules of the CAE/CAD tools.
- To investigate the main design flow for analog, analog-digital and digital integrated circuit
- To enable students to exercise appropriate design of digital and analog circuits.

LIST OF EXPERIMENTS:

1. Study of Basic CMOS technology and design rules.
2. Design low power digital integrated circuits
3. Analyze and compare advanced analog ICs based on CMOS techniques, such as different types of current sources, amplifiers, filters and comparators.
4. Analyze and compare simple digital circuits based on different CMOS techniques.
5. Designing of complex analog/digital systems starting from simpler analog/digital circuits.
6. Design and generate GDS files for mixed signal integrated circuits using appropriate EDA tools.
7. Design and develop testing methods for digital, analog and mixed signal integrated circuits using EDA tools.
8. Design low power VLSI signal processing architectures and implement on FPGA platforms.
9. Design of improved performance VLSI signal processing architectures and implement on FPGA platforms.
10. Case Study

TOTAL HOURS: 30**TEXT BOOKS**

1. Geert van der Plas, Georges Gielen Willy Sansen, "A Computer-Aided Design and Synthesis Environment for Analog Integrated Circuits", Kluwert Academic Publishers, 2002.

2. Louis Scheffer, Luciano Lavagno and Grant Martin, "Electronic Design Automation for Integrated Circuits Handbook, Volume 1, EDA for IC System Design, Verification and Testing", Taylor & Francis, 2006.
3. Louis Scheffer, Luciano Lavagno and Grant Martin, "Electronic Design Automation for Integrated Circuits Handbook, Volume 2, EDA for IC Implementation, Circuits Design and Process Technology", Taylor & Francis, 2006.

REFERENCES

1. Erik Brunvand, "Digital VLSI Chip Design with Cadence and Synopsys CAD Tools, Addison-Wesley, 2010
2. Dennis Fitzpatrick, "Analog Design and Simulation using OrCAD Capture and PSpice", Newnes, 2nd edition, December 13, 2017.

OUTCOMES:

On completion of the course, students will be able to

- Demonstrate knowledge and understanding of fundamental concepts in CAD
- Work on the simulation tool.
- Analyze any analog circuit using a simulation tool.
- Analyze any digital circuit using a simulation tool.
- Design a component or circuit for a specific application.
- Establish capability for CAD tool development and enhancement

ECCX 42	PRINCIPLES OF WIRELESS SENSOR NETWORKS	L T P C
		3 0 0 3

OBJECTIVES:

- To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks.
- To know physical layer issues, medium access control protocols, network layer characteristics and protocols.
- A broad coverage of challenges related to the design and management of wireless sensor networks.

PRE-REQUISITES:

- Knowledge on sensor characteristics
- Basics of Computer Networks.

MODULE I INTRODUCTION TO WIRELESS SENSOR NETWORKS 6

Introduction - Challenges and Constraints - Application of sensor networks - Node architecture.

MODULE II BASIC ARCHITECTURAL FRAMEWORK : PHYSICAL LAYER 8

Basic Components, Source Encoding, The Efficiency of a Source Encoder, Pulse Code Modulation and Delta Modulation, Channel Encoding, Types of Channels, Information Transmission over a Channel, Error Recognition and Correction, Modulation, Modulation Types, Quadratic Amplitude Modulation, Signal Propagation.

MODULE III MEDIUM ACCESS LAYER 8

Overview, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols and Hybrid MAC Protocols.

MODULE IV NETWORK LAYER 8

Overview, Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.

MODULE V EMI / EMC STANDARDS 8

Introduction - Standards for EMI/EMC - MIL-STD-461/462-IEEE/ANSI standard - CISPR/IEC standard - FCC regulations - British standards - VDE standards - Euro norms - Performance standards - Comparisons.

MODULE VI EMC DESIGN OF PCBs 7

PCB Traces - Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

TOTAL HOURS 45**TEXT BOOKS**

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 2nd edition 2011.
2. C.R.Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 2nd edition 2010.

REFERENCES

1. Henry W.Ott, " Electromagnetic Compatibility Engineering", John Wiley and Sons, New York, 2009.
2. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", 2nd Edition, wiley publishers, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Outline the basic knowledge of science in EMI & EMC for different environments.
- Distinguish coupling principles for EMI.
- Measure different EMI parameters
- Apply EMI control mechanisms for specific needs with appropriate techniques.
- Compare and discuss different standards for EMI/EMC.
- Design and analyze the process of creating EMC PCBs

MODULE IV PROTOCOLS 8

NFC, RFID, Zigbee - MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe - Wired vs. Wireless communication -GSM, CDMA, LTE, GPRS, 3G, LTE,small cells, SATCOM - Sensors and sensor networks - Wired connectivity - IPv4/IPv6 - Ethernet/GigE.

MODULE V EVALUATION OF THE INTERNET OF THINGS 9

Platforms - Mobile integration - Deployment - Data Visualization - Convergence with Social Networks - Value chain and Business models - User centric cloud based services - Analytical Hierarchy Process for technology selection - End-to-end security - Integration with IT systems, Cost/benefit constraints End-to-end compatibility, Application Architecture - Lifecycle solution management, Real-time response and delay.

MODULE VI INTERNET OF THINGS PRIVACY, SECURITY AND GOVERNANCE 7

Introduction, Overview of Governance - Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach - Data Aggregation for the IoT in Smart Cities, Security.

TOTAL HOURS : 45

TEXT BOOKS

1. Dr.Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013.

REFERENCES

1. Cuno P fister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
2. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014
3. Samuel Greengard, The Internet of Things, MIT Press, 2015.
4. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013.

OUTCOMES:

On completion of the course, students will be able to

- Explain and interpret the concepts of IoT.

- Apply the steps involved in IoT design Methodology for different applications.
- Identify the hardware and connecting methods of IoT Technologies.
- Explore the features of various protocols used for IoT.
- Experiment with the software & hardware IoT Technologies.
- Evaluate the performance of an IoT based prototype.

ECCX 45**RF SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the characteristics of RF basic components and RF transistors.
- To design and analyze all types of RF filters, amplifiers, oscillators.
- To understand and design the various impedance matching using smith chart.

PREREQUISITES

- Basics of Resonant Circuits, Biasing of transistor, Amplifier design.

MODULE I INTRODUCTION TO RF COMPONENTS 7

Wire – Resistor – Inductor – Capacitor – Toroids – Toroidal Inductor Design.

MODULE II RESONANT CIRCUITS 8

Resonance – Loaded Q – Insertion Loss -Impedance transformations – Coupling of Resonant circuits

MODULE III MODERN FILTER DESIGN 8

Filter types – Normalization and Low pass prototype- Frequency & Impedance Scaling – High Pass Filter design - Dual networks – Band Pass Filter design – Band Rejection filter Design – effects of finite Q.

MODULE IV IMPEDANCE MATCHING 8

Background – L Network design – Complex Loads – three element matching – Wideband matching Networks – Smith chart – Impedance Matching using smith chart.

MODULE V TRANSISTOR AT RADIO FREQUENCIES 8

Transistor equivalent circuit – Y parameters – S parameters – transistor biasing – Design Using Y parameters – Design using S parameters

MODULE VI RF AMPLIFIER & OSCILLATORS 6

RF Power amplifier characteristics – Transistor Biasing - Power amplifier Design – Matching to Coaxial feed lines – Broadband Amplifiers – Oscillators.

Total Hours – 45**TEXT BOOKS:**

1. Chris Bowick, "RF Circuit Design", Newnes Ltd., 2nd edition, 2007.
2. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design - Theory and Applications", 2nd Edition, Pearson Education Asia, 2009.
3. David.M.Pozar, "Microwave Engineering" 4rd Edition, John Wiley and Sons, 2013.

REFERENCES:

1. Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", 2nd Edition, Pearson Education Asia, 2002.
2. S.Y.Liao, "Microwave Amplifiers and Oscillators Design", Prentice Hall, New Jersey, 1999.
3. G.Gonzalez, "Microwave Transistors and Amplifiers: Analysis and Design", Prentice Hall, New Jersey 1999.

OUTCOMES:

On completion of the course, students will be able to

- Analyze the basic RF components Characteristics and resonant circuits.
- Design different types of filters for various applications.
- Identify impedance matching for various RF circuits using smith chart.
- Analyze the S parameter value for any RF transistors.
- Design RF power amplifiers and oscillators with proper transistor biasing
- Implement the design of RF components and circuits for various applications.

ECCX 46	VIDEO PROCESSING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the principles of video processing.
- To distinguish the types of image sequence segmentation.
- To discuss analysis techniques in two and three dimensional motion.
- To introduce the methods of video compression.

PREREQUISITES:

- Basic knowledge about signals and systems
- Fundamentals of signal and image processing

MODULE I INTRODUCTION 6

Principles of video processing -Video display-Progressive and interlaced scan - Sampling of video signals -overview of applications.

MODULE II MOTION ANALYSIS 9

Two dimensional motion- Pixel based motion estimation-Mesh based motion estimation-on estimation- Region based motion estimation -Three dimensional Feature based Motion Estimation.

MODULE III IMAGE SEQUENCE SEGMENTATION 8

Spatial segmentation (frame-by-frame)- temporal segmentation (scene cut detection), spatio-temporal segmentation

MODULE IV SPECTRAL ANALYSIS AND VIDEO ENHANCEMENT 8

Fourier analysis- discrete cosine transforms- wavelet-domain analysis - noise reduction- super-resolution- scratch/dust removal

MODULE V VIDEO COMPRESSION 8

Motion-compensated hybrid DCT/DPCM coding, H.26X and MPEGX families of compression standards, error resilience in video coding, introduction to motion-compensated wavelet-domain video compression (MCTF)

MODULE VI STREAMING VIDEO OVER THE INTERNET AND WIRELESS IP NETWORKS 6

Architecture for video streaming systems -Application layer QoS control for

streaming video -Protocols for streaming video- Streaming video over wireless IP networks.

TOTAL HOURS 45

TEXT BOOKS

1. Yao Wang, Jorn Ostermann, Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, 2002
2. J.W. Woods, "Multidimensional Signal, Image and Video Processing and Coding. Academic Press, 2nd edition - 2012
3. Alan C. Bovik, 'The Essential Guide to Video Processing', Elsevier Science, edition 2, 2009

REFERENCES

1. A. Bovik (Ed.), The Essential Guide to Video Processing. Academic Press, 2009
2. A. Murat Tekalp, 'Digital Video Processing', Prentice Hall, edition 2, 2015
3. A. Jain, Fundamentals of Digital Image Processing. Information and System Sciences Series, Prentice Hall, 1994

OUTCOMES:

On completion of the course, students will be able to

- Describe the video displays.
- Discuss the methods for motion analysis
- Illustrate the image sequence segmentation.
- Analyze the spectrum and enhancement of video signals.
- Acquire knowledge about compression techniques.
- Interpret the architecture for video streaming systems.

3. Simulation of 2 Element Antenna Array
4. Simulation of Planar Array
5. Simulation of Reconfigurable Antenna
6. Simulation of Millimeter wave Antenna
7. Simulation of Metamaterial Antenna
8. Simulation of MIMO Antenna
9. Simulation of Smart antenna
10. Antenna Measurements.
11. Fabrication and Testing of any one antenna

L – 30Hrs.; P – 30Hrs.; Total Hours –60

TEXT BOOKS:

1. C.A.Balanis,"Antenna Theory and Design", 3rd Ed., John Wiley & Sons., 2016.
2. W. L.Stutzman, and G.A. Thiele,"Antenna Theory and Design", 3rd Ed., John Wiley & Sons., 2012.
3. R.S.Elliot,"Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2015.

REFERENCES:

1. Ved Vyas Dwivedi, "Microstrip Patch Antenna Using Metamaterial", Lambert Academic Publishing, 2012
2. Lamont V. Blake, Maurice W. Long, "Antennas: Fundamentals, Design, Measurement", 3rd SciTech Pub., 2009.
3. Jaco du Preez, Saurabh Sinha, "Millimeter-Wave Antennas: Configurations and Applications", Springer, 2016
4. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas and Wave Propagation", 3rd Edition, Tata McGraw Hill, 2006
5. Frank Gross, "Smart Antennas for Wireless Communications: With MATLAB", 2nd edition, Tata McGraw Hill, 2005

OUTCOMES:

On completion of the course the students will be able to

- Describe the fundamental concepts of antennas.
- Analysis and design parameters pertaining to microstrip patch antennas
- Design antenna arrays and analyze mutual coupling among antennas
- Have an understanding of advanced antenna concepts such as millimeter-wave antennas, reconfigurable antennas, and metamaterial based antennas
- Formulate and execute a research plan to design advanced antenna types including simulations and measured results.
- Understand the concepts of smart antennas.

ECCX 48	ADVANCED ERROR CONTROL CODING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the course is to provide students with a sound knowledge of

- The motivation behind synthesis of Channel coding techniques, Historical development of this discipline and important milestones in its development.
- Classical channel codes including the classes of Cyclic codes, BCH codes, RS codes and various Convolutional codes
- Modern capacity approaching codes like Turbo and LDPC codes, their encoding and decoding strategies and performance evaluation.
- Few important applications of channel codes.

PRE-REQUISITES:

- Linear algebra
- Digital communication

MODULE I LINEAR BLOCK CODES 8

Introduction to coding- Basic algebra- Groups, rings, fields, vector spaces, linear algebra Basics of linear codes - Block codes, generator and parity check matrices, dual code, code parameters. Decoding linear codes -MAP decoder, ML decoder, standard array and syndrome decoding, bounded distance decoder- Distance properties of linear block codes- Repetition codes, , Hamming codes, Reed solomon codes

MODULE II CYCLIC CODES 7

Algebraic Structure of Cyclic Codes; Finite fields- Groups, Fermat's Little theorem, Finite fields, Polynomials over fields, Polynomial Division. Polynomial factorization over a field, Irreducible polynomials Binary Cyclic Code Properties; Encoding in Systematic Form; Error Detection and Correction; Hamming codes, BCH codes, Reed Muller codes

MODULE III CONVOLUTIONAL CODES 9

Introduction to convolutional codes-Encoding, state diagram, trellis diagram Classification, realization, distance properties,coding gain Decoding of convolutional codes- soft decoding, Hard decoding,Viterbi algorithm BCJR algorithm,Performance bounds for convolutional codes

MODULE IV LOW DENSITY PARITY CHECK CODES 7

Low density parity check codes – Encoding-Gallager construction, Parity check

MatrixTanner Graph-regular irregular LDPC codes,code rate Decoding – Soft Vs Hard decision decoding, Bit flipping algorithm Belief propagation algorithm on BSC and AWGN channels.

MODULE V TURBO CODES 7

Turbo codes- construction-serial concatenated and parallel concatenated turbo codes, Turbo encoding – interleaver, puncturing, Decoding- iterative decoding, ML and MAP decoding, three dimensional turbo codes.

MODULE VI APPLICATIONS OF ERROR CONTROL CODES 7

Cyclic Redundancy Check (CRC) Code; POCSAG Code used in Paging; CIRC (Cross-interleave Reed-Solomon Code) for Compact Disc (CD) digital audio system; Trellis Coded Modulation (TCM) for MODEM communication, 5G communication

TOTAL HOURS : 45

TEXT BOOKS

- 1 Shu Lin and Daniel Costello, "Error Control Coding", Pearson, II edition, 2010.

REFERENCES

- 1 RudigerUrbanke and Thomas Richardson "Modern coding theory", Cambridge 2008.
- 2 W. Cary Huffman and Vera Pless, "Fundamentals of Error-Correcting Codes" Cambridge University Press, 2010
- 3 DhouhaKbaier Ben Ismail, Catherine Douillard and Sylvie Kerouédan, "A survey of three-dimensional turbo codes and recent performance enhancements" Journal on Wireless Communications and Networking 2013, Vol. 2013:115.

OUTCOMES:

On completion of the course, students will

- have the knowledge of modern coding techniques.
- demonstrate the encoding and decoding procedures of various error control codes
- compare the error correction capability of different error control codes and their performances
- be able to develop an efficient coding technique for a given application
- design channel codes for Physical Layer and Storage system in industry.
- develop new channel coding scheme for future communication

ECCX 49**MEDICAL IMAGE PROCESSING****L T P C****3 0 0 3****OBJECTIVES:**

- To explain the methods of medical imaging.
- To model the medical imaging systems.
- To discuss analysis techniques in medical images.
- To extract features from medical images.

PREREQUISITES:

- Basic knowledge about signals and systems
- Fundamentals of signal and image processing

MODULE I INTRODUCTION**6**

Introduction to medical imaging technology - systems, and modalities -Brief history-importance – applications- trends-challenges. Medical Image Formation Principles.

X-Ray physics - X-Ray generation, attenuation, scattering; dose Basic principles of CT- reconstruction methods-artifacts -CT hardware.

MODULE II STORAGE AND PROCESSING**9**

Medical Image Storage - Archiving and Communication Systems and Formats Picture archiving and communication system (PACS).

Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement- Filtering Basic image processing algorithms Thresholding- contrast enhancement; SNR characteristics; filtering; histogram modeling.

MODULE III VISUALIZATION**10**

Medical Image Visualization Fundamentals of visualization- surface and volume rendering/visualization – animation - interaction.

Magnetic Resonance Imaging (MRI) Mathematics of MR- spin physics - NMR spectroscopy - imaging principles and hardware - image artifacts.

MODULE IV SEGMENTATION AND CLASSIFICATION**10**

Medical Image Segmentation - Histogram-based methods - Region growing and watersheds - Markov Random Field models - active contours - model-based segmentation. Multi-scale segmentation -semi-automated methods - clustering-

based methods - classification-based methods - atlas-guided approaches - multi-model segmentation. Medical Image Registration Intensity-based methods; cost functions; optimization techniques.

MODULE V NUCLEAR IMAGING 5

PET and SPECT Ultrasound Imaging methods-mathematical principles- resolution-noise effect-3D imaging-positron emission tomography-single photon emission tomography

MODULE VI MEDICAL IMAGE PROCESSING APPLICATIONS 5

Ultrasound imaging-applications. Medical Image Search and Retrieval Current technology in medical image search, content-based image retrieval, new trends-ontologies. Applications. Other Applications of Medical Imaging Validation, Image Guided Surgery- Image Guided Therapy -Computer Aided Diagnosis/Diagnostic Support Systems.

TOTAL HOURS 45

TEXT BOOKS

1. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, May 2017.
2. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.

REFERENCES

1. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
2. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition, Prentice Hall, 2005.
3. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.

OUTCOMES:

On completion of the course, students will be able to

- Describe the generation and characteristics of X-rays.
- Discuss the methods for storage and processing of medical images
- Illustrate the visualization of medical images.

- Analyze the segmentation and classification techniques of medical images.
- Acquire knowledge about nuclear imaging techniques.
- Summarize the medical image processing and modern technologies in hospital applications.

ECCX 50**SOFTWARE DEFINED RADIO****L T P C****3 0 0 3****OBJECTIVES:**

- To understand Modern Radio Communication System
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

PREREQUISITES:

- Basics of Analog and digital communication
- Basics of wireless communication

MODULE I SOFTWARE DEFINED RADIO FUNDAMENTALS 8

Introduction to SDR, Principles of SDR, Basic Principle and difference in Analog radio and SDR, SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio - GNU Radio Architecture, Hardware Block of GNU, GNU software, MATLAB in SDR, Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range, RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer, Diplexer, RF filter, LNA, Image reject filters, IF filters, RF Mixers Local Oscillator, AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion.

MODULE II SDR ARCHITECTURE 7

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Tradeoffs using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA.

MODULE III MULTI RATE SIGNAL PROCESSING 8

Sample timing algorithms, Frequency offset estimation and correction, Channel Estimation, Basics of Multi Rate, Multi Rate DSP, Multi Rate Algorithm, DSP

techniques in SDR, OFDM in SDR

MODULE IV SMART/MIMO ANTENNAS USING SOFTWARE RADIO 7

Smart Antenna Architecture, Vector Channel Modeling, Benefits of Smart Antenna Phased Antenna Array Theory, Adaptive Arrays, DOA Arrays, Applying Software Radio Principles to Antenna Systems, Beam forming for systems-Multiple Fixed Beam Antenna Array, Fully Adaptive Array, Relative Benefits and Trade-offs OF Switched Beam and Adaptive Array, Smart Antenna Algorithms, Hardware Implementation of Smart Antennas, MIMO-frequency, time, sample Synchronization, Space time block coding-Space Time Filtering, Space Time Trellis Coding .

MODULE V COGNITIVE RADIO 8

Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR, Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer, OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR.

MODULE VI APPLICATIONS OF SDR 7

Application of SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation–Environment, Location, other factors, Vertical Handoff, Network Interoperability.

Total Hours – 45

TEXT BOOKS:

1. Jeffrey.H.Reed ,Software Radio : A Modern Approach to Radio Engineering, Pearson, Prentice Hall Professional, 2002
2. Markus Dillinger, KambizMadani, Nancy Alonistioti, Software Defined Radio: Architectures, Systems and Functions, Wiley. John Wiley & Sons, 2005
3. Tony.J. Roupael, RF and DSP for SDR, Elsevier Newness Press, 2008

REFERENCES:

1. Dr.TajStruman, Evaluation of SDR – Main Document, QinetiQ Ltd, 2006
2. Bruce a. Fette, Cognitive Radio Technology, Newness, Elsevier, 2009.

OUTCOMES:

After successfully completing the course students will be able to

- Compare SDR with traditional Hardware Radio (HDR)
- Implement modern wireless system based on OFDM, MIMO & Smart Antenna

- Build experiment with real wireless waveform and applications.
- Analyze the Multi Rate Signal Processing
- Accessing both Physical and MAC layers.
- Parameter estimation of SDR

ECCX 51	OPTICAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic theory of light propagation.
- To introduce the basic concepts of optical properties of the signal.
- To give an overview of the optical signal imaging techniques.
- To discuss about the Laser optical signal application.

PRE-REQUISITES:

- Basic knowledge on Optical Communication.
- Fundamentals of Image Processing.

MODULE I	ANALYSIS OF TWO DIMENSIONAL SIGNALS AND SYSTEMS	7
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Fourier analysis in two dimensions, Local spatial frequency and space-frequency localization, linear systems, two dimensional sampling theory.

MODULE II	FOUNDATIONS OF SCALAR DIFFRACTION THEORY	8
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Kirchoff and Rayleigh-Sommerfield formulations, comparison of kirchoff and Rayleigh Sommerfield theories, Huygens-Fresnel principle, non-monochromatic waves, diffraction at boundaries, angular spectrum of plane waves, Fresnel and Fraunhofer diffraction, Fresnel approximation, Fraunhofer approximation.

MODULE III	WAVE OPTICS ANALYSIS OF COHERENT OPTICAL SYSTEMS	7
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Thin lens as phase transformation, Fourier transforming properties of lenses, image formation monochromatic illumination, analysis of complex coherent optical systems.

MODULE IV	FREQUENCY ANALYSIS OF OPTICAL IMAGING SYSTEMS	8
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Generalized treatment of imaging systems, amplitude transfer function, frequency response for coherent and incoherent imaging, aberrations and their effect on frequency response, Comparison of coherent and incoherent imaging, resolution beyond classical diffraction limit.

MODULE V WAVEFRONT MODULATION 7

Wave front modulation with Photographic film: Incoherent and coherent optical systems, liquid crystals modulators, Magneto-optical spatial light modulators, Multiple quantum well spatial light modulators, Acousto-optic spatial light modulators, diffractive optical elements.

MODULE VI ANALOG OPTICAL INFORMATION PROCESSING 8

Incoherent image processing systems, coherent optical image processing systems. Holography- wavefront reconstruction problem, gabor hologram, Leith-upatnieks holograms, image locations and magnification, holography with spatially incoherent light, applications of Holography.

TOTAL HOURS 45**TEXT BOOKS REFERENCES**

1. Joseph W. Goodman, "Introduction to Fourier Optics", 4th edition, Mc Graw Hill, 2017.
2. Pankaj K.Das," Optical signal processing fundamentals" Springer-verlag, 1991.

REFERENCES

1. P.M. Duffieux, "The Fourier Transform and its applications to Optics", John Wiley and sons 1988
2. Anthony Vanderlugt, "Optical Signal Processing", Wiley-Interscience; Revised edition, June 17, 2005.

OUTCOMES:

On completion of the course, students will be able to

- Classify time and frequency domain optical signal.
- Describe the Incoherent and coherent optical systems.
- Choose different optical signal imaging techniques based on the application.
- Apply the suitable wave front modulation in Photographic film.
- Make appropriate use of Fourier techniques in optical image processing.
- Design and evaluate optical communication system on need basis.

ECCX 52	GNU RADIO REALIZATION THROUGH PYTHON AND C++	L	T	P	C
		1	0	2	2

OBJECTIVES:

- Student will learn about open source software with respect to digital communications.
- Course is combined with USRP/RTL SDR to enable the use of, off the self-component for analysis of the RF signal, which are readily available at much lower cost than the standard testing rig
- Various system requirement for a good RF receiver

MODULE I GNU RADIO & RTL SDR 5+10

USRP/RTL hardware schematics (A/D convertor, OCXO, TCXO, PPM, USB interface)
- Sampling and bandwidth, SNR, Low Noise Amplifier, Down conversion - Gnu radio Companion (GRC) modules, source modules, sink modules, plotting of frequency response

Practical :

Sin wave generation using GRC
frequency plot using GRC

MODULE II GNU RADIO PYTHON & C++ 5+10

GRC Blocks, (GR-theano, GR-) - Modification of the python code generated by GRC
-Out of order (OOT) modules creation - How to add Python blocks with gr_modtool - create a module for QPSK mapping, create GRC binding for block

Practical :

Creation of AM receiver using GRC flow graph
Modify the python code for water fall frequency plot
Add the module to gr_modtool
Creation of QPSK block and add it to gr_modtool

MODULE III GNU RADIO INTERFACING WITH HARDWARE 5+10

gr-uhd-Interfacing with USRP - gr-osmosdr-interfacing with RTL-SDR, decimation, interpolation, wifi 802.11 (Phy and mac) layer, study and analysis using gr-ieee802-11

Practical :

- 1) Implementation of the OFDM receiver based on Wifi physical layer specification
- 2) Implementation of the 802.11 MAC layer packetization of the received MAC data (802.11) using gr-foo for analysis using wireshark

L – 15; P – 30; Total Hours – 45

TEXT BOOKS:

1. David Clark & Paul Clark, "Field Expedient SDR: Introduction to Software Defined Radio", 2014.
2. Carl Laufer, "The Hobbyist's Guide to the RTL-SDR: Really Cheap Software Defined Radio", 2011.
3. Mathew S. Gast, "802.11 wireless Networks : The definitive guide"

REFERENCES:

1. Simon Haykin and Michael Moher, "An Introduction to Analog and Digital Communications", JOHN WILEY & SONS, INC, .2006.

OUTCOMES:

- Proficient to build modules in GNU Radio
- Use off the self-components, to analyse different radio technology
- Will be trained in system design aspects of SDR

ECCX 53	IMPLEMENTATION OF GSM (2G), 3G STACK	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To have practical exposure on GSM stack implementation.
- GSM base station is a complex entity which had high cost and cannot be used for funding.
- Open BTS being open source and open hardware presents a simplified view of the base station

PREREQUISITES:

- Digital communication, Networking, wire shark

MODULE I INTRODUCTION TO GSM 5+10

GSM Architecture (HLR, VLR, Equipment identity register, Outgoing call, incoming call, BTS-L1(PHY), BTS-L2(MAC) - PSTN - VoIP (SIP) -Wireshark packet analysis

Practical :

Wireshark installation

Filtering of packet (UDP & TCP)

MODULE II OPEN BTS & USRP 5+10

USRP (dynamic range of the a/d converter, bandwidth, FPGA, UDP packet to the host from USRP, OCXO) - GSM BTS (PHY, MAC) module discussion with respect to specification - Sip authentication & registration per session (Register, invite, message), USRP B2xx internals (A/D Convertor, FPGA)

Practical :

Open BTS installation (clone, compiling, tool chain installation)

Mobile registration on the network

MODULE III CALL ESTABLISHMENT AND PACKET ANALYSIS 5+10

Registration of the mobile (message sequence) packet capture and analysis, (Paging request, System information)- SMS message sequence study(A-I/F DTAP, A-I/F RP, SMS TPDU)- Voice call message sequence(CCH, CI, LAI, BCCH) - 2G - Edge mode - UMTS data mode registration, packet capture and analysis

Practical :

capture and analysis of the packet for SMS

capture and analysis of the packet for voice

mobile registration rejection analysis

L – 15; P – 30; Total Hours – 45

TEXT BOOKS:

1. Michael Iedema, "Getting Started with OpenBTS: Build Open Source Mobile Networks", 2014
2. Martin Sauter , "From GSM to LTE: An Introduction to Mobile Networks and Mobile", 2014
3. Russell Bryant, Leif Madsen and Jim Van Meggelen, "Asterisk: The Definitive Guide: The Future of Telephony Is Now", 2013

REFERENCES:

1. Jorg Eberspacher, Hans-Joerg Vogel, Christian Bettstetter, Christian Hartmann, GSM - Architecture, Protocols and Services, Wiley 3rd Edition, 2009.
2. Chris Johnson, "Radio Access Networks for UMTS: Principles and Practice", Wiley, 2008,

OUTCOMES:

On completion of the course the students will be able to

- Analyze the wireshark installation
- Implement mobile registration on the network
- capture and analysis of the packet for SMS and Voice

ECCX 54**MASSIVE MIMO TECHNOLOGY****L T P C****1 0 0 1****OBJECTIVES:**

- To acquire principles and applications of OFDM technology.
- To gain techniques of MIMO communication.
- To apply the massive MIMO in 5G for various applications.

PREREQUISITE :

- Basics Concepts of Wireless Communications

MODULE I MIMO**7**

Basic principles of orthogonality , multi carrier transmission; OFDM modulation & demodulation, SISO Vs MIMO, Space diversity, Smart Antenna system and MIMO, MIMO-Based system architecture, MIMO exploits multipath, Space-time coding, Antenna diversity, MIMO channel modeling, Millimeter-wave Communications – Massive MIMO- propagation channel models, MIMO-OFDM.

MODULE II MASSIVE MIMO**8**

Massive MIMO: Resource allocation and transceiver algorithms for massive MIMO - Fundamentals of baseband and RF implementations in massive MIMO - Beamforming 5G - spectrum regulations, deployment scenarios, Propagation Characteristics of 5G Channel physical layer techniques, interference and mobility management.

TOTAL HOURS 15**TEXT BOOKS**

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017
2. Wireless Communications and Networking By Vijay K. Garg, Morgan Kaufmann Publications
3. Theodore S.Rappaport, Robert W.Heath, Robert C.Daniels, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.

REFERENCES

1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell, 2016.

OUTCOMES:

On completion of the course, students will be able to

- Describe the concepts of MIMO OFDM Wireless communication systems.
- Determine the capacity and bit error rate of MIMO OFDM system for a given power delay profile of the MIMO channel.
- Compare the operation of SISO, SIMO, MISO and MIMO channels.
- Apply the concepts of 5G.
- Analyze the performance of Massive MIMO in 5G.
- Evaluate the effect of MIMO OFDM on various applications.

ECCX 55	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the fundamentals of robotics systems.
- To analyze the methods of training a robot, to listen and speak.
- Apply the artificial common sense abilities to recognize objects using computer vision and artificial personality.
- To discuss and select the various machine learning methods for robotic system training

PREREQUISITES:

- Knowledge on Digital Electronics, Signal and systems, Data structures.

MODULE I FOUNDATIONS FOR ADVANCED ROBOTICS AND AI 8

The basic principle of robotics and AI, advanced robotics techniques, introducing the robot and our development environment, Software components (ROS, Python, and Linux), Robot control systems and a decision-making framework. A systems engineering-based approach to robotics.

MODULE II SPEECH RECOGNITION 7

Robot speech recognition, Speech to text, natural language processing.

MODULE III SENSING TECHNIQUES 7

Logical sensors, Behavioral Sensor Fusion, Designing a Sensor Suite, proprioceptive Sensors for robots (Motor speed sensors, Wheel load sensors, Robot arm joint angles sensors, light intensity sensors), Proximity Sensors, Computer Vision, Range from Vision.

MODULE IV DEEP LEARNING AND IMAGE PROCESSING 8

The image recognition process, the image recognition training and deployment process, Image processing, Convolution, Artificial neurons, The convolution neural network process, Build the toy/not toy detector.

MODULE V ARTIFICIAL PERSONALITY 8

Introduction to artificial personality, The Turing test, An emotion state machine, Playing the emotion game, Creating a model of human behavior, Integrating artificial personality into our robot, Personality construction – building blocks, The robot emotion engine, The human emotion model.

MODULE VI MACHINE LEARNING**7**

Inferential Statistics and Hypothesis Testing, Linear Regression, Logistic Regression, Decision Tree, Random Forest Trees, Principal Component Analysis, Clustering, Regression and Model Selection on Sage maker.

TOTAL HOURS 45**TEXT BOOKS**

1. Francis X. Gover S, "Artificial Intelligence for Robotics", Packet Publishing, 2018.
2. Robin R. Murphy , "Introduction to AI Robotics "A Bradford Book The MIT Press Cambridge, Massachusetts London, England, 2000.

REFERENCES

1. Tom Taulli, "Artificial Intelligence Basics: A Non-Technical Introduction", Kindle Edition, Apress publications; 1 edition (August 1, 2019)
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, First edition, July 2017.

OUTCOMES:

On completion of the course, students will be able to

- Describe the fundamentals of Robotics systems.
- Design and train a robot to listen and speak.
- Design a robot with artificial common sense abilities.
- Develop a robot to recognize objects using computer vision.
- Design and train a robot with artificial personality
- Choose a appropriate machine learning methods for robotic system training

ECCX 56**VLSI SIGNAL PROCESSING****L T P C****3 0 0 3****OBJECTIVES:**

- To learn different algorithms used for DSP processors and fundamentals of pipelining and parallel processing on FIR filters.
- To understand different fast convolution algorithms and pipelining/parallel processing techniques for IIR filters.
- To study the concepts of retiming, unfolding, transforms and rank order filters.
- To study different bit level architectures and their complexities.
- To study the general architectures of programmable Digital signal processors.

PRE-REQUISITES:

- Digital Signal Processing, Computer Architecture

MODULE I INTRODUCTION TO DSP SYSTEMS 5

Typical DSP algorithms: Convolution, correlation, Digital filters, Adaptive filters, Discrete cosine transform Decimators and Expanders, wavelets and filter banks, DSP application demands and scaled CMOS technologies

MODULE II PIPELINING AND PARALLEL PROCESSING 9

Data flow graph representations, loop bound and iteration bound, Algorithms for computing iteration bound: Longest path Matrix algorithm, Iteration bound for multirated data flow graphs Pipelining and parallel processing - Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.

MODULE III RETIMING, ALGORITHMIC STRENGTH REDUCTION 9

Definitions and properties of retiming, an algorithm for unfolding, properties of unfolding, Applications of unfolding: sample period reduction , parallel processing

MODULE IV FAST CONVOLUTION AND ALGORITHMIC STRENGTH REDUCTION IN FILTERS AND TRANSFORMS 9

Cook Toom algorithm, modified Cook-Took algorithm, parallel FIR filter, 2-parallel fast FIR filter, parallel architectures for rank-order filters, odd- even merge- sort architecture, parallel rank-order filters.

MODULE V BIT LEVEL ARITHMETIC ARCHITECTURES 9

Parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry save multiplier, bit Baugh-Wooley multipliers, parallel multipliers with modified booth recoding, Bit serial multipliers.

MODULE VI PROGRAMMABLE DIGITAL SIGNAL PROCESSORS 4

Introduction, evolution of programmable DSP, important features of DSP processors, DSP processors for mobile and wireless communication.

TOTAL HOURS 45**TEXT BOOKS**

1. Keshab K.Parhi, "VLSI Digital Signal Processing systems, Design and implementation", Wiley, Inter Science, 2007.
2. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw-Hill, 1994.

REFERENCES

1. S.Y. Kung, H.J.White House, T.Kailath,"VLSI and Modern Signal Processing ", Prentice Hall, 2011.
2. Jose E. France, YannisTsvividls, Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing' Prentice Hall, 1994.
1. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004.

OUTCOMES:

On completion of the course, students will be able to

- Analyze various algorithms to apply for the specific VLSI architecture.
- Describe the fast convolution algorithms and high speed multipliers.
- Select appropriate DSP processors to find solution for a specific application
- Apply the advantages of retiming, unfolding and folding on pipelined and parallel processed architectures.
- Have the ability to develop advanced DSP filters and processors.
- Develop optimized DSP designs by employing the advantages of VLSI concepts.

TEXT BOOKS:

1. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Springer-Verlag New York Inc, 2013.
2. A.L. Crouch, "Design Test for Digital ICs and Embedded Core Systems", Pearson Education Limited, 2008.

REFERENCES:

1. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, Third Edition, 2011.
2. M. Abramovici, M.A. Breuer, and A.D. Friedman, "Digital Systems Testing and Testable Design", Jaico Publishing House, 1st Edition, 2002.

OUTCOMES:

On completion of the course the students will be able to

- Apply the standard procedures and principles to test digital VLSI circuits
- Use appropriate testing principles to test digital circuits logically using stuck at faults models.
- Analyze and compare the performance of the fault models used to perform testing of digital circuits.
- Apply the design for test (DFT) principles for designing digital systems.
- Generate test vectors using ATPG algorithms for combinational and sequential circuitsTo function in teams involving the testing of digital VLSI systems

ECCX 58**FINFET TECHNOLOGY****L T P C****3 0 0 3****OBJECTIVES:**

- To understand the necessary of scaling of MOS transistor.
- To introduce the concepts of nanoscale MOS transistor concepts and their performance characteristics.
- To study the various nano scaled MOS transistors.

PREREQUISITE :

Sound knowledge of MOSFET device and SCEs

MODULE I INTRODUCTION TO NOVEL MOSFETS 8

from Single Gate to Multigate, MOSFET scaling and Moore's law, Short-Channel Effects, Gate Geometry and Electrostatic Integrity, History and Multigate MOSFET Physics

MODULE II MULTIGATE MOSFET TECHNOLOGY 7

Introduction, Active Area: Fins, Gate Stack, Source/Drain Resistance and Capacitance, Mobility and Strain Engineering, Contacts to the Fins

MODULE III PHYSICS OF THE MULTIGATE MOS SYSTEM 7

Device electrostatics, Double gate MOS system, Two-dimensional confinement

MODULE IV MOBILITY IN MULTIGATE MOSFETS 8

Introduction, Double-Gate MOSFETs and FinFETs, Silicon multiple-gate nanowires

MODULE V MULTI-GATE MOSFET CIRCUIT DESIGN: 7

Introduction, Digital Circuit Design, Analog Circuit Design, SOC Design and Technology aspects

MODULE VI DESIGN OF ANALOG BUILDING BLOCKS 8

VT-based current reference circuit- Bandgap voltage reference- Operational amplifier- Comparator- Mixed-signal aspects- RF circuit design.

TOTAL HOURS 45

TEXT BOOKS

1. J. P. Colinge, "FinFETs and Other Multigate Transistors", Springer Publications, 2008
2. Kim DM, Jeong Y-H, "Nanowire FETs: principles and applications, springer, New York, Section 4.1, 2014.
3. Niraj K. Jha and Deming Chen, "Nanoelectronic Circuit Design", Springer Publications, 2010

REFERENCES

- 1 Mark Lundstrom Jing Guo, Nanoscale Transistors: Device Physics, Modeling and Simulation, Springer, 2006.
- 2 M S Lundstorm, Fundamentals of Carrier Transport, 2nd Ed., Cambridge University Press, Cambridge UK, 2000

OUTCOMES:

On completion of the course, students will be able to

- Realize limitations of MOSFET technology.
- Apply the merits of FinFET technology.
- Analyze FinFET physics and modeling.
- Determine FinFET circuit design approaches.
- Analyze various issues with FinFET device
- Explore research opportunities in FinFET technology

ECCX 59	REAL TIME EMBEDDED SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce the concepts of embedded systems
- To learn about the data management system for real time
- To introduce the fundamentals of real time communication
- To familiarize different algorithms and techniques used for real time systems

PRE-REQUISITES:

- Basics of embedded system, Network protocols.

MODULE I REAL TIME EMBEDDED SYSTEM 7

Real Time Computing and its issues - Structure of a Real Time System – Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times.

MODULE II TASK ASSIGNMENT AND SCHEDULING 8

Introduction - Classical uniprocessor scheduling algorithms – Uniprocessor scheduling of IRIS tasks tasks – Task assignment – Mode changes and Fault Tolerant Scheduling.

MODULE III PROGRAMMING TOOLS 8

Introduction – Desired language characteristics – Data typing – Control structures – Facilitating Hierarchical Decomposition, Packages, Run time (Exception) Error handling – Overloading and Generics – Multitasking – Low level programming – Programming Environments – Runtime support.

MODULE IV REAL TIME DATABASES 7

Basic Definition- Real time vs General Purpose Databases- Main Memory Databases - Transaction priorities - Transaction Aborts - Concurrency control issues - Disk Scheduling Algorithms -Databases for Hard Real Time Systems.

MODULE V COMMUNICATION PROTOCOLS 7

Network Topology - contention based Protocol, Token Based Protocol, Stop-and-Go multihop Protocol, Polled Bus Protocol , Hierarchical Round Robin Protocol, Deadline-Based Protocols

MODULE VI EVALUATION TECHNIQUES**8**

Reliability Evaluation Techniques – Obtaining parameter values - Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

TOTAL HOURS 45**TEXT BOOKS**

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 2010.
2. Rajib Mall, “Real-time systems: theory and practice”, Pearson Education, 2009.
4. Xiacong Fan, “Real-Time Embedded Systems – Design Principles and Engineering Practices”, Newnes, 2015.
5. Jim Cooling, “Real-time Operating Systems: Book 1 - The Theory”, Lindentree Associates; 1 edition (14 November 2013).

REFERENCES

1. Chris Hobbs, “Embedded Software Development for Safety-Critical Systems, 1st Edition, Auerbach Publications 2015.
2. Xiacong Fan, “Real – Time Systems”, Newnes, 1st edition, 2015.
3. Philip.A.Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 4th Edition, April 2011.
4. Elecia White, “Making Embedded Systems: Design Patterns for Great Software”, O'Reilly Media, 1st edition 201.1

OUTCOMES:

On completion of the course, students will be able to

- Describe the concepts of Embedded Systems.
- Illustrate task assignment and scheduling.
- Discuss about error handling and multitasking.
- Understand real time data bases and transaction.
- Describe deadline based protocols and fault tolerance techniques.
- Discuss about the reliability evaluation techniques and tolerant synchronization algorithms.

ECCX 60**INTRODUCTION TO RTOS****L T P C****3 0 0 3****OBJECTIVES:**

- To explain the aspects of the Operating systems and Real-time Operating Systems
- To analyze the unique issues in the design and analysis of computer systems.
- To describe Resource management, time-constrained communication, scheduling and imprecise computations, real-time kernels and case studies on RTOS

PRE-REQUISITES:

Basics of embedded system

MODULE I OVERVIEW OF OPERATING SYSTEM 7

Computer-System Organization-Operating-System Structure -Operating-System Operations - Process Management - Memory Management -Storage Management - Protection and Security - Kernel Data Structures - Computing Environments - Open-Source Operating Systems-Operating system structures-System Calls-Operating-System Design and Implementation-Operating-System Structure -Operating-System Debugging - Operating-System Generation - System Boot

MODULE II REAL TIME OPERATING SYSTEMS 8

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Task, Tasks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency, Semaphores, Defining Message Queue, States, Content, Storage, Operations and Use.

MODULE III KERNEL OBJECTS AND RTOS SERVICES 7

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

MODULE IV Exceptions , Interrupts and Memory Management 8

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Dynamic memory allocation.

- Analyze the use of synchronization techniques in real-time systems.
- Illustrate exceptions, timer and memory management in OS.
- Justify the type of real time operating system needed for particular application.

ECCX 61**MECHATRONICS****L T P C****3 0 0 3****OBJECTIVES:**

- To Identify the different components for mechatronics system design.
- To gain sufficient knowledge regarding PIC Microcontroller and its interfacing concept.
- To study the applications of electronics, electrical and mechanical systems for the control of mechanical and electronic systems.
- To impart knowledge on the role of sensors, transducers, control, and machine intelligence in mechanical- electronics engineering.
- To gain knowledge on the concepts and techniques involved in PLC systems which are widely used in mechatronics
- To develop the mechatronics systems for real time applications.

PRE-REQUISITES:

- Basics of Microcontroller, Basics of Programmable logic devices, peripheral interfacing.

MODULE I FUNDAMENTALS OF MECHATRONICS 8

Introduction to Mechatronics systems – elements – design process – Types of Design: Traditional and Mechatronics design - Integrated product design - Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

MODULE II PIC MICROCONTROLLER 7

Architecture of PIC 18 – Pin Description – Memory organization: Program memory – Data Memory – I/O Ports – Timers / Counters – Capture / Compare /PWM mode – External Hardware Interrupts – USART – ADC.

MODULE III PIC 18 EMBEDDED C PROGRAMMING 7

I/O ports: Register configuration–programming – Timers: modes–programming – Counters – ADC: configuration registers–programming – External Hardware Interrupts: types–programming.

MODULE IV PROGRAMMABLE LOGIC CONTROLLERS SYSTEMS 8

Introduction — PLC Architecture, specifications and operation – PLC hardware components, Analog & digital I/O modules , CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder

diagram in to PLC relay ladder diagram. PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches - Latching relays.

MODULE V SYSTEM INTERFACING: 7

Introduction – Elements of data acquisition and system – Overview of I/O process - Installation of I/O card and software – serial interface standards (RS232/422/485) – General Purpose Interface Bus (IEEE 488) - GUI card – Ethernet switch - Man Machine Interfaces. Sensor interfacing – LED interfacing – LCD interfacing – Motor interfacing – High power devices using relays.

MODULE VI CASE STUDY ON MECHATRONICS SYSTEMS: 8

Disk Drive – Transducer calibration system - Strain gauge weighing system - Controlling temperature of a hot / cold reservoir using PID – pH Control system. virtual instrumentation, Electronics engine management system - Control of pick and place robot – Automatic washing machine - Artificial Intelligence in Mechatronics: Neural network and Fuzzy logic system.

TOTAL HOURS 45

TEXT BOOKS

- 1 Devdas Shetty and Richard A. Kolk, —Mechatronics System DesignII, Thomson Learning/ Vikas Publishing House, New Delhi, 2011.
- 2 Mazidi, Muhammad Ali, Mckinlay, Rolin D., and Causey Danny, —PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18II, Pearson Education Asia, 2015.
- 3 Bolton W, “Mechatronics”, Pearson education, sixth edition, 2015.
- 4 Dr. Edwin Kiel,” Drive Solutions: Mechatronics for Production and Logistics” Springer-Verlag Berlin Heidelberg, 2008

REFERENCES

- 1 Valvano Jonathan W., —Embedded Microcomputer Systems: Real Time InterfacingII, 3rd Edition, Thomson Asia, Singapore, 2011
- 2 Peatman John B., —Design with PIC MicrocontrollersII, Pearson Education, New Delhi, 2009.
- 3 Sanjay Gupta and Joseph John, "Virtual Instrumentation and LabVIEW", Tata McGraw Hill Publications, Co., 2005.

- 4 Gary Dunning, 'Introduction to Programmable Logic Controllers' Thomson Learning, 2005

OUTCOMES:

On completion of the course, students will be able to

- Identify the components for mechatronics system design.
- Apply the data acquisition system, display systems, recorders, alarms, measurement of voltage, current, frequency, temperature, displacement and pressure in process control industries.
- Develop programmable logic controllers systems
- Interpret architecture and interfacing concepts of PIC18 microcontroller.
- Select the suitable PLC interface for mechatronics system.
- Develop the physical system based on mechatronics design process.

ECCX 62	NANOSCALE DEVICES AND CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Gain knowledge of the various process techniques to synthesis nanostructured materials
- To introducing concepts of quantum mechanics and nano systems.
- Analyze structural and optical properties of nano structured materials
- To introducing the concepts of micro electromechanical devices.
- To know the fabrication process of Microsystems.

PRE-REQUISITES:

- Basics of Materials.

MODULE I	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	6
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Basic concepts of Nanoscience and Nanotechnology – Quantum wire – Quantum well – Quantum dot – fullerenes – Graphene – Carbon nanotubes – Material processing by chemical vapor deposition and physical vapor deposition – Principle of SEM, TEM, AFM, Scanning near-field optical microscopy (SNOM)

MODULE II	BASICS AND SCALE OF NANOTECHNOLOGY	8
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Introduction – Scientific revolutions –Time and length scale in structures – Definition of a nanosystem –Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress- surface defects-Properties at nanoscale (optical, mechanical, electronic,and magnetic).

MODULE III	DIFFERENT CLASSES OF NANOMATERIALS	8
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Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon-based nano materials (buckyballs, nanotubes, graphene)– Metalbased nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics -Biological nanomaterials.

MODULE IV	SYNTHESIS OF NANOMATERIALS	8
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Chemical Methods: Metal Nanocrystals by Reduction - Solvothermal Synthesis- Photochemical Synthesis - Sonochemical Routes- Chemical Vapor Deposition

(CVD) – Metal Oxide - Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

MODULE V FABRICATION AND CHARACTERIZATION OF 8 NANOSTRUCTURES

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)- Nanoimprint – Softlithography patterning. Characterization: Field Emission Scanning Electron Microscopy (FESEM) – Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM)

MODULE VI APPLICATIONS 7

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with a special architecture , Applications in displays and other devices -Nanomaterials for data storage - Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology – Nanotoxicology challenges.

Total Hours –45

TEXT BOOK

1. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.
2. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

REFERENCES

1. Nabok A., “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. Dupas C., Houdy P., Lahmani M., “Nanoscience: Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. David. J, Griffiths, “Introduction to Quantum Mechanics”, Pearson, 2009.

OUTCOMES:

On completion of the course, students will be able to

- Describe the fundamentals of nanotechnology
- Give a general introduction to different classes of nanomaterials
- Improve their knowledge on various synthesis methods of nanomaterials
- Analyze the characterization techniques involved in nanotechnology

- Familiarize themselves with nanotechnology potentialities
- Design circuits with quantum mechanics and nano systems

ECCX 63	SYSTEM DESIGN WITH FPGA	L T P C
		3 0 0 3

OBJECTIVES:

- To describe the Hierarchy, controller (FSM), meta-stability, synchronization.
- To analyze the FSM issues, timing issues, pipelining, resource sharing.

PRE-REQUISITES:

- Basics of VLSI design.

MODULE I REVISION OF BASIC DIGITAL SYSTEMS 6

Combinational Circuits, Sequential Circuits, Timing, Electrical Characteristics, Power Dissipation.

MODULE II CURRENT STATE OF THE FIELD 8

SoC, IP Design, SoPC, Design methodology, System Modeling, HardwareSoftware Co-design. Device Technology. Application Domains.

MODULE III DIGITAL SYSTEM DESIGN. 8

Top down Approach to Design, Case study. Data Path, Control Path. Controller behavior and Design. Case study Mealy & Moore Machines. Timing of sequential circuits. Pipelining, Resource sharing, FSM issues (Starring state, Power on Reset, State diagram optimization, State Assignment, Asynchronous Inputs, Output Races, fault Tolerance).

MODULE IV VHDL FOR SYNTHESIS. 8

Introduction. Behavioral, Data flow, Structural Models. Simulation Cycles. Process. Concurrent Statements. Sequential Statements. Loops. Delay Models. Sequential Circuits, FSM Coding. Library, Packages. Functions, Procedures. Operator Inferencing. Test bench.

MODULE V PROGRAMMABLE LOGIC DEVICES. 8

Introduction. Evolution: PROM, PLA, PAL. Architecture of PAL's. Applications. Programming PLD's. Design Flow. Programmable Interconnections. Complex PLD's (MAX - 7000, APEX). Architecture, Resources. Applications. Tools. Demonstration of the tool.

MODULE VI DFPGA's.**7**

Introduction. Logic Block Architecture. Routing Architecture. Programmable Interconnections. Design Flow. Xilinx Virtex-II (Architecture). Altera Stratix, Actel 54SX Architecture. Boundary Scan. Programming FPGA's. Constraint Editor, Applications. Tools. Case Study. Xilinx Virtex II Pro, Embedded System on Programmable Chip. Hardware-software co-simulation, Bus function models, BFM Simulation. Debugging FPGA Design, Chipscope Pro. Static Timing Analysis. One hot encoding.

Total Hours –45**TEXT BOOK**

1. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall, 4th edition, 2014.
2. Kevin Skahil, VHDL for programmable logic, Addison Wesley, 1st edition, 1996.

REFERENCES

1. ZainalabedinNavabi, VHDL, analysis and modeling of digital systems, McGraw-Hill, 2nd edition, 1997
2. PLD, FPGA data sheets.

OUTCOMES:

On completion of the course, students will be able to

- Analyze sequential system design, processor datapath and control unit
- Apply SPLD and CPLD architecture, timing, applications.
- Comprehend the logic block and routing architecture.
- Hardware-software co-simulation.
- Bus function models, SoPC.
- Architecture development on FPGA

**Physics Elective Courses
(To be offered in II Semester)**

PHCX 01	FUNDAMENTALS OF ENGINEERING MATERIALS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To familiarize students with basic ideas of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To help students acquire the properties and applications of magnetic materials and dielectric materials.
- To familiarize students with basics ideas about the properties of dielectric and its applications
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 7

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentrations, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS 8

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field -Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in FERAM - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS 7

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton –Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application -Giant Magneto-resistance effect(GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS**8**

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, grapheme - nanocomposites – applications.

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

L : 30 periods, P: 30 periods, Total: 60 periods**REFERENCES:**

- ↘ William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
- ↘ Raghavan, V., Materials Science and Engineering, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
- ↘ Wahab.M.A, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
- 2. Pillai, S.O., Solid State Physics, New Age International, New Delhi, 2005.
- 3. Charles P.Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
- 4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

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

- Differentiate between the properties of the nanomaterials compared to bulk materials.
- Comprehend the significance of properties of magnetic materials and derive these properties from synthesized materials.
- Apply the concepts of conducting and semiconducting materials for solid state devices.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

L T P C

PHCX 02**HEAT AND THERMODYNAMICS****2 0 2 3****OBJECTIVES:**

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT**10**

Definition of temperature, thermal and thermodynamic equilibrium- relationship between temperature and kinetic energy- definition of solid, liquid, gas- Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- Microscopic model of ideal gas- equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION**10**

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe's method – thermal conductivity of a bad conductor – Lee's disc method – conduction of heat through compound media-radiation – Planck's law blackbody radiation – Wien's law – Stefan's law – Newton's law of cooling from Stefan's law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS**10**

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics -Heat engine – Carnot's engine – Carnot's theorem – Internal combustion engines – petrol and diesel engines(qualitative) – Entropy – entropy and available energy – temperature – entropy diagram for Carnot's cycle - Third Law of thermodynamics(qualitative).

L : 30 periods**PRACTICALS**

1. Determination of mechanical equivalent of heat by Joule's calorimeter.
2. Relation between temperature of a body and time by plotting a cooling curve- Newton's law of cooling.

3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a bad conductor-Lee's disc method
5. Determination of thermal conductivity of a good conductor-Forbe's method

P: 30 periods

Total: 60 periods

REFERENCES :

- ↘ Mathur. D.S, "Heat & Thermodynamics", S.Chand & Co., 2009.
- ↘ Brijlal & Subramaniam, "Heat and Thermodynamics", S.Chand & Co, Delhi., 2010.
- ↘ Gupta. A.B and Roy. H, "Thermal Physics", Books and Allied Ltd., 2002.
- ↘ Sharma. J.K and Sarkar. K.K, "Thermodynamics and statistical Physics", Himalaya Publishing House, 1988.

OUTCOMES:

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

- Understand the concepts of heat and its properties.
- Comprehend the ideas governing the conduction and radiation processes.
- Understand and apply the ideas of laws of thermodynamics in thermodynamic systems.
- Perform heat based experiments and determine its various properties.

PHCX 03	INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY	L T P C 2 0 2 3
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OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot- nanoporous materials- zeolite, mesoporous materials, carbon nanotubes, graphene- nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling-sol-gel approach-hydrothermal method-precipitation method-spray pyrolysis-spin coating-self assembled monolayer (SAM)-Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method. Optical microscopy – Phase contrast and interference microscopy –confocal microscopy- high resolution Scanning electron microscope (HRSEM)- high resolution Transmission electron microscope (HRTEM)-Atomic force microscope-Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography-nanoimprint lithography - soft lithography - nanoelectromechanical systems (NEMS) - nanoindentation principles.

L : 30 periods**PRACTICALS**

1. Synthesis of nanomaterials by sol-gel method.

2. Synthesis of nanomaterials by hydrothermal method.
3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

P: 30 period

Total: 60 periods

REFERENCES:

1. Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
2. Cao. G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., "Handbook of NanoScience, Engineering and Technology", CRC Press, 2002.
4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, "Fundamental Principles of Optical Lithography: The Science of Microfabrication", John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., "Nano Materials", New Age International Publishers, New Delhi, 2008.

OUTCOMES:

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

- Understand the importance and basic concepts of the nanomaterials.
- Comprehend the imaging techniques for nanomaterials.
- Illustrate the various nanofabrication techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04

LASERS AND THEIR APPLICATIONS

L	T	P	C
2	0	2	3

OBJECTIVES

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

MODULE I LASER THEORY**8**

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

MODULE II DIFFERENT LASER SYSTEMS**8**

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser- Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS**8**

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION**6**

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

L : 30 periods

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

P: 30 periods**Total: 60 periods****REFERENCES:**

1. William T. Silfvast, "Laser Fundamentals", Cambridge University Press, 2009.
2. Ghatak. A. & Thyagarajan. K. "Optical Electronics", Cambridge University, 1994.
3. Laud.B.B., "Laser and Non-Linear Optics", Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., "Lasers Principle, Types and Applications", New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., "Opto Electronics - An Introduction", Prentice Hall, 1992.
6. William M.Steen, "Laser Material Processing", Springer-Verlag, Berlin, Third Edn., 2005.

OUTCOMES:

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

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength
- To measure the loss of information involved in fibre optic communication
- To correlate the results for application.

PHCX 05**MATERIALS SCIENCE****L T P C**
2 0 2 3**OBJECTIVES**

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide a basis for understanding properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 8

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 7

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS 8

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES

1. Palanisamy P.K., "Physics II", Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Kasap. S.O., "Principles of Electronic materials and devices", McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II", Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., "Semiconductor Devices – Physics and Technology", John Wiley, 2nd Edition. 2002.
5. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India, 5th Edition, 2004.

OUTCOMES

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

- Gain knowledge about fundamentals of conducting and semiconducting materials
- Understand the concepts and applications of Dielectric, Magnetic materials
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06**NON-DESTRUCTIVE TESTING****L T P C****2 0 2 3****OBJECTIVES:**

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD**10**

Ultrasonic Testing- Principle of operations- types of sound waves -types of Transducers-transmission and pulse-echo method- straight beam and angle beam, instrumentation- calibration methods-ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction-thickness determination-, advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD**10**

Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Equipment-Exposure charts-Types of films-Fluoroscopy- Xero-Radiography –Limitations-Gamma radiography-Equipment, radiation sources- method of generation- film processing- interpretations of radiography-safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES**10**

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants-developers- advantages and disadvantages of various methods- Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing. Magnetic Particle Testing- Principle-magnetizing technique-procedure –equipment-Interpretation and evaluation of test indications-.applications and limitations-demagnetization.

L : 30 periods**PRACTICALS**

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.
3. Inspection on non magnetic materials by eddy current method.
4. Inspection on magnetic materials by eddy current method.

5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector- Inspection of defects.
9. Demonstration of Radiographic inspection.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash., "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix., "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

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

- Illustrate the ultrasonic inspection methods of NDT.
- Understand the basic concept of radiographic inspection method.
- Test the surfaces by the various surface NDT techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07	PROPERTIES OF MATTER AND ACOUSTICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY**8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY**8**

Viscosity- Newton's formula for viscous flow- Streamline and turbulent motion- Reynolds number - Poiseuille's formula- Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke's method - Lubricants and its applications –viscosity measurements- Viscometer- Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING**7**

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials-vibration and noise control systems for buildings.

MODULUE IV PHOTOELASTICITY**7**

Polarization- double refraction-Theory of Plane, Circularly and Elliptically polarized light- Quarter wave plate and half wave plate- photo elasticity- Theory of photo-elasticity- Stress optic relations- model materials-analysis techniques- Photo elastic

bench.- Three dimensional photo elasticity-Digital photo elasticity- Photo elastic coatings.

L : 30 periods

PRACTICALS

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam., " Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J., " General Properties of Matter", Orient & Longman, 1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

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

- Understand the basic concepts of the elasticity of materials.
- Comprehend the concepts of viscosity of liquid and measurement.
- Demonstrate the acoustical aspects of building and its importance in construction.
- Illustrate the fundamental concept of photo elasticity and its use for the stress analysis of the object.

PHCX 08	PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY**8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment- Cantilever-Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES**8**

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance - Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel (qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES**6**

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method- Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography- method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing- Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS**8**

Definition of Refrigeration and Air-Conditioning - Types of **Refrigeration Systems**- Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain - **Cryogenic treatment - Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties.**

L : 30 periods**PRACTICALS**

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
4. Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

P: 30 periods**Total: 60 periods****REFERENCES:**

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Brijlal & Subramaniam, " Properties of Matter", Eurasia Publishing Co, Delhi, 2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. Baldev Raj., Jayakumar T., Thavasimuthu M., "Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal & Subrahmanyam., "Heat and Thermodynamics" S.Chand & Company Ltd, 2002.
6. Paul E Mix., " Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier., " Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

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

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- Demonstrate the various NDT techniques and its importance.
- Illustrate the low temperature systems and its applications.

PHCX 09	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L T P C 2 0 2 3
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OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS**8**

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

MODULE II OPTOELECTRONIC DEVICES**7**

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS**7**

Modulation of light – birefringence – Modulation Techniques - Electro optic effect – Electro optic materials – Types of Electro optic Modulators : Kerr and Pockel modulators – Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS**8**

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode – Avalanche Photodiode (APD) characteristics - APD design of detector arrays –

Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck's constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

P: 30 periods

Total: 60 periods

REFERENCES:

1. Arumugam. M, "Physics II", Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., "Semiconductor Devices – Physics and Technology", 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996.
4. Bhattacharya, "Semiconductor optoelectronic devices", Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, "Optoelectronics & Photonics:Principles & Practices", Second Edn, Pearson Education,2013.
6. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

OUTCOMES:

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

- Understand the principles of Physics behind semiconductor devices.
- Choose the correct semiconductors for electronic devices and display.
- Differentiate the working principle of LED and Diode Laser.
- Apply the knowledge of modulation of light for different types of optical modulators.
- Select suitable photodetectors for different types of applications.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PRACTICALS

1. Conductometric titrations: acid-base and precipitation titrations
2. Potentiometric titrations
3. Determination of pH of the unknown solution
4. Estimation of alkali metals using flame emission spectroscopy
5. Estimation of metal ions of coloured solutions using colorimetric analysis
6. Separation of compounds using gas chromatography
7. Separation of compounds using high performance liquid chromatography
8. Analysis of the given sample and interpretation of the data using IR, UV-Visible spectroscopy
9. Demonstration of TGA/DTA and DSC and interpretation of data.

P:30 periods**Total: 60 periods****REFERENCES**

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

OUTCOMES

The student will be able to

- state the principle and applications of various electro-analytical techniques
- identify the right separation method for a given sample using different chromatographic techniques
- explain the principle, instrumentation & applications of various spectroscopic methods and also to interpret the data
- elaborate the principle, instrumentation and applications of various thermal analytical techniques and interpret the data.

CHCX02**CORROSION AND ITS CONTROL**

L	T	P	C
2	0	2	3

OBJECTIVES

To make the student conversant with

- Basic concepts, principles and factors affecting corrosion
- Types and mechanism of corrosion
- Control measures of corrosion by material selection, proper design and by applying organic coatings
- Control of corrosion by applying inorganic coatings

MODULE I BASIC CONCEPTS OF CORROSION**8**

Corrosion – causes and impacts of corrosion – mechanism of corrosion: Dry corrosion- oxidation corrosion - corrosion by other gases – Pilling-Bedworth rule- Corrosion by hydrogen: hydrogen blistering, hydrogen embrittlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embrittlement or cracking) – Wet corrosion : hydrogen evolution – presence and absence of oxygen and absorption of oxygen – difference between dry and wet corrosion-factors influencing corrosion-polarization-passivity-emf series and galvanic series- corrosion current -rate of corrosion.

MODULE II FORMS OF CORROSION**7**

Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion – differential aeration corrosion: pitting, water line, wire fencing, crevice and filiform corrosion – stress corrosion – Intergranular corrosion- erosion corrosion – soil corrosion – microbiological corrosion- fretting corrosion- corrosion in composites.

MODULE III CORROSION CONTROL AND ORGANIC COATINGS**8**

Corrosion control – selection of materials and designing- cathodic protection – sacrificial anode and impressed current cathodic protection – corrosion inhibitors: anodic, cathodic and vapour phase inhibitors.

Organic protective coatings – paints: constituents – functions – varnishes : types-constituents – functions – lacquers : constituents – functions –enamels- constituents – functions – special paints : fire retardant, water repellent, heat resistant, temperature indicating and luminous paints.

MODULE IV INORGANIC COATINGS**7**

Treatment of metal surface-inorganic coatings- classification- metallic coatings : anodic and cathodic coatings-hot dipping : galvanizing and tinning- electroplating—

electroless plating – cementation (diffusion) : sherardizing, calorizing and chromizing – metal cladding-metal spraying – non metallic coatings (chemical conversion coatings) : phosphate, chromate, oxide coatings and anodizing – comparison of anodic and cathodic protection.

L : 30 periods

PRACTICALS

1. Determination and comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
2. Determination of rate of corrosion of iron in the presence of various acids by weight loss method.
3. Determination of rate of corrosion of iron in the presence and absence of anodic Inhibitor by weight loss method.
4. Determination of rate of corrosion of iron in the presence and absence of cathodic Inhibitor by weight loss method.
5. Electroplating of base metal with copper.
6. Electrolessplating of base metal with copper
7. Chemical conversion coatings such as chromate and phosphate coatings.
8. Demonstration on the study of rate of corrosion by using cyclic voltametry.

P:30 periods

Total: 60 periods

REFERENCES

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company, NewYork, 1984.
4. S. Banerjee, A.K. Tyagi, Functional Materials- Preparation, Processing and Applications, ELSEVIER Publications, London ; Waltham, MA : 2011

OUTCOMES

The students will be able to

- explain the mechanism, compare and enumerate the factors affecting corrosion
- describe and identify the place and types for a given situation.
- choose and elaborate the suitable organic coating method for a given real time situation.
- apply a suitable metallic coating for a given situation

CHCX03**ELECTRICAL MATERIALS AND BATTERIES****L T P C****2 0 2 3****OBJECTIVES**

To make the student conversant with

- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I**POLYMERS FOR ELECTRICAL
AND ELECTRONIC APPLICATIONS****8**

Preparation, properties and applications : polyethylene, polypropylene, EPDM, Nylon-6,6, PVC, PTFE, polycarbonates, ABS, phenol formaldehyde, urea formaldehyde, epoxy resins – polymer blends and alloys.

MODULE II**ELECTRICAL ENGINEERING MATERIALS****7**

Conductors: Silver, Copper, Gold, Aluminum – Semiconductors: Germanium, Silicon, Gallium Arsenic – Insulating Materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers – Magnetic Materials: ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites

MODULE III**BATTERIES****7**

Electrochemical and electrolytic cell – batteries: types (primary, secondary and flow cell) – primary batteries: dry cells, alkaline batteries – secondary batteries: nickel-cadmium cell – lead acid storage cell, lithium battery: primary and secondary type – solar cell – dye sensitized solar cell.

MODULE IV**FUEL CELLS****8**

Difference between batteries and fuel cells - chemistry of fuel cells - types of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cells (SOFC).

L:30 periods

PRACTICALS

1. Free radical polymerization of styrene.
2. Free radical polymerization of PMMA.
3. Preparation of phenol-formaldehyde.
4. Preparation of urea-formaldehyde.
5. Synthesis of epoxy resin.
6. Demonstration of mechanical properties of insulating materials using UTM
7. Demonstration of electrical properties of insulating materials
8. Construction of batteries using natural resources
9. Measurement of EMF for different batteries.

P:30 periods**Total: 60 periods****REFERENCES**

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2013.
2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. H.F. Mark and N. Gaylord, Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV Interscience, 2nd Ed. 1988.
4. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.
5. [R.K. Rajput](#), A Textbook of Electrical Engineering Materials, Firewall Media, 2004
6. Vladimir S. Bagotsky, Fuel Cells: Problems and Solutions, 2nd Edition, John Wiley and Sons, 2012.
7. B. Viswanathan and M. Aulice Scibioh, Fuel Cells: Principles and Applications, Taylor and Francis Group, 2007.

OUTCOMES

The student will be able to

- summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- enumerate the properties and uses of electrical engineering materials
- illustrate various types of batteries with the aid of a diagram
- classify the fuel cells and elaborate the different types of fuel cells.

CHCX04**ENGINEERING MATERIALS****L T P C****2 0 2 3****OBJECTIVES**

To make the student conversant with

- properties and uses of different types of refractories and abrasives
- adhesives, cements and lime, setting of cements and their chemical behaviors.
- types, properties and uses of lubricants.
- various types of composite materials.

MODULE I REFRACTORIES AND ABRASIVES**8**

Introduction refractory: -classification - based on chemical nature- characteristic and selection of good refractory - general manufacture of refractory- preparation properties and uses of: silica refractory - magnesite refractory - zirconia refractory, properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability, Cermets - super refractory.

Abrasives : introduction - Moh's scale - natural abrasives: diamond – corundum – emery - garnet and quartz, synthetic abrasives: preparation properties and uses: carborundum (silicon carbide)– alundum - boron (norbide) carbide

MODULE II ADHESIVES AND BINDING MATERIALS**8**

Introduction - classification of adhesives –advantage –limitation of adhesive bonding –development of adhesive- factors influencing adhesive action: chemical and physical, application techniques of adhesive – Lime: classification – manufacture - setting and hardening, Gypsum: -Manufacture and properties and uses - Cement : chemical composition- Manufacture – setting and hardening – concrete – weathering of cement and concrete and its prevention- special cements: high alumina cement - sorel cement - white portland cement – water proof cement.

MODULE III LUBRICANTS**7**

Introduction –functions of lubricant- mechanism of lubrication - classification of lubricant – liquid lubricant: vegetable and animal oils – mineral oils, semisolid: grease(calcium, lithium, aluminium) – petroleum jelly, solid lubricant: graphite - molybdenum disulphide, Properties of lubricant: viscosity - viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue.

MODULE IV COMPOSITE MATERIALS**7**

Introduction – advantageous characteristics of composites, applications of composites, main constituent of composites, types and applications of composites: RCC fibre-reinforced plastics (glass, carbon and aramid) - particulate composite - metal matrix composite - layered composites - failures in fibre-reinforced composites, ceramic matrix composites (CMC) – properties and applications.

L:30 periods**PRACTICALS**

1. Preparation of refractory bricks
2. Preparation of abrasive papers/cloth
3. Preparation of simple adhesives
4. Estimation of alkalinity in cements
5. Determination of cloud point and pour point
6. Determination of flash point and fire point
7. Preparation of fibre-reinforced composite

P:30 periods**Total: 60 periods****REFERENCES**

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnagar, "Engineering Chemistry", Tata McGraw-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Wiley India Publisher, New Delhi, 2011.
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.

OUTCOMES

The student will be able to

- classify and describe the manufacture the refractories and enumerate the properties and uses of abrasive materials.
- elaborate the manufacture, properties and uses of various adhesives and binding materials.
- classify lubricants and describe the properties and uses of them
- enumerate the properties and uses of various composite materials.

CHCX05**FUELS AND COMBUSTION****L T P C**
2 0 2 3**OBJECTIVES**

To make the students conversant with the

- three types of fuels available and the different processes involved in it.
- analysis of fuel characteristics and manufacture of fuels
- calculations involved in calorific values and minimum air requirement for complete combustion.
- classification, functions, mechanism and properties of lubricants.

MODULE I SOLID FUELS**7**

Characteristics of good fuel. Solid fuel – Wood, Coal – Ranking of coal – selection of coal. Analysis of coal – Proximate analysis. Pulverized coal – Metallurgical coke – Carbonization of coal – types. Manufacture of metallurgical coke – Beehive oven and Otto Hoffman's by-product oven methods.

MODULE II LIQUID AND GASEOUS FUELS**8**

Liquid fuel: Petroleum: Refining of petroleum, Liquid fuels derived from petroleum – Cracking: Thermal (Liquid and Vapour phase) – Catalytic (fixed bed and moving bed cracking – Synthetic petrol: Fischer-Tropsch method– Knocking in petrol and diesel engine: octane number and antiknocking – cetane number and improvement of cetane number – biodiesel (trans-esterification) – Gaseous fuels: Compressed natural gas (CNG) – LPG – oil gas – producer gas – water (blue) gas – biogas.

MODULE III COMBUSTION**8**

Calorific value: Gross and net caloric value – Bomb Calorimeter, Gas calorimeter - Definition of combustion – calculation of minimum requirement of air (problems) – theoretical calculation of calorific values (Dulong's formula), Gross and net calorific values ((problems) – Analysis of flue gas: Orsat's gas analysis method, explosive range, Ignition temperature. Introduction to air pollution from IC (Internal combustion) engines, photochemical smog, primary and secondary pollutants.

MODULE IV LUBRICANTS**7**

Friction and wear – lubricants: definition, functions and mechanism of lubrication (thick film and thin film) –classification: liquid lubricants: animal and vegetable origin, mineral oil, blended oils, lubricating emulsions and silicones – properties of

lubricating oils: viscosity and viscosity index; Flash and fire-point, Cloud and pour point, oiliness, emulsification number, volatility, carbon residue, aniline point – semisolid lubricant: greases and waxes – solid lubricant: graphite and molybdenum disulphide –nanolubricants.

L:30 periods

PRACTICALS

1. Testing of fuels - proximate analysis (moisture, volatile matter, ash content and fixed carbon present in coal, coke, charcoal etc)
2. Ash content and carbon residue test
3. Biodiesel synthesis by trans-esterification method (from coconut, groundnut, mustard oil, palm oil)
4. Determination of calorific value of a solid fuel using Bomb calorimeter (coal, charcoal, coke etc)
5. Determination of calorific value of a liquid fuel using Bomb calorimeter (petrol, diesel, biodiesel etc)
6. Determination of cloud point and pour point of a lubricant
7. Determination of flash and fire point of diesel.
8. Aniline Point of diesel
9. Viscosity Index of lubricants and Fuels by Viscometer
10. Flue gas analysis by Orsat's gas analysis method – Demonstration
11. Working of internal combustion engine - Demonstration

P:30 periods

Total: 60 periods

REFERENCES

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi, 2001.
2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
3. John Griswold, Fuels Combustion and Furnaces, Mc-Graw Hill Book Company Inc. University of Michigan, 1946.
4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
5. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.

OUTCOMES

The students will be able to

- compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- analyse the fuel properties such as moisture, volatiles matter, ash content, calorific value etc
- calculate minimum air required for complete combustion and calorific values of fuels.
- categorize different lubricants into three types, explain the preparation and determine their properties.

CHCX06**FUNDAMENTALS OF PHYSICAL CHEMISTRY****L T P C**
2 0 2 3**OBJECTIVES**

To make the student conversant with the

- various thermodynamic terms and relate the laws of thermodynamics in chemical processes
- molecularity and order of reaction and derive the rate constant for different order of reactions
- basics of adsorption of different materials and propose mechanisms and surface area measurement
- conditions for equilibrium and learn different components at equilibrium

MODULE I BASIC THERMODYNAMICS**8**

Introduction - Thermodynamic terms - Thermodynamic equilibrium and processes - 1st law of thermodynamics: internal energy, enthalpy, heat capacity, isothermal and adiabatic expansion, Joule-Thomson effect - Zeroth law of thermodynamics: absolute temperature - 2nd law of thermodynamics: - spontaneous and cyclic process, Entropy in isothermal, isobaric and isochoric processes, work and free energy function, Maxwell's relation - 3rd law of thermodynamics

MODULE II CHEMICAL KINETICS**8**

Rate of chemical reaction - order and molecularity of a reaction - Rate constant - kinetics of opposing, parallel and consecutive and chain reactions - isotope effects - effect of temperature on reaction rate - collision theory - absolute reaction rate theory - kinetics in enzyme catalysis

MODULE III SURFACE SCIENCE AND CATALYSIS**8**

Adsorption - adsorption isotherms - uni and bimolecular adsorption reactions - parahydrogen conversion - factors affecting adsorption – Langmuir adsorption isotherm - Hinshelwood mechanism and *Eley-Rideal* mechanism with example - adsorption of gases on solids and surface area measurement by BET method - Terms in catalysis - homogeneous and heterogeneous and enzyme catalysis with example

MODULE IV PHASE RULE**6**

Terms involved - Conditions for equilibrium - application of phase rule to water, lead-silver system, freezing mixtures, thermal analysis: cooling curves.

L:30 periods

PRACTICALS

1. Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter. Calculation of enthalpy of combustion and formation for camphor.
2. Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.
3. *Kinetics of first and second order reactions.*
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzene and p-nitro toluene.

P:30 periods**Total: 60 periods****REFERENCES**

1. Rajaram J. and Kuriacose J.C., Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson Education, India, 2013.
2. Samuel Glasstone, Thermodynamics for Chemists, Read Books, United Kingdom, 2007.
3. James E. House, Principles of Chemical Kinetics, 2nd Edition, Academic Press, United States of America, 2007.
4. Keith J. Laidler, Chemical Kinetics, Pearson Education, India, 1987.
5. Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, 1984.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co. India, 2016.

OUTCOMES

The student will be able to

- calculate entropy, enthalpy and free energy change for different chemical processes
- calculate the rate constant for any chemical and biochemical processes
- differentiate the adsorption processes and calculate the surface area and predict the suitability of catalysts for different chemical processes
- predict the equilibrium conditions for water, alloys, freezing mixtures and draw the thermal curves for phase transition

CHCX07**GREEN TECHNOLOGY****L T P C****2 0 2 3****OBJECTIVES**

To make students conversant with the

- basic principles of green chemistry and green technology.
- wastes that causes hazards to human health
- chemicals that harms our environment
- need for green processes in various industries

MODULE I GREEN CHEMISTRY PROTOCOL**7**

Need – Significance – 12 Principles with examples – R4 model – Life cycle analysis – sustainable and cleaner production - Green Technology: definition, examples: CFC free refrigerants, green building, energy, 3D printers, nanotechnology – Awards for Green chemistry – organization promoting green chemistry.

MODULE II WASTE & WASTE MINIMISATION**8**

Source of wastes: domestic, industrial, medical, nuclear, e-waste; problems; prevention – economy of waste disposal – Waste minimization techniques: general waste treatment and recycling – alternate waste water treatment technologies: hybrid process – Green computing: goals, green cloud, green ICT - Pollution statistics from various industries (Industrial case studies).

MODULE III GREEN SYNTHESIS**7**

Introduction - Solvent free reactions - green reagents, green solvents in synthesis - microwave and ultrasound assisted reactions – supercritical fluid extraction – green oxidation and photochemical reactions – catalyst and biocatalysts.

MODULE IV GREEN INDUSTRIAL PROCESSES**8**

Polymer industry: biodegradable polymer - textile industry: greener approaches of dyeing, waste disposal – ecofriendly agrochemicals: biofertilizers, biopesticides – Pharmaceutical industry: atom economy, reduction of toxicity, use of biocatalyst, zero waste disposal – Leather industry: greener process in tanning, crusting, surface coating – ecofriendly batteries & fuel cells.

L:30 periods

PRACTICALS

1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic chemicals.
2. Green bromination of stilbene (using pyridine hydrobromide).
3. Green synthesis: Photocatalytic reactions, solvent-free organic reaction – Aldol; green oxidation, green reduction.
4. Microwave assisted chemical reaction. (synthesis of aspirin, pinacol-pinacolone reaction, etc).
5. Comparison of conventional reaction with microwave assisted reactions (atom economy, solvent, etc) [Ex: aldehyde and ketones with hydrazines to give hydrazones].
6. Diels-Alder reaction in eucalyptus oil (green process).

P:30 periods**Total: 60 periods****REFERENCES**

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
3. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.
4. Rashmi Sanghi, M. M. Srivastava, Green chemistry, Narosa publishers, New Delhi, 2003.

OUTCOMES

The students will be able to

- outline the principles and implications of green chemistry.
- comprehend the potential risks of waste generated and analyse the threats to human and environment.
- integrate information into design of molecules to avoid/eliminate toxic solvents & reagents or reduce toxic products.
- identify various alternate greener technologies for various industries.

3. Separation of sugars – TLC and/or paper chromatography.
4. Quantitative estimation of lipids.
5. Separation of amino acids – TLC and/or paper chromatography.
6. Quantitative estimation of proteins by Lowry's method.

P:30 periods

Total: 60 periods

REFERENCES

1. V. K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishers, New Delhi, 2002.
2. Johnson Arthur T., Biology for Engineers, CRC Press, Finland, 2011.
3. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
4. David L. Nelson, Michael M. Cox, Lehninger Principles of biochemistry, Macmillan press, London, 2010

OUTCOMES

The students will be able to

- classify organic compounds and explain the mechanism of various organic reactions.
- draw the structures and enumerate the functions of carbohydrate, lipids and vitamins.
- correlate the relationship among amino acids, peptides and proteins.
- recognize the role of nucleic acid in the formation of RNA & DNA and differentiate DNA & RNA using their structure and function.

CHCX09**POLYMER SCIENCE AND TECHNOLOGY****L T P C**
2 0 2 3**OBJECTIVES**

To make the student conversant with the

- basic concepts of polymers, classification, types of polymerization and molecular weight & its distribution
- preparation, properties and applications of thermoplastics and introduction to biodegradable polymers
- properties and applications of thermosets, elastomers and FRP
- different types of moulding techniques

MODULE I BASIC CONCEPTS OF POLYMERS**8**

Definitions: monomer, polymer, functionality, degree of polymerization – classification of polymers: source, structure, application, thermal processing behavior (thermoplastics and thermosets), composition and structure (addition and condensation), mechanism (chain growth and step-wise growth) – copolymer: types – Definition – nomenclature of polymers – tacticity – types of polymerization : free radical, cationic and anionic polymerization (concepts only) – average molecular weight of polymer: number, weight – molecular weight distribution (problems)

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS**8**

Preparation, properties and applications : LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymer blends and alloys – basics of biodegradable polymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP**7**

Thermoset resins : phenolic resins, amino resins (urea and melamine formaldehyde), epoxy resins, unsaturated polyesters – polyurethanes – elastomers : vulcanization of natural rubber, diene based elastomers – fibre reinforced plastics: glass, aramid and carbon.

MODULE IV MOULDING TECHNIQUES**7**

Moulding constituents: functions – moulding techniques: compression, injection, extrusion (single screw), blow moulding, thermoforming, (mechanical and vacuum forming), lamination.

L: 30 periods

PRACTICALS

1. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
2. Free radical polymerization of styrene.
3. Free radical polymerization of PMMA.
4. Preparation of phenol-formaldehyde.
5. Preparation of urea-formaldehyde.
6. Synthesis of epoxy resin.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.
9. Demonstration of injection moulding, compression moulding and blow moulding.

P:30 periods**Total: 60 periods****REFERENCES**

1. Billmeyer F.N., Text Book of Polymer Science, 3rd Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3rd Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
4. Jacqueline I., Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, New York, 1998.
5. Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV, H.F. Mark and N. Gaylord, Interscience, 2nd Ed. 1988.
6. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.

OUTCOMES

The student will be able to

- classify various polymers, name the polymers and types of polymerization reactions, calculate molecular weight of polymers,
- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application

MACX 02	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to impart the

- knowledge of the theory of probability and random variables
- techniques to carry out probability calculations and identifying probability distributions
- application of statistical inference in practical data analysis

MODULE I BASICS OF PROBABILITY AND STATISTICS 8+2

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Descriptive Statistics.

MODULE II ONE DIMENSIONAL RANDOM VARIABLE AND 7+3
PROBABILITY DISTRIBUTION FUNCTIONS

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 8+2

Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables.

MODULE IV SAMPLING AND ESTIMATION 7+3

Sampling distributions – basic knowledge on Random , simple random , stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V THEORY OF INFERENCE 8+2

Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student's t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE VI DESIGN OF EXPERIMENTS**7+3**

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Interpretations - case studies.

L – 45; T – 15; Total Hours –60**TEXT BOOKS:**

- T.Veerarajan, "Probability and Statistics", Tata McGraw-Hill Education, 2008.
- Miller, I., Miller, M., Freund, J. E., "Mathematical statistics", 7th Edition, Prentice Hall International, 1999.
- S.P.Gupta, "Applied Statistics", Sultan Chand & Sons

REFERENCES:

- S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, Elsevier.
- S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics" First edition, Sultan Chand and Sons.
- Arora and Arora, "Comprehensive Statistical Methods", S. Chand, 2007

OUTCOMES:

On completion of the course, students will be able to

1. do basic problems on probability and descriptive statistics.
2. derive the probability mass / density function of a random variable.
3. calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
4. calculate point and interval estimates.
5. apply some large sample tests and small sample tests.
6. carry out the data collection representation analysis and implications and the importance of inferences.

MACX 03**RANDOM PROCESSES**

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of the course are to

- acquire the knowledge of the theory of probability and random variables
- study discrete and continuous probability distributions.
- demonstrate the techniques of two dimensional random variables and its distributions.
- introduce the random process, stationarity, Markov process and the study of correlation function and spectral analysis.

MODULE I Basics of Probability 7+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye’s theorem - Tchebychev’s inequality.

MODULE II One dimensional Random variable and Probability Distribution functions 7+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 7+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 8+2

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities.

MODULE V CORRELATION FUNCTIONS 8+2

Autocorrelation function and its properties - Cross Correlation function and its properties - Linear system with random inputs – Ergodicity.

MODULE VI SPECTRAL DENSITY 8+2

Power spectral Density Function - Properties - System in the form of convolution - Unit Impulse Response of the System – Weiner-Khinchine Theorem - Cross

Power Density Spectrum.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

- 1 Veerarajan T., “Probability, Statistics and Random Processes”, Tata McGraw Hill,3rd edition, 2008.
- 2 Papoulis, “Probability, Random Variables and Stochastic Processes”, 4th Edition, Tata McGraw Hill Company, 2002.
- 3 S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elsevier

REFERENCES:

- 1 Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009.
- 2 Trivedi K S, “ Probability and Statistics with reliability, Queueing and Computer Science Applications”,Prentice Hall of India,New Delhi,2nd revised edition, 2002

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- identify and study the different random processes.
- compute correlation functions and related identities.
- compute power spectral density functions and apply Weiner-Khinchine formula.

MACX 04	APPLIED NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of the course are to

- introduce basic computational methods for analyzing problems that arise in engineering and physical sciences.
- acquire knowledge about approximation theory and convergence analysis associated with numerical computation.

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 7+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II INTERPOLATION 8+2

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III NUMERICAL DIFFERENTIATION AND INTEGRATION 8+2

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV INITIAL VALUE PROBLEMS FOR FIRST ORDER 7+3
ORDINARY DIFFERENTIAL EQUATIONS

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods

MODULE V INITIAL AND BOUNDARY VALUE PROBLEMS FOR 8+2
ORDINARY DIFFERENTIAL EQUATIONS

Numerical solutions by Taylor's Series method - Runge – Kutta Method of fourth order of second order ODE. Finite difference methods.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL 7+3
DIFFERENTIAL EQUATIONS

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace equation.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Grewal, B.S., “Numerical methods in Engineering and Science”, 7th edition, Khanna Publishers, 2007.
2. C.F.Gerald, P.O.Wheatley, “Applied Numerical Analysis” ,Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. “Numerical Methods for Engineers”, 5th Ed., McGraw Hill, 2006.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, “Numerical methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003

OUTCOMES:

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

1. solve algebraic, transcendental and system of equations.
2. apply interpolation techniques.
3. carry out numerical differentiation and integration using different methods.
4. solve first order ODE using single and multi step methods.
5. solve second order ODE, initial and boundary value problems.
6. solve the boundary value problems in PDE.

Maths Elective Courses
(To be offered in VI Semester)

MACX 05	MATHEMATICAL PROGRAMMING	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of the course are to

- acquire knowledge and training in optimization techniques.
- obtain knowledge about optimization in utilization of resources.
- understand and apply operations research techniques to industrial operations.

MODULE I LINEAR PROGRAMMING PROBLEM 10

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ADVANCED LINEAR PROGRAMMING PROBLEMS 8

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships.

MODULE III TRANSPORTATION PROBLEM 7

Transportation problems – Initial basic feasible solutions, MODI method, Unbalanced transportation problem, Degeneracy in transportation models,.

MODULE IV ASSIGNMENT PROBLEM 5

Assignment problem – Minimization and Maximization type of problems by Hungarian method.

Total Hours –30

TEXT BOOKS:

1. Hamdy A Taha, "Operations Research - An introduction", 8th edition, Phil Pearson, 2007.
2. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, "Operations Research Applications and Algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald J Lieberman, "Operations Research Concepts and Cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research: Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
4. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

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

1. formulate industrial problems as mathematical programming problems.
2. solve linear programming problems by different methods.
3. solve transportation problems by different methods.
4. solve assignment problems by Hungarian method.

MACX 06	STATISTICAL METHODS FOR DATA ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aim of the course is to

- introduce statistical quality control tools.

MODULE I	TESTS OF HYPOTHESES AND STATISTICAL INFERENCE	8
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Small sample tests – Student's 't' test for single mean, difference of means, paired t test – F test for difference of variances – Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE II	DESIGN OF EXPERIMENTS	7
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Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Statistical analysis - Interpretations - case studies.

MODULE III	STATISTICAL QUALITY CONTROL-I	8
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Quality improvement and statistics – Statistical quality control- statistical process control – control charts – design of control charts – analysis of patterns on control charts - X bar chart, R chart and S chart.

MODULE IV	STATISTICAL QUALITY CONTROL-II	7
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Process and product control – attribute charts – P, np and C charts – control charts performance.

Total Hours –30

TEXT BOOKS:

1. Douglas C. Montgomery, George C. Runger "Applied Statistics and probability for Engineers" V Edition – John Wiley & Sons Inc.
2. Miller, I., Miller, M., Freund, J. E. "Mathematical statistics" 7th Edition. Prentice Hall International, 1999.

REFERENCES:

1. Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.
2. Chin Long Chiang "Statistical Methods of Analysis" World Scientific Books,

2003.

3. S.C.Gupta and V.K. Kapoor, "Mathematical Statistics" , Sultan Chand publications.
4. Veerarajan "Fundamentals of Mathematical Statistics" I Edition, Yes Dee Publishing Pvt. Ltd., 2017.

OUTCOMES:

On completion of the course, students will be able to

1. develop and test hypothesis for different statistical tests
2. design an experiment and case study the experiment with different data.
3. analyze the industrial data using quality control design tools statistically.
4. analyze the industrial data using process and product control tools statistically.

MACX 07	NUMERICAL METHODS FOR INTEGRATION AND DIFFERENTIAL EQUATIONS	L	T	P	C
		2	0	0	2

OBJECTIVES:

1. This course aims to solve numerically integral and differential equations.

MODULE I NUMERICAL INTEGRATION 8

Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two Point and Three point Gaussian quadrature formulae.

MODULE II NUMERICAL DOUBLE INTEGRATION 6

Double integrals using trapezoidal and Simpson's 1/3 rules

**MODULE III NUMERICAL SOLUTIONS OF ORDINARY
DIFFERENTIAL EQUATIONS 8**

Milne's Predictor and Corrector Method – Adam's Predictor-Corrector Method - Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

**MODULE IV BOUNDARY VALUE PROBLEMS FOR PARTIAL
DIFFERENTIAL EQUATIONS 8**

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations

Total Hours –30

TEXT BOOKS:

- M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
- Grewal, B.S., "Numerical methods in Engineering and Science" 7th edition, Khanna Publishers, 2007

REFERENCES:

1. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi 2002.
2. P.Dechaumphai, N. Wansophark, "Numerical Methods in Engineering", Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- solve the integration by numerical methods.
- solve the double integration by numerical methods
- find numerical solution of ordinary differential equations in engineering problems.
- find numerical solution of partial differential equations in engineering problems.

MACX 08	MATHEMATICAL MODELLING	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of the course are to

1. provide basic idea of formation and use of Mathematical models for different purposes.
2. determine the extent to which models are able to replicate real-world phenomena under different conditions

MODULE I PRINCIPLES OF MATHEMATICAL MODELING 7
 Mathematics as a modelling language - Classification of models - Building, studying, testing and using models - Black and white box models – Difference equations

MODULE II PHENOMENOLOGICAL MODELS 7
 Linear, Multiple linear and nonlinear regression - Neural networks - Fuzzy model - Stability and higher dimensional systems

MODULE III MECHANISTIC MODELS –I 8
 Setting up ODE models – Initial and Boundary value problems - Numerical solutions - Fitting ODE to data - Applications

MODULE IV MECHANISTIC MODELS –II 8
 Linear and nonlinear equations - Elliptic, parabolic and hyperbolic equations - Closed form solutions - Finite difference and finite element methods

Total Hours –30

TEXT BOOKS:

- G . Ledder , “Calculus, modelling , probability and dynamic systems”, Springer 2013
- Kei Velten, “Mathematical modelling and simulation”, J. Wiley and sons,2009

REFERENCES:

1. Michael D Alder, “An introduction to Mathematical modelling”, Heaven for Books.com
2. Alfio Quarteroni, “Mathematical models in science and engineering”,

Notices of AMS

3. J.N. Kapur, "Mathematical models in Biology and Medicine", Affiliated East-West Press Private Limited, New Delhi, 1992.

OUTCOMES:

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

- identify the relationship between real world and mathematical models
- Classify the data and choose the appropriate model
- Distinguish between linear and nonlinear models
- identify the relationship between empirical and mechanistic models

MACX 09	GRAPH THEORY	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aims of this course are to

- represent the real life situations diagrammatically.
- appraise different methods to find solutions to graph theory problems.

MODULE I INTRODUCTION TO GRAPH THEORY 8

Graphs - finite and infinite graphs - Incident and degree-isolated vertex, pendent vertex and null vertex.

MODULE II PATH AND CIRCUIT 8

Isomorphism – sub graphs-walks, paths and circuits – connected and disconnected graphs- Euler graphs – operation on a graph.

MODULE III TREES AND FUNDAMENTAL CIRCUITS 7

Trees- some properties of trees- pendent vertices in a tree – rooted binary tree- spanning trees-fundamental circuits.

MODULE IV CUT SETS AND CUT VERTICES

Cut sets – some properties of cut sets- fundamental circuits and cut sets- network flows.

Total Hours –30

TEXT BOOKS:

1. NARSINGH DEO, Graph theory with applications to Engineering and Computer Science, Prentice Hall INC, New Delhi,
2. J.A. Pandy and U.S.R. Murthy, North Holland, Oxford, New York Graph theory with applications

REFERENCES:

1. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011
2. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011
3. Md. Saidur Rahman, “Basic graph theory”, Springer, 2017

OUTCOMES:

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

- demonstrate the basic concepts of Graph theory.
- explore connected and disconnected graphs.
- identify the real life problems with trees and circuits.
- bring out the cut set properties and network flows properties.

Humanities Elective I**(To be offered in III Semester)**

SSCX01	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain and discuss the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and public finance.
- To apprise the students about Indian economy and the role of engineers in economic development.

MODULE I DEMAND AND SUPPLY ANALYSIS 8

Classification of economy – open and closed economy, Demand - Types of demand - Determinants of demand – Law of Demand - Demand elasticity - Supply - Determinants of Supply – Law of Supply - Supply elasticity - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 7

Concepts of National income and measurement – Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – meaning of inflation- types - causes and preventive measures

MODULE III MONEY, BANKING AND PUBLIC FINANCE 9

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and Expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) .

MODULE IV INDIAN ECONOMY AND THE ROLE OF ENGINEERS 6

Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
- Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

- Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
- Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCXO2**PRINCIPLES OF SOCIOLOGY.**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process- Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Giddens A. 1989. "Sociology" Cambridge: Polity Press.
- Heald Haralambos, R.M(2014) . "Sociology Themes and Perspectives", Oxford, New Delhi-92
- Bhushan Vidya and D.R. Sachdeva (2012). "Fundamental of Sociology", Pearson, Delhi.

REFERENCES:

- Das Gupta, Samir and Paulomi Saha (2012), "An Introduction to Sociology", Pearson, Delhi
- Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCXO3	SOCIOLOGY OF INDIAN SOCIETY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, nature, social disorganization; Population explosion-causes, effects, relationship with development; Child Labour- causes, magnitude and consequences; Unemployment-nature , types, causes and effects; Gender issues-social status of women, violence against women and women in work place; Contemporary issues- communalism, terrorism and corruption.

MODULE IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization;
Processes of Social change- Industrialization, Urbanization, Globalization; Development- definition, elements, role of government, industry and corporate sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
- Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
- Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
- Ahuja Ram. 2014. *Society in India*,, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), “Indian Society and Social Institutions” Atlantic Publishers & Distri,
2. Atal, yogesh (2006), “Changing Indian Society” Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

1. Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
2. Students will be sensitized to the various categories ,Inequalities and their challenges
3. Students will be exposed to the social problems encountered in contemporary India.
4. Students will gain knowledge about the various forms and trends of the social change.
5. Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II
(To be offered in IV Semester)

SSCXO4	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal. International responses to environmental challenges - Global policy such as Kyoto Protocol, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT 8
SUSTAINABILITY

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability, Globalization and Global Governance. Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE 7
DEVELOPMENT

Principles of environmental policy for achieving sustainable development:

precautionary principle and polluter pays principle – Business Charter for Sustainable Development. Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), “*Environmental Economics and Natural Resource Management*”, Routledge, 3rd edition.
2. Karpagam M (1999), “*Environmental Economics: A Textbook*”, Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), “*Green Management Theory and Applications*”, Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), “*Ecology and Economics: An Approach to Sustainable Development*”, Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCX05**INDUSTRIAL SOCIOLOGY**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- definition, scope and importance; Theoretical approaches- scientific management, human relations approach, theory of bureaucracy, Fordism and post-fordism; Production system- concept and characteristics of factory system, automation and rationalization; Industrial conflict- strike , lockout and trade unions.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility; Informal organization- definition, characteristics, types and relevance; Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction; Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 8

Group dynamics- Definition, Group behaviour model, Group decision making process, group cohesiveness; Leadership- definitions, style and effective supervision; Communication- concepts, types, model barriers; Job satisfaction- nature, employee compensation and job satisfaction.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

- Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
- Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

1. Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
2. Students will be familiar with structure of authority, roles and responsibility in organizational settings.
3. Students will imbibe leadership, communication and behavioral acumen to govern organization
4. Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCX06**LAW FOR ENGINEERS**

L	T	P	C
2	0	0	2

OBJECTIVES:

1. To understand the Constitution and Governance of our country.
2. To apprise the students of human rights - local and international and redressal mechanism.
3. To have an insight into the industrial, corporate and labour laws of our country.
4. To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 7

Human rights – meaning and significance, Covenant on civil and political rights, Covenant on Economic, Social and Cultural rights, UN mechanism and agencies, The Protection of Human Rights Act, 1993 – watch on human rights and enforcement.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights*, Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967), *Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of this course,

1. Students will be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
2. Students will have gained knowledge in human rights, cultural, social and political rights.
3. Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
4. Students will have an overview of IPRs and laws related to Intellectual Property Rights.

- Describe the origin, changes and management of environmental hazards.
- Develop the knowledge on natural disasters.
- Develop the knowledge on man-made disasters.
- Discuss the different segments of disaster management.
- Explain the concept of different disaster relief measures.
- Achieve sufficient knowledge on the National Policy on Disaster Management.

GECX102**TOTAL QUALITY MANAGEMENT****L T P C****3 0 0 3****OBJECTIVES:**

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I**INTRODUCTION****8**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs- Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II**TQM PRINCIPLES****7**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III**TQM IMPROVEMENT PROCESS****8**

Continuous Process Improvement – Juran Trilogy, PDCA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV**STATISTICAL PROCESS CONTROL (SPC)****8**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE V**TQM TOOLS****7**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss

GECX103	ENERGY STUDIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

**MODULE IV COGENERATION, WASTE HEAT RECOVERY AND 8
COMBINED CYCLE PLANTS**

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX104	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the robots, various components, of Robots, programming and their applications.

MODULE I **8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL **8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS **8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES **7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS **7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS **7**

Forward and inverse Kinematic equations, Denavit – Hartenbers representations
Fundamental problems with D-H representation, differential motion and velocity of frames - Dynamic equations for single, double and multiple DOF robots – static force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

1. Yoram Koren, "Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al, "Expert Systems and Robotics", Springer – Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX105	TRANSPORT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

GECX106	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND 6
APPLICATION OF CONTROL SYSTEMS

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

L – 45; Total Hours –45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GECX107	INTRODUCTION TO VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics

Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.

MODULE II LOGIC DESIGN USING VERILOG HDL 8

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.

MODULE V TRANSISTOR THEORY 7

GECX 108	PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

L – 45; Total Hours –45

REFERENCES:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.
3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004
4. [R. Keith Mobley](#), Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX109	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

MODULE I INTRODUCTION 6

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key Infrastructure -Federated Identity Management - Web Security Considerations -

Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC 8
MAIL SECURITY AND IP SECURITY

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

MODULE VI SYSTEM SECURITY 8

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

L – 45; Total Hours –45

REFERENCES:

1. William Stallings, "Network security Essentials: Applications and standards", Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013
2. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, ISBN-13:978-0-273-79335-9,2013
3. Behrouz Forouzan, Debdeep Mukhopadhyay, Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016
4. Wikipedia, "Network Security and Management" , [https://en.wikipedia.org/wiki/Book:Network Security and Management](https://en.wikipedia.org/wiki/Book:Network_Security_and_Management), 2014.
5. Nitesh Dhanjani, Justin Clarke, "Network Security Tools", O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques
- Apply the cryptographic algorithms in different applications
- Express the network security designs using available secure solutions such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

GECX110	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, "Knowledge Management", Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, "Handbooks on Knowledge Management", 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, "Knowledge Management: Systems and Processes", 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX111**CYBER SECURITY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cybersecurity.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

MODULE VI COMPUTER FORENSICS 7

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.
2. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education,2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education,2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education,2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill,2000.

OUTCOMES:

Upon completion of this course, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

GECX112	GENETIC ENGINEERING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING 9

Objectives, Selfing and crossing techniques, Male sterility, Incompatibility, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT 9

Genetic diseases in humans, Genetics and society

L – 45; T – 15; Total Hours –60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prentice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic material Describe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

GECX113	FUNDAMENTALS OF PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management-Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS 8
AND GAME THEORY

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hamdy ATaha, "Operations Research an introduction", 8th edition, Phil Pearson, 2007.
2. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, "Operations Research concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
- A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
3. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GECX115	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic, transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size

analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, “Handbook of Nanostructured Materials and Nanotechnology”, Academic Press, 2000.
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press (2011).
3. Zhong Lin Wang, “Handbook of Nanophase and Nanomaterials (Vol 1 and II)”, Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.

REFERENCES:

1. A. Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX116	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart carefully maintaining their vehicle and can increase driving safety.

MODULE I MAINTENANCE, WORKSHOP PRACTICES, 7
SAFETY AND TOOLS

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM 8
MAINTENANCE

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE 8

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal, Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnicks.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- Analyze the causes and remedies for fault in transmission and drive line systems.
- Analyze the causes and remedies of steering and suspension systems.
- Analyze the causes and remedies of brake system.
- Demonstrate the procedure for wheel alignment and wheel balanced.

GECX117	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

MODULE II COLOR IMAGE PROCESSING 8

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

MODULE III IMAGE ENHANCEMENT 7

Basic gray level Transformations, Histogram Processing, Spatial Filtering

MODULE IV IMAGE TRANSFORMS 7

2D-DFT, DCT, Haar Transform, Fundamentals of 2D-wavelet transform, sub-band coding

MODULE V IMAGE SEGMENTATION AND RESTORATION 8

Point, line and edge detection methods, Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

MODULE VI IMAGE COMPRESSION 7

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

TOTAL HOURS : 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses
(To be offered in VII Semester)

GECX201	GREEN DESIGN AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in a buildings.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues- Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO 8
ECONOMIC SYSTEMS

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, "Sustainable Development", Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., "Sustainable Construction: Green Building Design and Delivery", 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- describe the elements in green building design and suggest ideas for attaining sustainability in building.

Government Policies- Energy Policy-Appropriate technology Development
Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours –45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, "Appropriate Technology: Tools Choices and Implications", Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, "Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology", Stanford, 1986.

REFERENCES:

1. Richard Heeks, "Technology and Developing Countries: Practical Applications Theoretical Issues", 1995.
2. John Pickford, "The Worth of Water : Technical Briefs on Health, Water and Sanitation", Intermediate Technology Publications, 1998.

OUTCOMES:

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

- describe about the tools, choices of appropriate technology along with concepts of energy fundamentals
- conceptualize the techniques to be adopted in building design for saving energy and water.
- acquire knowledge about the techniques for water, health and sanitation management
- explain the classification, collection dispose and recycling systems adopted in waste management.
- elucidate the concepts of green building and renewable energy sources.
- express the polices relevant to technology and recommend an appropriate technology for an sustainable development.

GECX203	ENGINEERING SYSTEM MODELLING AND	L	T	P	C
	SIMULATION	3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION 6

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES 7

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS 7

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES 10

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6

Case Study using simulation languages

L – 45; Total Hours –45

REFERENCES:

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., "System Improvement Using Simulation", 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.
4. Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GECX204	VALUE ANALYSIS AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagramming - Cost Modelling. Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND 6
RECOMMENDATION

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. "Value Engineering- A systematic approach", McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), "Value Engineering", Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, "Value Engineering: A Plan for Invention", St.Lucie Press, New York, 1999.
2. Lawrence, D.M., "Techniques of Value Analysis and Engineering", McGraw Hill 1988.
3. George, E.D., "Engineering Design: a Material and Processing Approach", McGraw Hill, 1991.
4. Heller, D.E., "Value Management, Value Engineering and Cost Reduction", Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GECX205	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and

maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Blake R.B., "Industrial Safety", Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., "Construction Safety, Security, and Loss Prevention", John Wiley and Sons, 1979.
4. Fordham Cooper W., "Electrical Safety Engineering", Butterworths, London, 1986.
5. Alexandrov M.P., "Material Handling Equipment", Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX206	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning- practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial

neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
4. Kalymanoy Deb, "Optimization for Engineering Design", PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

- Formulate a real life situation as an optimization the problem.
- Identify the appropriate solution methodology and provide a solution

GECX 207	MATLAB SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION 7

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION 7

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER REPRESENTATION OF NUMBERS 7

Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8

Numerical integration and solving 1st order, ordinary differential equations (Euler's method and Runge-Kutta)- Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8

Converting 2nd order and higher ODEs to systems of 1st order ODEs- Solving systems of ODEs via Euler's method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations

MODULE VI INTRODUCTION OF SIMULINK**8**

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45**REFERENCES:**

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
- Make use of Matlab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECX208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples- Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms- Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

**MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS 8
and TOOLS**

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V PROGRAM MODELING IN EMBEDDED SYSTEMS 8

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

MODULE VI EMBEDDED SYSTEMS APPLICATION 5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours –45

TEXT BOOKS:

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons,2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta , "Embedded Realtime Systems Programming "TataMcGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems",CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

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

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

GECX209**USABILITY ENGINEERING****L T P C****3 0 0 3****OBJECTIVES:**

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION**6**

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES**8**

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN**8**

Process of Interaction Design - Establishing Requirements – Design, Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING**8**

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS**8**

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human - Computer Interaction”, John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, “Usability Engineering”, Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Interaction”, Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, “Usability Engineering: Process, Products, and Examples”, Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX210	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 8

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain -
Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX211	SYSTEMS ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS 7
DEVELOPMENT

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System

GECX212**ADVANCED MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES:

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I**8**

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect- Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II**8**

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)- Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III**8**

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers- Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV**7**

Nano Materials- The nanosize range- classification of nanomaterials- processing of nanomaterials- properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V**7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI**7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys, Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45**REFERENCES:**

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition, Prentice Hall of India, 2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX213	NATIONAL SERVICE SCHEME	L	T	P	C
		2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.

To achieve the above objective, the following should be adhered:

- To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- To develop certain basic skills for personality development through community development.
- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving and
- Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme-
The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT SKILLS 8

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution-Globalization and its Economic Social Political and Cultural impacts.

L – 30; Total Hours –30**TEXT BOOKS:**

- National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
- National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
- Social Problems in India, *Ram Ahuja*.

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building Students will gain

GECX214	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NO_x, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

MODULE I EMISSION FROM AUTOMOBILES 8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of pollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

MODULE II SI ENGINE EMISSIONS AND CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NO_x, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

MODULE III CI ENGINE EMISSION AND CONTROL 8

Formation of White, Blue, and Black Smokes, NO_x, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE IV NOISE POLLUTION FROM AUTOMOBILES 8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE V TEST PROCEDURES 6

GECX215	MOTOR VEHICLE ACT, INSURANCE AND POLICY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn about various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on conviction- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership- Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance- Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle
Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45**TEXT BOOKS:**

1. The motor vehicle act 1988, Universal law publishing co.cpvvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications

& Table of Offences and Punishments Asia Law House; 15th edition
(2014)

2. Assessment of Compensation in Accidents under Motor Vehicles Act by
Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

TEXT BOOKS:

1. A.Bruce Carlson, Paul B. Crilly, "Communication Systems", 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, "Principles of Communication Systems" 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, "An Introduction To Analog And Digital Communications", 1st Edition, Wiley India, 2010.
3. Simon Haykin , "Communications Systems" 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, "Analog and Digital Communications" 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

- Identify various communication systems and the corresponding modulation schemes.
- Predict the characteristics of various analog and digital modulation schemes.
- Interpret the effect of noise and bandwidth in a communication systems
- Apply the Nyquist criteria for a given baseband signals.
- Evaluate the performance of communication receivers.
- Demonstrate the applications of common communication systems.

GECX 217**LEAN MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

The objective of the Course to make the student know about

- The basics of leanproduction management,
- How Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I**7**

Lean production – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II**8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III**7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV**8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools - Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - Cellular systems. - Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - Leveling. - Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V**8**

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and

encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

MODULE VI

7

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

Total Hours –45

TEXT BOOKS:

1. The Toyota Way Field book, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings at <http://www.leanconstruction.org/readings.htm>
2. Hopp, W. J., and Spearman, M. L. (2011). Factory Physics, Third Edition, Waveland Press, Long Grove, IL. 720pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in lean production activities.
- Select the tools that can be used implementing lean production in production operations.
- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

3 0 0 3**OBJECTIVES:**

- To impart knowledge on the fundamental representation and analysis of geospatial phenomena and provides the various methods and algorithms used in GIS analysis.
- To focus in terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena – Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND 8

LANDFORMS

Methods for flow routing and flow accumulation – Extraction of stream networks – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.

MODULE VI MODELING OF GEOSPATIAL PROCESSES 7

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

Total Hours –45

TEXT BOOKS:

1. Hassan A, Karimi (2017), Geospatial Data Science Techniques and Applications, CRS Press & Co.
2. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014), Hierarchical Modeling and Analysis for Spatial Data, CRS Press & Co.

REFERENCES:

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

OUTCOMES:

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

- apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.
- employ the spatial tools to make simulations and predictions of real life phenomena.
- integrate and develop models with geospatial data through GIS.
- evaluate models in terms of accuracy, sensitivity, and uncertainty.
- perform a system-based approach for problem solving, with an emphasis on sustainability.
- execute the hydrological, erosion and environmental modeling through GIS.

GECX 219	ADVANCED ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop an entrepreneurial mindset.
- To learn the tools and methods for achieving sustainable growth.
- To explore various funds for a business and to get know about importance of a good team.
- To select public image branding and examine all channel types.
- To identify technology needs and establish key metrics to measure progress the business.
- To know about legal issues, regulations of starting and operating a venture and capstone presentation on practice venture.

Course Pre-requisites Completion of Social Entrepreneurship Course
Access to Learnwise Platform

MODULE I ENTREPRENEURSHIP BASICS & REFINING BUSINESS MODEL 8

Entrepreneurship Basics - Recap of Key Concepts, Introduction to First Venture, Recap of idea selection and Lean Canvas, Revisit product/service, Business model, Team formation. **Refining Business Model** –Pivoting, Types of Business Model, Refining Business Models, Evaluate business model, Identify additional customer segments, Analyze Business Model of Competitors, Importance of Product Management.

MODULE II BUSINESS PLANNING & REVENUE 8

Business Planning – Introduction to Business Plan, Make a Sales Plan, Hiring Sales Team, Make a People Plan for Venture, Financial Planning and Forecasting Template, Revisit Business Model, Create a Procurement Plan, Negotiation. **Revenue** –Exploring ways to Increase Revenue, Understanding Primary Revenue Source, Customer Lifecycle for Growing Customers, Exploring Secondary Sources of Revenue.

MODULE III FUNDING GROWTH & BUILDING A-TEAM 7

Funding Growth – Funding Options for an Entrepreneur, Explore the Right Funding Options, Exploring crowd funding platforms, Create Your Funding Plan, Pitch Practice. **Building A-Team** – Intro to Building an A-Team, Defining roles and

responsibilities, Pitching to Attract Talent, Setting Your Team Up for Success, Defining Role of a New Hire

MODULE IV BRANDING AND CHANNEL STRATEGY 7

Branding and Channel Strategy– Intro to Branding, Draw your Venture’s Golden Circle, Define Your Values, Positioning Statements, Selecting Brand Name, Social Media Handle, Logo and Mobile app names for Your Venture, Creating online public profiles, Bulls Eye Framework and other traditional channel types, Identify your Right Channel using Bulls Eye Framework.

MODULE V LEVERAGING TECHNOLOGIES AND AVAILABLE PLATFORMS & MEASURING PROGRESS 8

Leveraging Technologies and Available Platforms – Leaping Ahead with Technology, Digital Marketing for Your Startup, Plan a Social Media Campaign, Digital Collaboration, Store Your Documents Online, Other Platforms, Make Your Tech Plan and Platform Wish List. **Measuring Progress** – Metrics for Customer Retention and Satisfaction, Find your CAC, CLV, and ARPU, Key Financial Metrics, How to Communicate Your Metrics, Find New Revenue Streams based on Your Key Financial Metrics, Re-forecast your Financial Plan to Increase Margin.

MODULE VI LEGAL MATTERS & SEEKING SUPPORT & FINAL PROJECT 7

Legal Matters – Identify the Professional Help and Legal and Compliance Requirements for Your Venture, Conduct a Trademark Search for Your Company/Brand Name. **Seeking Support** – How Mentors Help to Create Successful Startups, Identify Mentors and Advisors, Scout for Board of Directors. **Final Project** – Capstone Project Presentation.

Total Periods- 45

TEXT BOOKS

1. Learn wise platform - Wadhvani Foundation, 2018.
2. All Lessons are delivered as Online videos accessible using Wadhvani Foundation’s Learnwise Platform - <https://lms.learnwise.wfglobal.org>

OUTCOMES:

On completion of the course, students will be able to

- Achieve sustainable growth by pivoting, refining business models, expand customer segments, and business planning for developing early customer traction into a repeatable business.
- Develop strategies to grow revenues and markets.
- Develop an A-Team, brand strategy and create digital presence.
- Develop brand and channel strategy for customer outreach
- Leverage social media to reach new customers cost effectively.
- Explore licensing and franchising for business expansion.

GECX220	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of Electric Vehicles.
- To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.
- To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves

MODULE I INTRODUCTION 8

A Brief History - Types of Electric Vehicle in Use Today : Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles - Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors - Ultra Capacitor – Ultra high Speed Flywheels.

MODULE II BATTERIES 7

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries - Sodium-based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid Vehicles - Battery Modeling.

MODULE III FUEL CELLS 8

Hydrogen Fuel Cells - Fuel Cell Thermodynamics - Connecting Cells in Series - Water Management in the PEM Fuel Cell - Thermal Management of the PEM Fuel Cell - A Complete Fuel Cell System - Hydrogen Supply - Fuel Reforming - Hydrogen Storage.

MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS 7

Tractive Effort - Modeling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

MODULE V DESIGN OF ANCILLARY SYSTEMS 7

Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refueling Systems.

MODULE VI ENVIRONMENTAL IMPACT AND ENERGY STORAGE 8

Vehicle Pollution - The Effects - A Quantitative Analysis - Vehicle Pollution in Context - Alternative and Sustainable Energy Used via the Grid Hybridization of Energy Storages - Energy Consumption in Braking - Brake System of EVs and HEVs - Antilock Brake System.

Total Hours – 45

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2nd edition, 2015.
2. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 3rd Edition, 2018.
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
4. Tom Denton, "Electric and Hybrid Vehicles" Routledge Publishers, 1st edition, March 2016.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Identify and quantify the important energy transfer for Batteries and fuel cell schemes.
- Identify the opportunities and challenges of advances in Electric Vehicles.
- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on Resources
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicles
- Identify the current industry activities by car makers, electricity utilities, parts, suppliers (motors and batteries), including joint ventures, product announcements and pilot projects.

MODULE VI GENETIC MODELING AND APPLICATIONS**8**

Genetic operators, cross over types, mutation operator, coding steps of GA, convergence characteristics, applications of AI techniques in various domains using GATool in matlab

Total Hours –45**REFERENCES:**

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. David Goldberg, "Genetic Algorithms and Machine learning", PHI
4. Wassermann, P. D. "Neural Computing" Van Reinhold, 1988.
5. Zimmermann, H. J., 'Fuzzy Set Theory and Its Applications', 2nd Edition, Kluwer Academic Publishers.
6. Martin T. Hogan, Howard B. Demuth. M., 'Neural network design' 4th edition
7. Zureda, J.M., 'Introduction to Artificial Neural Systems', Jaico publishing house Bombay, 1994.
8. Bose N.K, Liang P. 'Neural Network Fundamentals with graphs, Algorithms and applications', TMH Pub. Co. Ltd, 2001.
9. S.Rajasekaran, G.A.Vijayalaxmi Pai , Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applications , PHI private learning Ltd., New Delhi, 2011.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Enumerate the theoretical basis of soft computing.
- Discuss the neural networks and supervised and unsupervised learning networks
- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems
- Apply the most appropriate soft computing algorithm for a given situation
- Know the key issues in using these techniques for search of difficult search-spaces
- Be aware of the different approaches and different applications in the field.