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

(WITH AMENDMENTS INCORPORATED TILL AUGUST 2018)

(As approved by the 12th Academic Council)

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 Engineering, Science, Technology and Management and to play a vital role in the socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned Institution.
- To empower the youth through quality education and to provide professional leadership
- 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

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 a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, 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. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every programme will have 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.

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

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. The minimum credits to be earned will be between 174 and 180, depending on the program.

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 will 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 will 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) will be 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 will 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 will be constituted branch-wise and semester-wise

8.1 The composition of class committees for first and second semester will be 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 will be 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 four times during the semester. The first meeting will 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 will be decided for the first and second assessment. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

8.4 During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process.

8.5 The fourth 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 ENROLMENT

9.1 Except for the first semester, every student shall register for the ensuing semester during a specified week before the semester end examination of the ongoing semester. Every student shall submit a completed registration form indicating the list of courses intended to be enrolled during the ensuing semester. Late registration with the approval of the Dean (Academic Affairs) along with a late fee will be permitted up to the last working day of the current semester.

9.2 From the second year onwards, all students shall pay the prescribed fees for the year on a specific day at the beginning of the semester confirming the registered courses. Late enrolment along with a late fee will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.

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

9.4 A student should have registered for all preceding semesters before registering for a particular 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 assessment 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 assessment 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 will 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 ENROLMENT & 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:

Assessment No.	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 Exam	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 will 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.

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 will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the Department. A progress report from the industry will also be taken into account for evaluation. The weightage for 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(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50%. Of the remaining 50%, 20% will be for the project report and 30% for the Viva Voce examination.

13.8 Assessment of seminars and comprehension will 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 will 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 has missed, for genuine reasons, a maximum of one of the two continuous assessments of a course may be permitted to write a substitute examination paying the prescribed substitute examination fees. 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 Dean of School for that purpose. However there is no Substitute Examination for Semester End examination.

14.2 A student who misses any continuous assessment test in a course 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 missed assessment test. However the Substitute Examination will be conducted after the last working day of the semester and before 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 Institution 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 will consolidate and furnish the list of students who have earned less that 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 re-do 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 will 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 will 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 will not be 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 will 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

All assessments of a course will 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 Schools 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 will contain the following details. The list of courses enrolled during the semester including redo courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the 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 Ci, is the number of credits assigned for the i^th^ course and GPi is the Grade Point in the i^th^ course,

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

Where n = number of courses

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

“I” and **"W"** grades will be excluded for calculating GPA .

"U", **“I”**, **"AB"** and **"W"** grades will be 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 will 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 will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will 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/ self study courses not exceeding a total of six credits 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. In case of credits earned through online mode ratified by the respective Board of Studies, the credits may be transferred following the due approval procedures. The students shall undergo self study courses on their own with the mentoring of a member of the faculty. The online/ self study courses can be considered in lieu of elective courses.

19.0 SUPPLEMENTARY EXAMINATION

Final Year students can apply for supplementary examination for a maximum of two 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 two 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.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo practical training.

- **National Cadet Corps (NCC)** will have to undergo specified number of parades.
- **National Service Scheme (NSS)** will have social service activities in and around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
- **Rotaract** will have social service activities in and around Chennai.

21.0 DISCIPLINE

21.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to affect the prestige of the Institution.

21.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee nominated by the Vice-Chancellor, 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

iii) no disciplinary action pending against him/her.

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

23.0 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	MAC1181	Differential Calculus and Geometry	3	1	0	4	
2.	HS	ENC1181/ ISC 1181/ LNC1181/ LNC1182 / LNC1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC1181	Physics	3	0	2	4	
4.	BS	CHC1181	Chemistry	3	0	2	4	
5.	ESF	GEC1101	Engineering Graphics	2	0	2	3	
6.	ESF	GEC1102	Engineering Design	2	0	0	2	
7.	ESF	GEC1103	Basic Engineering Practices Laboratory	0	0	2	1	
8.	ESF	GEC1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC1211	Engineering Mechanics	3	1	0	4
5.	BS	GEC1212	Environmental Science	2	0	0	2
6.	ESF	GEC1213	Computer Programming II	1	0	2	2
7.	EC	ECC1201	Circuit and Network Analysis	2	0	2	3

8.	EC	ECC1202	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	MAC2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC2181	Oral Communication	0	0	2	1	
4.	EC	ECC2101	Electronic Circuits	3	1	0	4	
5.	EC	ECC2102	Signals and Systems	3	0	2	4	
6.	EC	ECC2103	Digital Electronics	3	0	0	3	
7.	EC	ECC2104	Electromagnetic Fields and Transmission Lines	3	1	0	4	
8.	EC	ECC2105	Electronic Circuits Laboratory	0	0	2	1	
9.	EC	ECC2106	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	ENC2282	Written Communication	0	0	2	1	
4.	EC	ECC2201	Digital Signal Processing	3	1	0	4	
5.	EC	ECC2202	Linear Integrated Circuits	3	0	0	3	
6.	EC	ECC2203	Communication Theory and systems	3	0	0	3	
7.	EC	ECC2204	Microprocessors and Microcontrollers	3	0	0	3	
8.	EC	ECC2205	Microprocessor & Microcontroller Laboratory	0	0	2	1	
9.	EC	ECC2206	Digital Signal Processing Laboratory	0	0	2	1	
10.	EC	ECC2207	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	ENC3181	Communication and soft skill – I Career Choice	0	0	2	1	
4.	EC	ECC3101	Digital Communication	3	1	0	4	
5.	EC	ECC3102	Computer Networks	3	0	0	3	
6.	EC	ECC3103	VLSI Design	3	0	0	3	
7.	EC	ECC3104	VLSI Laboratory	0	0	2	1	
8.	EC	ECC3105	Computer Networks Laboratory	0	0	2	1	
9.	EC	ECC3106	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	ENC3281	Communication and soft skill – II Confidence Building	0	0	2	1
4.	EC	ECC3201	Microwave and Antenna Theory	3	0	0	3
5.	EC	ECC3202	Embedded Systems	3	0	0	3
6.	EC	ECC3203	Microwave and Antenna Laboratory	0	0	2	1
7.	EC	ECC3204	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	ECC4101	Introduction to Wireless Communication	3	0	0	3	
3.	EC	ECC4102	Optical Communication	3	0	0	3	
4.	EC	ECC4103	Optical Communication Laboratory	0	0	2	1	
5.	EC	ECC4104	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	ECC4105	Internship / Industry Training / Mini Project				1[#]	**21**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	ECC4201	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 will be awarded in the 7th Semester.

* Student has to take courses for a minimum of 3 credits from the list of electives for the corresponding semester.

PROFESSIONAL ELECTIVES

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX01	Digital System Design	3	0	0	3
2.	PE	ECCX02	Computer Architecture	3	0	0	3
3.	PE	ECCX03	Control Systems	3	0	0	3
4.	PE	ECCX04	Biomedical Electronics	3	0	0	3
5.	PE	ECCX05	Image Processing	2	0	2	3
6.	PE	ECCX06	Advanced Microprocessor and Microcontrollers	3	0	0	3
7.	PE	ECCX07	PCB Design	1	0	2	2
8.	PE	ECCX08	Data structure and its algorithms	1	0	2	2
9.	PE	ECCX09	Java Programming	3	0	0	3
10.	PE	ECCX10	MATLAB Programming	1	0	0	1
11.	PE	ECCX11	Python Programming	1	0	0	1

SEMESTER VI

RF AND COMMUNICATION STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX12	Introduction to Satellite Communication	3	0	0	3
2.	PE	ECCX13	Telecommunication Switching Networks	3	0	0	3
3.	PE	ECCX14	Radar Systems Engineering	3	0	0	3
4.	PE	ECCX15	Wireless Networks	3	0	0	3
5.	PE	ECCX16	Multimedia Communication	3	0	0	3

			Systems				
6.	PE	ECCX17	Introduction to Network Security	3	0	0	3
7.	PE	ECCX18	Information coding Techniques	3	0	0	3
8.	PE	ECCX19	RF MEMS Circuit Design	3	0	0	3
9.	PE	ECCX20	Radio Navigational Aids	2	0	0	2
10.	PE	ECCX21	Voice over Internet Protocol	2	0	0	2
11.	PE	ECCX22	Simulation of RF Circuits and Components	0	0	2	1
12.	PE	ECCX23	RF Test and measurement	0	0	2	1
13.	PE	ECCX24	Modern Television Engineering	2	0	0	2

SIGNAL PROCESSING STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX14	Radar Systems Engineering	3	0	0	3
2.	PE	ECCX16	Multimedia Communication Systems	3	0	0	3
3.	PE	ECCX18	Information coding Techniques	3	0	0	3
4.	PE	ECCX25	Biomedical Signal Processing	3	0	0	3
5.	PE	ECCX26	DSP Architecture and Programming	3	0	0	3
6.	PE	ECCX27	Statistical Signal Processing	3	0	0	3
7.	PE	ECCX28	Wavelet Theory and Applications	3	0	0	3
8.	PE	ECCX29	Neural Network and Fuzzy Systems	3	0	0	3
9.	PE	ECCX30	Artificial Intelligence	3	0	0	3
10.	PE	ECCX31	Chaotic Signal Processing	2	0	0	2

11.	PE	ECCX32	DSP applications	0	0	2	1

VLSI & EMBEDDED SYSTEM STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX26	DSP Architecture and Programming	3	0	0	3
2.	PE	ECCX33	Fundamentals of Nano technology	3	0	0	3
3.	PE	ECCX34	Embedded processor for Digital signal processing	3	0	0	3
4.	PE	ECCX35	Introduction to Reconfigurable Computing	3	0	0	3
5.	PE	ECCX36	Programming in Embedded systems	3	0	0	3
6.	PE	ECCX37	Multicore Architecture and Parallel Programming	3	0	0	3
7.	PE	ECCX38	Advanced Computer Architecture	3	0	0	3
8.	PE	ECCX39	Introduction to System Verilog for verification	3	0	0	3
9.	PE	ECCX40	IC technology	3	0	0	3
10.	PE	ECCX41	Design using EDA Tools	0	0	2	1
11.	PE	ECCX22	Simulation of RF Circuits and Components	0	0	2	1

SEMESTER VII

RF AND COMMUNICATION STREAM

Sl. No.	Course Code	Course Title	L	T	P	C
1.	ECCX42	Principles of Wireless Sensor Network	3	0	0	3
2.	ECCX43	Electromagnetic Interference & Compatibility	3	0	0	3

3.	ECCX44	Fundamentals of Internet of Things	3	0	0	3
4.	ECCX45	RF System Design	3	0	0	3
5.	ECCX46	Microwave & Millimeter Wave Systems	3	0	0	3
6.	ECCX47	Advanced Antenna Design	2	0	2	3
7.	ECCX48	Introduction to Error control coding	3	0	0	3
8.	ECCX49	Satellite Image processing	3	0	0	3
9.	ECCX50	Software defined radio	3	0	0	3
10.	ECCX51	GNU radio realization through python and C^{++}	1	0	2	2
11.	ECCX52	Implementation of GSM 2G, 3G stack	1	0	2	2
12.	ECCX53	Mobile Technologies	1	0	0	1
13.	ECCX54	Study on Network Simulators	0	0	2	1
14.	ECCX55	MIMO & OFDM Technology	1	0	0	1

SIGNAL PROCESSING STREAM

Sl. No.	Course Code	Course Title	L	T	P	C
1.	ECCX44	Fundamentals of Internet of Things	3	0	0	3
2.	ECCX56	VLSI Signal Processing	3	0	0	3
3.	ECCX57	Medical Image Processing	3	0	0	3
4.	ECCX58	Computer Vision and its Applications	3	0	0	3
5.	ECCX59	Signal Detection and Estimation	3	0	0	3
6.	ECCX60	Video Processing Techniques	3	0	0	3
7.	ECCX61	Optical Signal processing	3	0	0	3
8.	ECCX51	GNU radio realization through python and C^{++}	1	0	2	2

9.	ECCX52	Implementation of GSM (2G), 3G stack	1	0	2	2
10.	ECCX55	MIMO and OFDM Technology	1	0	0	1

VLSI & EMBEDDED SYSTEM STREAM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	ECCX42	Principles of Wireless Sensor Network	3	0	0	3
2.	PE	ECCX44	Fundamentals of Internet of Things.	3	0	0	3
3.	PE	ECCX56	VLSI Signal Processing	3	0	0	3
4.	PE	ECCX62	Digital VLSI Testing	3	0	0	3
5.	PE	ECCX63	Fin FET Technology	3	0	0	3
6.	PE	ECCX64	Real Time Embedded Systems	3	0	0	3
7.	PE	ECCX65	Introduction to RTOS	3	0	0	3
8.	PE	ECCX66	Mechatronics	3	0	0	3
9.	PE	ECCX67	Nanoscale Devices and Circuit Design	3	0	0	3
10.	PE	ECCX68	System Design with FPGA	3	0	0	3
11.	PE	ECCX51	GNU radio realization through python and C^{++}	1	0	2	2
12.	PE	ECCX52	Implementation of GSM(2G), 3G stack	1	0	2	2
13.	PE	ECCX53	Mobile Technologies	1	0	0	1

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.	GECX101	Disaster Management	Civil
2.	GECX102	Total Quality Management	Mechanical
3.	GECX103	Energy Studies	Mechanical
4.	GECX104	Robotics	Mechanical
5.	GECX105	Transport Management	Automobile
6.	GECX106	Control Systems	EEE
7.	GECX107	Introduction to VLSI Design	ECE
8.	GECX108	Plant Engineering	EIE
9.	GECX109	Network Security	CSE
10.	GECX110	Knowledge management	CSE
11.	GECX111	Cyber security	IT
12.	GECX112	Genetic Engineering	LS
13.	GECX113	Fundamentals of Project Management	CBS
14.	GECX114	Operations Research	Mathematics
15.	GECX115	Nano Technology	Physics / Chemistry
16.	GECX116	Vehicle Maintenance	Automobile
17.	GECX117	Fundamentals of Digital Image Processing	ECE

Group II Courses

(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX201	Green Design and Sustainability	Civil
2.	GECX202	Appropriate Technology	Civil / Mechanical
3.	GECX203	Engineering System Modelling and Simulation	Mechanical
4.	GECX204	Value Analysis and Engineering	Mechanical
5.	GECX205	Industrial Safety	Mechanical
6.	GECX206	Advanced Optimization Techniques	Mechanical
7.	GECX207	Mat Lab Simulation	EEE
8.	GECX208	Embedded Systemsand its Applications	ECE
9.	GECX209	Usability Engineering	CSE
10.	GECX210	Supply Chain Management	CBS
11.	GECX211	System Analysis and Design	CA
12.	GECX212	Advanced Materials	Physics & Chemistry
13.	GECX213	National Service Scheme	School of Humanities
14.	GECX214	Automotive Pollution and Control	Automobile
15.	GECX215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX216	Principles of Communication Systems	ECE
17.	GECX217	Lean Management	Civil
18.	GECX218	Spatial Data Modeling & Analysis	Civil

SEMESTER I

MAC 1181	DIFFERENTIAL CALCULUS AND GEOMETRY	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- introduce eigen values and eigenvectors of matrix algebra.
- make the student knowledgeable in the area of Three Dimensional Analytical Geometry.
- demonstrate the application of Differential Calculus.
- familiarize the student with the functions of several variables.
- develop the use of ODE solvable techniques necessary for engineering applications.
- motivate the students with some basic engineering application problems in ODE.

MODULE I **MATRICES** **8+2**

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II **THREE DIMENSIONAL ANALYTICAL GEOMETRY** **7+3**

Direction cosines and ratios – angle between two lines – equations of a plane – equations of a straight line, coplanar lines - shortest distance between skew lines - sphere – tangent plane – plane section of a sphere – orthogonal spheres.

MODULE III **DIFFERENTIAL GEOMETRY** **7+3**

Curvature – Cartesian and polar coordinates – centre and radius of curvature – circle of curvature – involutes and evolutes – envelopes.

MODULE IV **DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES** **8+2**

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor’s series expansion – Optima of two variables – 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 EQUATIONS 7+3

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 expereince

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. Exersice book 1of 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, CO_2 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, "Nanochemistry: 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 nanochemistry 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 Edtion, (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 understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role 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

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

GEC1103	**BASIC ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
		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 SPECIAL FUNCTIONS 7+3

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" (43^{rd} 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", 4^{th} 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" (7^{th} 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 – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia- Mass moment of Area

MODULE V FRICTION 08

Introduction to friction- types of friction- Laws of Coloumb friction- Frictionalforce – simple contact friction – Rolling resistance –ladder friction

MODULE VI LAWS OF MOTION 10

Review of laws of motion – Newton's law – Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

L – 45; T – 15; TOTAL HOURS – 60

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics & Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003.

OUTCOMES:

On completion of this course students should be able

- Analyse and resolve forces, moments and solve problems using various principles and laws of Mechanics
- Apply the concept of equilibrium to particles and solve problems
- Apply the concept of equilibrium to rigid bodies and solve problems
- Analyse and determine the properties of surfaces
- Analyse and evaluate the fractional forces between the bodies
- Apply the laws of motion in solving dynamics problems

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 Jersy, 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.

ECC1202	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To brief about the semi-conductor devices and their types.
- To describe the working of different diodes and transistors with their applications.
- To analyze the characteristics of diodes and transistors.
- To explain the working of different power control devices.

PREREQUISITES:

- Fundamentals of semiconductors.
- Electrical and physical characteristics of conductors, semiconductors and insulators.

MODULE I PN JUNCTION DIODE 8

Introduction to semiconductors – PN junction diode – Characteristics - Current Components –Temperature dependence – Breakdown - Transition and diffusion capacitance – switching characteristics – Application of PN junction diode : Clipper, clamper and slicer.

MODULE II SPECIAL SEMICONDUCTOR DEVICES 8

Zener Diode - Varactor Diode - Backward diode - Schottky Diode - Tunnel Diode - Current regulator Diode - PNPN diode – LDR – Characteristics and applications.

MODULE III BIPOLAR JUNCTION TRANSISTORS 8

Construction, Configurations and Characteristics of BJT - Current components - Hybrid Model - Transistor switching times.

MODULE IV FIELD EFFECT TRANSISTORS 9

Construction, Configuration and Characteristics of JFET -Relation between Pinch off Voltage and drain current - Applications of JFET. Construction, Configuration and Characteristics of MOSFET - Applications of MOSFET- Comparison of BJT and FET.

MODULE V RECTIFIERS AND REGULATORS 6

Analysis of half wave Rectifier, Full wave Rectifiers: Center tap and Bridge without filters and with C, L and LC filters - series and shunt regulators.

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 unrepeated 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

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 RESPONSE OF AMPLIFIERS 9

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

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

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

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 GENERATORS 7

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", 4thedition, 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, 5thEdition, 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 7

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 6

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

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

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

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

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; T – 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 Verillog 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

ECC2104	**ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

- To interpret the relation between the fields under time varying situations
- To introduce principles of propagation of uniform plane waves.
- To familiarize with propagation of signals through transmission lines and waveguides.
- To analyze the characteristics of transmission lines and waveguides.
- To study in detail various modes of radio propagation.

PREREQUISITES:

- Basic properties of Electric and magnetic fields
- Knowledge on engineering mathematics
- Familiarity of electromagnetic spectrum

MODULE I REVIEW OF STATIC FIELDS 9

Coulomb's Law in Vector Form - Electric Field due to discrete charges - Electric field due to continuous charge distribution - Electric Scalar Potential-Relationship between potential and electric field -Gauss Law-The Biot-Savart Law in vector form - Magnetic Field intensity due to a finite and infinite wire carrying a current I - Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I - Ampere's circuital law.

MODULE II TIME VARYING FIELDS 8

Displacement current - Ampere's circuital law in integral form - Modified form of Ampere's circuital law - Maxwell's first equation in integral form - Equation expressed in point form.– Faraday's law - Maxwell's Second Equation in integral form from Faraday's Law –Equation expressed in point form - Poynting Vector and the flow of power - Power flow in a co-axial cable - Instantaneous Average and Complex Poynting Vector.

MODULE III ELECTROMAGNETIC WAVES 9

Derivation of Wave Equation - Uniform Plane Waves - Maxwell's equation in Phasor form - Wave equation in Phasor form - Plane waves in free space and in a homogenous material.Wave equation for a conducting medium - Plane waves in lossy 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

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

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

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.
4. Determination of frequency response, input impedance and output impedance of two stage RC Coupled Amplifier, Darlington amplifier.
5. Determination of CMRR of Differential amplifier.
6. Design and Analysis of Feedback Amplifiers
7. Design of Class C Single Tuned Amplifier
8. Determination of frequency response, input impedance and output impedance of Cascode amplifier
9. Design and Verification of Oscillators
10. 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
ECC2201	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 integerfactor, 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", 3rdEdition, 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 LINEAR ICS 8

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 AMPLIFIERS 8

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 AMPLIFIERS AND ANALOG MULTIPLIER 8

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', 2ndEdiiton, 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

1. Determine the difference between ideal and practical AC & DC characteristics of an Operational Amplifier.
2. Differentiate linear and non-linear applications of operational amplifiers
3. Generate waveforms using Op-Amp.
4. Identify the special purpose ICs
5. Apply IC 555 and PLL for different applications
6. 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-Keyboard 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. Doughlas 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. Doughlas 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, Pacesetting 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	COMMUNICATION AND SOFT SKILLS - I CAREER CHOICE	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To create awareness of industrial trends and market demands.
- To encourage students to explore career opportunities in an industry and evaluate themselves in relation to industry preparedness

MODULE I **6**

Knowledge about specific industry-Discussion with industry experts --Self evaluating career prospects through survey questionnaire (based on his/her eligibility for taking up a job (industry preparedness)

MODULE II **6**

. Knowing case studies of industries(pertaining to students' choice of career)- Reading and discussing about job markets-goal setting, working on creativity.

MODULE III **4**

SWOC analysis and discussing outcomes--exploring mini projects or case studies of latest industries.

MODULE IV **6**

Writing statement of purpose pertaining to career choice---- Outcomes

MODULE V **8**

Project or case study presentations (Presentation in pairs) -mini project report or case study report.

Total Hours – 30

REFERENCES:

1. Brown,D.(2002). Career Choice and Development. Wiley,J. & Sons.USA
2. Lore,N.(1998). The Pathfinder: How to Choose or Change Your Career for a Lifetime of Satisfaction and Success. Simon & Schuster.USA.
3. Shell, G.R.(2013). Springboard Launching your Personal Search for Success.Portfolio.USA.

OUTCOMES:

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

- Speak about their career choice.
- Self evaluate their strengths and weaknesses and speak about it.

- Make effective presentations on case studies or relating to projects.
- Write the statement of purpose relating to their career choice.

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 SIGNALING 10

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 wil 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 ApproachFeaturing the Internet", SixthEdition, 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 provide rigorous foundation in MOS and CMOS digital circuits
- To introduce the fundamental principles of MOS and CMOS process technology and to examine the basic building blocks of large-scale digital integrated circuits.
- To introduce the concepts of modeling a digital system using Hardware Description Language.
- To offer a profound understanding of the design of complex digital VLSI circuits.

PREREQUISITES:

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

MODULE I — MOS TRANSISTOR PRINCIPLES — 8

MOS transistor, threshold voltage equation, body effect, MOS device design equation, sub threshold region, Channel length modulation. mobility variation, Tunnelling, punch through, hot electron effect MOS models, small signal AC Characteristics, CMOS inverter, ßn / ßp ratio, noise margin, static load MOS inverters, differential inverter, tristate inverter, BiCMOS inverter.

MODULE II — CMOS PROCESS TECHNOLOGY — 7

Semiconductor Technology overview, basic CMOS technology, Current CMOS enhancement, Circuit elements – resistor – capacitor – interconnects - sheet resistance & standard unit capacitance concepts delay unit time, inverter delays, driving capacitive loads, propagate delays, MOS mask layer, stick diagram, design rules and layouts, symbolic diagram, scaling of MOS circuits, Lambda Based Design rules, scaling factor, Elmore’s constant.

MODULE III — COMBINATIONAL AND SEQUENTIAL CMOS LOGIC CIRCUITS — 8

Combinational MOS Logic circuits- CMOS logic circuits with a MOS load, complex logic circuits, Transmission Gate, Pass Transistor Logic.. Sequential MOS logic Circuits - Behaviour of hi stable elements, S-R latch Circuit, clocked latch and Flip Flop Circuits, CMOS D latch and triggered Flip Flop. Dynamic Logic Circuits - principles of pass transistor circuits, Dynamic CMOS circuit techniques

MODULE IV — ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES — 8

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Speed and Area Tradeoffs, Memory Architectures, and Memory control circuits.

MODULE V **DYNAMIC CMOS AND CLOCKING** **7**

Introduction, advantages of CMOS over NMOS, CMOS\SOS technology, CMOS\bulk technology, latch up in bulk CMOS., static CMOS design, Domino CMOS structure and design, Charge sharing, Clocking- clock generation, clock distribution, clocked storage elements.

MODULE VI **PROGRAMMING USING VERILOG HDL** **7**

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 benche 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 Addision 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

- Explain data communication systems and its components.
- Enumerate the layers of OSI model ad TCP/IP.
- Implement the error detection and correction techniques in computer networks
- Understand and build the sub-netting and routing mechanisms.
- Compare the operation and features of application layer protocol.
- Have a basic knowledge of the use of cryptography &security issues.

ECC3104 VLSI LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To learn coding of combinational and sequential circuits using Verilog HDL
- To familiarize 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

REFERENCES:

1. John.G. Proakis and Masoud Salehi, ”Communication Systems Engineering”, 2nd 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”, 5^{th} Edition, McGraw Hill Int., 2017.

COURSE 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

MSC4182	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 Periods- 45

TEXT BOOKS

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. Learn wise platform - Wadhwani 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, Routlege, 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	COMMUNICATION AND SOFT SKILLS - II CONFIDENCE BUILDING	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop professional skills like work ethics, analytical skills, presentation skills etc.
- To train them in problem solving skills and leadership skills pertaining to industries.
- To train them in team building skills.
- To train in setting up career goals

MODULE I **6**

Brief about Multinational companies- Analysing work ethics of multinational companies and small industries- discussing as pairs-Knowledge about etiquette (different types)

MODULE II **6**

Visit to an Industry and prepare reports --Critically reading of industry specific journal articles and write ups-- preparing reports.

MODULE III **4**

Analysing problem solving situations in industries (relating to application of core subject to specific jobs) and discussing about them- working on a sample case

MODULE IV **6**

Developing Leadership in team projects-- debating about various aspects of leadership: for example, responsibility and reliability-time management

MODULE V **8**

Team building skills-- group discussions pertaining to industries-- presenting career goals. --preparing for interviews- interpersonal skills

Total Hours – 30

REFERENCES:

1. Covey,S.R. (2004). The 7Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK
2. Fine, P.M.& Alice Olins. (2016).Step up: Confidence, Success and Your Stellar Career in 10 Minutes a Day. Vermilion.UK
3. Pai, A. (1993).How to Develop Self-Confidence. Amazon.com
4. Wentz,F.H.(2012). Soft skills training: A Workbook to Develop Skills for Employment. Amazon.com

OUTCOMES:

After completing the course students would be able to

- Exhibit critical reading skills through review of industry specific articles.

- Provide solutions to problem based situations.
- Exhibit leadership qualities by debating over industry specific issues.
- Participate in group discussions confidently.
- Present their career goals.

ECC3201 MICROWAVE AND ANTENNA THEORY

	L	T	P	C
ECC3201 MICROWAVE AND ANTENNA THEORY	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.
- 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, ConductorMaterials, Dielectric Materials, Resistive Materials - Monolithic Microwave Integrated- Circuit Growth - MMIC Fabrication Techniques.

TOTAL HOURS 45

TEXT BOOKS

1. Samuel Y Liao,“Microwave Devices & Circuits”, Prentice Hall of India, 2006.
2. Robert.E.Collin-Foundations of Microwave Engg–McGraw Hill, 2002.
3. 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 HFSS.
11. Characteristics of microwave components/Antennas using Vector Network Analyzer.

TEXT BOOKS

1. Samuel Y Liao,“Microwave Devices & Circuits”, Prentice Hall of India, 2006.
2. Robert.E.Collin-Foundations of Microwave Engg–McGraw Hill, 2002.
3. 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.

OUTCOMES:

On completion of the course, students will be able to

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

SEMESTER VII

ECC4101 INTRODUCTION TO WIRELESS COMMUNICATION **L T P C**

3 0 0 3

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. KamiloFeher, “Wireless Digital Communications: Modulation and Spread Spectrum Applications”, 1st Edition, PHI Learning, 2009.

OUTCOMES:

On completion of the course, students will be able to

8. Describe and apply the fundamental concepts of Mobile Communication.
9. Recognize various wireless communication services and modulation techniques.
10. Classify channel models and signal models.
11. Analyze the various multiple access techniques
12. Identify various Wireless systems and standards.
13. 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 TRANMISSION 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 45

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.
- explaining 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

TOTAL HOURS 30

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 UniversityPress, 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:

<u>Mini Project</u>

- 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.

<u>Internship</u>

- 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.

<u>Industry Training</u>

- 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
SEMESTER V

ECCX01 **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, Elesevier, 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.

ECCX02 **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.

ECCX03	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

ECCX04 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 MONITOR 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, Opthalmoscope, 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. Leislie 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. Webestered / Medical Insturmentation / Houghton Mifflin, Fourth edition,2010
3. A. M. Cook and J. G. Webester, 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

ECCX05 **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 of 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 :

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

ECCX06	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 ARMARCHITECTURE 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. Kai Hwang, “Advanced Computer Architecture”, Tata McGraw-Hill Education, 2011.

3. James L. Antonakos , “ The Pentium Microprocessor ‘’ Pearson Education , 1997.
4. Steve Furber , ‘’ ARM System –On –Chip architecture “Addision Wesley , 2000.
5. 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.

ECCX07 **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**

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 PROCESS** **6**

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 ASSEMBLY** **2**

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.

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.,

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
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

ECCX08 DATA STRUCTURE AND ITS ALGORITHMS

L	T	P	C
1	0	2	2

OBJECTIVES:

- To introduce the fundamental concepts of data structure.
- To understand the basic operations of stacks and queues for real time scenario.
- To comprehend the significance of sorting algorithms.
- To demonstrate the understanding of various searching algorithms.

MODULE I BASICS OF DATA STRUCTURES 5

Introduction to Data Structures-Data Structure Operations- Algorithm: complexity, Time- space tradeoff- Linked lists-Representation of linked lists in Memory-Traversing a linked list, Searching a linked list- insertion into linked list, Deletion from a linked list- Types of linked list: Singly Linked Lists – Doubly Linked Lists – Circular List

MODULE II STACK ,QUEUES & TREES 5

Introduction, Array Representation of Stack-Operations on Stack: Infix, prefix and postfix notations-Application of stack, Queue- Array Representation of Queue- Trees: Definitions and Concepts- Operations on Binary Trees, Representation of binary tree –Tree Traversal.

MODULE III GRAPHS: SEARCHING TECHNIQUES ELEMENTARY ALGORITHMS 5

Graphs: Matrix Representation of Graphs, Breadth First Search, Depth First Search, -Searching Techniques: Sequential Searching, Binary Searching, Search Trees, Sorting: Introduction, O notation, Exchange sort- Bubble sort, Quick sort- Elementary Algorithms: Characteristics of an Algorithm; Building Blocks of Algorithms- Outline of Algorithms

PRACTICALS :

1. Write a C program to implement the doubly linked list.
2. Write a C program to implement the Circular list.
3. Write a C program to implement the tower of Hanoi.
4. Write a C program to demonstrate the working of stack, of size N using Array. The program should check overflow and underflow also.
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.

ECCX09 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.

ECCX10 **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

ECCX11 **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

SEMESTER VI

RF AND COMMUNICATION STREAM

ECCX12	INTRODUCTION TO SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To define satellite orbits and to understand about satellite communication
- To illustrate geostationary orbit and to formulate uplink and down link equations
- To explain the basic concepts of earth and space segments
- To introduce the principles and mechanism involved in satellite systems
- To illustrate the facts and ideas of different satellite services and its applications

PREREQUISITES:

- Basic knowledge on electronic communication
- Characteristics of electromagnetic wave s and fields

MODULE I ORBITAL MECHANICS AND LAUNCHER 9

Orbital Mechanics – Look angle determination –Orbital perturbations – Orbit determination- launches and launch vehicles – Orbital effects in communication systems

MODULE II THE SPACE AND EARTH SEGMENT 7

Space segment: Satellite subsystems – Attitude and orbit control systems – Telemetry, Tracking, Command and Monitoring – Power systems – Communication Subsystems. Earth segment: Receive only Home TV Systems- Master antenna TV systems – community antenna TV systems - Transmit-Receive Earth stations.

MODULE III SATELLITE ANTENNAS CHARACTERISTICS 7

Satellite antennas– Antenna foot prints- horn antenna- Parabolic Antenna – Multibeam Antenna – Phased array antenna –Frequency reuse in multibeam and Phased array antenna

MODULE IV THE SPACE LINK AND INTERFERENCE 7

EIRP- transmission loss- the link power budget equation –system noise –CNR-the uplink- the downlink – Effects of rain – Combined uplink and down link – Intermodulation noise- Intersateliite links- Interference between satellites – Energy dispersal – Coordination

MODULE V SATELLITE DIGITAL AUDIO RADIO SERVICE AND VSAT NETWORKS FOR INTERACTIVE APPLICATION 7

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 MOBILE SATELLITE SERVICE 8

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. Satellite Communications Network Design and Analysis, Kenneth Y. Jo, Artech House, 2011- Artificial satellites in telecommunication
2. The Satellite Communication Applications Handbook, 2nd edition Bruce R. Elbert , Artech House, 2004 - Technology & Engineering
3. Introduction to Satellite Communication, Bruce R. Elbert , 3rd edition Artech House, 2008 - Technology & Engineering
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, VSS etc.…

ECCX 13 TELECOMMUNICATION SWITCHING NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

The purpose of this course is to introduce students to

- Various Telecommunication systems and networks.
- Understand the concept in PSTN communication.
- Understand the various switching and signalingtechniques.
- Analyze the concepts in network traffic and its engineering.
- Identify the applications of telecom networks.

PREREQUISITES:

- Basic knowledge on Probability theory,
- Basic Network Concepts.

MODULE I TELECOMMUNICATION CONCEPTS 7

Introduction to Telecommunication Switching, QoS, Traffic Engineering, Standardization in Telecom, Telecom Transmission types and various Access Networks.

MODULE II PUBLIC SWITCHING TELEPHONE NETWORK 8

Manual, Electromechanical and Electronic Exchanges – Basic Principles of SPC Exchanges – PCM Principles – Digital Switching System – Time Switch – Space Switch – Packet Switching/Circuit Switching/ Message Switching. Long distance network and routing.

MODULE III SWITCHING TECHNIQUES 8

Introduction to Switching techniques-Message and Packet Switching-, Voice Telephony, operation of telephone subset, Subscriber Loop Design, Design of Local Area Wire-Pair Trunks (Junctions), VF Repeaters (Amplifiers), Long-Distance PCM Transmission, Digital Switching, Digital Loop Carrier

MODULE IV SIGNALLING 7

Inband/outband signalling, Link by link and end to end signalling, Channel Associated vs Common Channel Signalling, CCS7 Signalling, SSTP concept and NGN.

MODULE V DATA COMMUNICATION PRINCIPLES 8

Layered Architecture and Standards OSI Model X.25/ATM/Frame Relay. Point to Point, IP and MPLS Networks – VPN over Broadband/MPLS etc.

MODULE VI TELECOM NETWORKS 7

Overview of communication Networks- ISDN PRI/BRI, IN concept, Broadband Services. WIFI/Wimax.

TOTAL: 45

TEXT BOOKS:

1. Fundamentals of Telecommunications, Roger L. Freeman, A Wiley-Interscience publication, fourth edition, JOHN WILEY & SONS, INC. New York,2004

2. Communication Networks Fundamental Concepts And Key Architectures 2nd Edition, Alberto Leon-Garcia, Tata McGraw-Hill publishing company limited, New Delhi,2004 edition.
3. Telecommunication Switching Systems and Networks , ThiagarajanViswanathan, Manav , Second edition,2015,PHI learning PVT Ltd.

REFERENCES:

1. Telecommunications Engineer's Reference Book,Edited By FraidoonMazda,ButterworthHeimannLimited,Part of Reed International Books,1993
2. Telecommunication Switching, Traffic And Networks, J.E.Flood, Pearson Education, Second Impression 2007.
3. Network Routing Algorithms, Protocols And Architechtures, DeepankarMedhi, KarthikeyanRamasamy, Elseiver Publication 2007.

OUTCOMES:

On completion of the course the students will be able to

- Explain the telecommunication concept.
- Differentiate PSTN from other networks.
- Describe the switching types.
- Compute traffic in a telecom network.
- Explain the signaling techniques.
- Apply suitable network for suitable system.

ECCX14 RADAR SYSTEM ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To become familiar with radar equation and range.
- to provide an understanding of the basic concepts, operation of modern radar systems
- To elaborate the mathematical background for range, cross-section and tracking.
- To develop the knowledge and techniques necessary to analyze the performance of radar systems
- To give an overview of radar applications.
- To specify the subsystem performance requirements in a radar system design

PREREQUISITES:

- Familiarity with engineering mathematics
- Basic knowledge on electronic communication
- Characteristics of electromagnetic wave s and fields

MODULE I RADAR EQUATION 5

Radar Range Equation: Radar fundamentals, Derivation of range equation, the search radar equation, Jamming and radar range with jamming, Radar clutter and radar range with clutter, Radar range with combined interference sources.

MODULE II RADAR DETECTION 9

Theory of Target Detection: Noise and false alarms, Detection of one sample of signal with noise, Integration of pulse trains, Detection of fluctuating targets, CFAR, Optimum and matched filter Theory, Loss factors in detection.

MODULE III RADAR CROSS SECTION 9

Targets and Interference: Definition of radar cross section, Radar cross section of simple and complex objects, Spatial distribution of cross section, Bistatic cross section, CW and FM Radar: Doppler Effect, CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

MODULE IV MTI AND PULSED DOPPLER RADAR 8

MTI Radar: Delay lines and line cancellors, Subclutter Visibility. MTI using range gates and filters, Pulse Doppler radar, Non-coherent MTI radar, Application of Digital signal processing to radar system.

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. MerrilSkolnik, “Introduction to Radar Systems”, 3rd Edition, McGraw Hill Higher Education, 2001.
2. Peyton Z. Peebles, "Radar Principles", 1st Edition, Wiley, 2007.

REFERENCES

1. David Barton .K ,” Modern Radar System Analysis”, Artech House, 1988.
2. Jian Li, Robert Hummel, PetreStoica, Edmund G. Zelnio, “Radar Signal Processing and Its Applications” ,Springer, 21-Dec-2013
3. VyacheslavTuzlukov, “Processing in Radar Systems” , CRC Press, 19-Dec-2017
4. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw Hill Professional, 15-Jul-2005
5. G. S. N. Raju, Radar Engineering, I. K. International Pvt Ltd, 04-Oct-2008
6. Fred Nathanson E, “Radar Design Principles Signal Processing and The Environment”, McGraw Hill, 1969.
7. J.C. Toomay,Paul J. Hannen, "Principles of Radar", 3rd Edition, PHI Learning, 2010.

COURSE 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 the Doppler shift.
- Apply knowledge of Radar to analyze MTI and PDR.
- Comprehend common applications of radar.

ECCX15 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 – WLANtechnologies:Infrared, UHF narrowband, spreadspectrum - 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 - UTMS 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. AymanElNashar, 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.

ECCX16	**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 tospeech coding - G.722.H.261 - H.263 - MPEG 1, 2, 4.

MODULE V **REQUIREMENT AND PERFORMACE 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.

ECCX17	**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 SIGNATURES AND RSA 8

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 INFRASTRUCTURE (PKI) 8

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, students will be able to:

- Understand basic cryptographic algorithms, web authentication and security issues.
- Analyze the vulnerabilities in any computing system and hence be 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.
- Understand the current legal issues towards information security.

ECCX18 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 VOICECODING 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.

ECCX19	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 45 HOURS

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.

ECCX20	**RADIO NAVIGATIONAL AIDS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES:

- To understand the basics of navigation systems
- To study the different navigation systems
- To study the concepts and working of GPS, GLONASS, Galileo
- To give an overview of differential of GPS and the errors
- To discuss about the applications of GNSS Systems

MODULE I Navigational Systems 7

Review of Navigational Systems: Aircraft navigational system. Geometry oftheearth.Navigationequation.Navigationerrors.Radio navigation system types and Performanceparameters.ILS System, Hyperbolic navigation systems, Loran, Omega, Decca Radio directionfinding, DME.TACAN and VORTAC.

MODULE II Global Navigation Satellite System 8

Global Positioning System (GPS) for Navigation: Overview of GPS, Reference systems. Satellite orbits, Signal structure, GLONASS- Overview of GPS, Reference systems. Satellite orbits, Signal structure, Galileo - Overview of GPS, Reference systems. Satellite orbits, Signal structure. GAGAN

MODULE III Other GNSS Systems and Errors 8

Global systems, Regional systems, Differential systems, Augmentation systems – Errors in navigation Systems - differential of GPS

MODULE IV Application of GNSS 7

GPS Navigational Application: General applications of GPS, DGPS, Marine. Air and Land Navigation, Surveying, Mapping and Geographical information systems, Military and Space. GLONASS, Galileo Applications

Total Hours –30

TEXT BOOKS:

1. Bernhard Hofmann-Wellenhof Herbert LichteneggerElmarWasle, “GNSS – Global Navigation Satellite Systems GPS, GLONASS, Galileo, and more” Springer, 2007
2. Myron Kavton and Walter Friend, R, “Avionics Navigation Systems”, Wiley 2nd

Edition, 2007

3. Parkinson B.W. Spilker, “Global Positioning System Theory and Applications”, Progress in Astronautics, Vol. I and II, 1996.

REFERENCES:

1. Hoffman. B., Wellenhof. H. Lichtenegger and J. Collins, “GPS Theory and Practice”, Springer Verlang Wien New York, 1992.
2. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House. Inc., 1996.
3. Lieck Alfred, “GPS Satellite Surveying”, John Wiley, 1990.

ECCX21 VOICE OVER INTERNET PROTOCOL

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the Internet Protocol suite
- To have the basic understanding of the standards
- To introduce the concept of SIP protocol
- To discuss on SS7 signaling protocol and its operations

MODULE I IP Protocol Suit 7

Overview of IP Protocol Suite: The Internet Protocol, The Transmission Control Protocol (TCP), The User Datagram Protocol (UDP), The Real-time Transport Protocol (RTP), IP multicast, IP version 6 (IP v6), Interworking IPv4 and IPv6, The VoIP Market, VoIP Challenges.

MODULE II H.323 and H.245 Standards 8

H.323 and H.245 Standards: The H.323 Architecture, Call Signaling-Call Scenarios, H.245 Control Signaling Conference calls- The Decomposed Gateway.

MODULE III SIP Protocol 8

The Session Initiation Protocol (SIP): SIP architecture- Overview of SIP Messaging SyntaxExamples of SIP Message sequences- Redirect Servers- Proxy Servers. The Session Description Protocol (SDP) - Usage of SDP With SIP.

MODULE IV SS7 Protocol 7

The SS7 Protocol Suite, SS7 Network Architecture, ISUP, PerformanceRequirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures

Total Hours –30

TEXT BOOKS:

1. Collins, “Carrier Grade Voice over IP”, 2nd ed., TMH.

2. Nicholas Wittenberg ,“Understanding Voice over IP Technology”,Cengage, 1st Ed., 2010.

REFERENCES:

1. Michael, F. Finnevan, “Voice Over WLANS – The Complete Guide”, Elsevier, 2008.

OUTCOMES:

On completion of the course the students will be able to

- Illustrate the concepts of Internet protocol
- Explain the importance of Internet protocol
- Classify various media standards
- Familiar with the latest SIP protocol
- Understand the SS7 signaling method
- Explain the operations of SS& signaling methods

ECCX22	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.

PREREQUESITES:

- 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.

ECCX23 **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.

ECCX24 MODERN TELEVISION ENGINEERING

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

- To Identify different components and section in TV receiver.
- To gain sufficient knowledge regarding different modules present in the TV transmitter and receiver and their design considerations.
- To Understand the background technologies of Modern digital television systems

MODULE I ELEMENTS OF TV SYSTEM, TV SIGNAL TRANSMISSION AND PROPAGATION 6

TV transmitter and receiver, TV signal propagation, TV broadcast channels, TV transmission antennas, Receiver antennas. Monochromatic picture tube, electrostatic focusing, beam deflection, picture tube characteristics and specifications, , TV standards: American 525 line B&W TV system, NTSC color system, 625-line monochrome system.

MODULE II COLOR TV 6

Color picture tubes, Interleaving process, Three Color theory, Chrominance Signal, composite color signal, comparison of NTSC, PAL and SECAM Systems. Color television display tubes (Delta gun, PIL, Trinitron). Color signal transmission.

MODULE III DIGITAL TELEVISION 6

Fundamentals of Digital TV systems, Digital television standards, high definition TV & ultra-high definition, interactivity & return channel for digital TV systems.

MODULE IV AUDIO AND VIDEO CODING 6

Sampling, Quantization, and Source Coding process, Video encoding standards - MPEG-1, MPEG-2, MPEG-4, H-264, Error correction in digital television standards.

MODULE V ADVANCED DISPLAY TECHNOLOGIES 6

Emissive and nonemissive displays, Thin-Film Transistors, Liquid Crystal Displays, Plasma Display panels, LED Display Panels, OLED Displays, Field Emision Displays.

Total Hours 30

TEXT BOOKS

1. R.R Gulati, “Modern Television Practice: Transmission, Reception and Applications”, 1st Edition, New Age International Pvt. Ltd., 2015.
2. Marcelo S. Alencar, “Digital Television Systems”, Cambridge University Press, 2009.

3. Jiun-Haw Lee, David N. Liu, Shin-Tson Wu, "Introduction to Flat Panel Displays", John Wiley & Sons Ltd, 2008.

REFERENCES

1. R.R Gulati, “Monochrome and Color Television”, 3rd Edition, New Age International Pvt. Ltd., 2014.
2. S.P.Bali, “Color Television - Theory and Practice”, Tata McGraw Hill Publishing Co. Ltd., 2007.
3. Arvind M. Dhake, “Television and Video Engineering”, 2nd Edition, McGraw Hill Higher Ed, 2006.
4. Bernard Grob, Charles Herndon, "Basic Television and Video Systems" 2nd Revised Edition, McGraw-Hill Education, 1999.

COURSE OUTCOMES:

On completion of the course the students will be able to

- Identify various elements and sections in TV receiver.
- Explain the working principles involved in both Monochrome and Color Television.
- Get familiarized with principles involved in the modern televisions system.
- Distinguish Technologies and standards used in modern television system
- Analyze the encoding techniques used in various television standards.
- Evaluate the emerging trends in TV and display technologies.

SIGNAL PROCESSING STREAM

SEMESTER VI

ECCX25 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-l -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 ENCEPHELOGRAM 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 Telestimulation

MODULE VI BIOMEDICAL APPLICATIONS 5

Case Study HL7 Protocol- Patient Monitoring System - Wearable Devices- Nano medicine and application.

TOTAL 45 HOURS

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. Leislie 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.

ECCX26	**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.

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. B. Venkataramani, M. Bhaskar "Digital Signal Processors: Architecture, Programming and Applications", Tata McGraw-Hill Education, 2002
2. Avtar Singh, S.Srinivasan ,"DSP Implementation using DSP microprocessor with Examples from TMS32C54XX" -Thomson 2004
3. Sen-Maw Kuo, Woon-SengGan,"Digital signal processors architectures, Implementations, and applications", Pearson Prentice Hall, 2005

REFERENCES:

1. Phil Lapsley, Jeff Bier, AmitShohan, Edward A Lee, "DSP Processor Fundamentals, Architectures & Features". S. Chand & Co, 2000
2. Jonathan Stein, "Digital signal processing" John Wiley 2005.
3. S.K. Mitra, "Digital Signal Processing", Tata McGraw-Hill Publication, 2001.
4. Alan V. Oppenheim,"Discrete-Time Signal Processing", Pearson Education India, 2006.

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.

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ECCX27 STATISTICAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concept of discrete random signal processing
- To estimate the spectrum of Discrete Random Signals
- To model and design adaptive filters
- To explain the concepts of multirate signal processing

MODULE I DISCRETE RANDOM SIGNAL PROCESSING8

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony's method.

MODULE II SPECTRUM ESTIMATION 7

Non-Parametric methods - Correlation method - Co-variance estimator, Performance analysis of estimators – Unbiased consistent estimators ,Periodogram estimator - Bartlett spectrum estimation - Welch estimation – Model based approach - AR, MA, ARMA Signal modeling – Parameter estimation

UsingYule-Walker method.

MODULE III LINEAR ESTIMATION 6

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive Bayesian Estimation.

MODULE IV LINEARPREDICTION8

Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

MODULE V ADAPTIVE FILTERS 8

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm -Adaptive channel equalization – Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters.

MODULE VI SIGNAL DETECTION 8

Detection of Deterministic Signals- Matched filter detector and its performance, Detection of Random Signals- Estimator-correlator, linear model, general

Gaussian detection. Nonparametric Detection- Detection in the absence of complete statistical description of observations, sign detector.

TOTAL HOURS 45

TEXT BOOKS:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2008.
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2nd Edition, 2007.

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi 4th Edition, 2007.
2. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, 5th Edition 2013.
3. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs, NJ1988.
4. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

OUTCOMES:

OUTCOMES:

On completion of the course, students will be able to

- Classify and model random signals
- Estimate the spectrum of discrete signals
- Apply various linear estimation techniques
- Recognize and use optimum filters for signal prediction
- Implement an appropriate filter for given application
- Detect deterministic and random signals

ECCX28 WAVELET THEORY AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the basics of Fourier transforms.
- To understand multi resolution analysis.
- To discuss about continuous wavelet transforms and discrete wavelet transforms
- To understand the applications of wavelet transforms.

PREREQUISITES:

- Basic knowledge about signals and systems
- Fundamentals of signal and image processing

MODULE I INTRODUCTION 8

Stationary and non-stationary signals- Signal representation using basis and frames-Brief introduction to Fourier transform and Short time Fourier transform-Time-frequency analysis.

MODULE II CONTINUOUS WAVELET TRANSFORM 9

Continuous wavelet transform (CWT)-Time and frequency resolution of the continuous wavelet transform - Construction of continuous wavelets- orthonormal - bi-orthonormal, Inverse continuous wavelet transform-Filtering in continuous wavelet transform domain.

MODULE III DISCRETE WAVELET TRANSFORM 7

Discrete wavelet transform-Non-linear approximation in the Wavelet domain-Construction and Computation of the discrete wavelet transform- the redundant discrete wavelet transform.

MODULE IV MULTI RESOLUTION ANALYSIS 7

Multirate discrete time systems-Parameterization of discrete wavelets- Bi-orthogonal wavelet bases- Two dimensional wavelet transforms and Extensions to higher dimensions.

MODULE V FILTERBANKS 7

Orthogonal and bi-orthogonal two-channel filter banks-Design of two-channel filter banks- Tree-structured filter banks.

MODULE VI APPLICATIONS 7

Signal and Image compression- Detection of signal changes-analysis and classification of audio signals using CWT-Wavelet based signal de-noising -Wavelets in adaptive filtering -Image fusion- Edge Detection and object isolation.

TOTAL HOURS 45

TEXT BOOKS

1. S. Mallat, “A Wavelet Tour of Signal Processing, 3rd edition, Academic Press, 2009.
2. Rao R M and A S Bopardikar, “Wavelet Transforms Introduction to theory and
   Applications”, Pearson Education, Asia, 2000.

REFERENCES

1. J.C. Goswami and A.K. Chan, “Fundamentals of Wavelets: Theory, Algorithms, and Applications”,2nd ed., Wiley, 2011.
2. Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichelPoggi, “Wavelets and their Applications”, John Wiley & Sons, 2010
3. Soman K P and Ramachandran K I,”Insight into Wavelets From Theory to practice”, Prentice Hall, 2004.

OUTCOMES:

On completion of the course, students will be able to

- Discuss about the Fourier transforms to analyse signals.
- Classify various wavelet transform and explain the importance of it
- Describe Continuous Wavelet Transform and Discrete Wavelet Transform
- Acquire knowledge about multi resolution analysis.
- Develop and realize filter banks for signal processing
- Explain the properties and application of wavelet transform

ECCX29	NEURAL NETWORKS AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To cater the knowledge of Neural Networks and Fuzzy Logic Control
- To apply the concepts of neural networks and Fuzzy logic for controlling real time systems.

PREREQUISITES:

- Set Theory

MODULE I ARCHITECTURES 7

Introduction –Biological neuron-Artificial neuron-Neuron modelingLearning rules-Single layer-Multi layer feed forward network-Back propagation-Learning factors.

MODULE II SELF-ORGANIZING NETWORKS 8

Networks that extracts principal components; networks that does clustering; learning vector quantization (LVQ); self-organizing feature maps (SOFM).

MODULE III NEURAL NETWORKS FOR CONTROL 7

Feedback networks-Discrete time hop field networks-Schemes of neuro –control, identification and control of dynamical systems

MODULE IV FUZZY SYSTEMS 8

Classical sets -Fuzzy sets -Fuzzy relations - Fuzzy logics – Fuzzy control systems.

MODULE V FUZZY LOGIC CONTROL 7

Membership function – Knowledge base-Decision –making logic – Optimizations of membership function using neural networks-Adaptive fuzzy systems-Introduction to generate to genetic algorithm.

MODULE VI APPLICATION OF NEURAL NETWORKS FLC 8

Fuzzy logic control-Inverted pendulum-Image processing-Home Heating system-Blood pressure during anesthesia- Pattern recognition & classification - Recognition of symbols and printed Characters -Introduction to neuro fuzzy controller.

L – 45; Total Hours –45

TEXT BOOKS:

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", PrenticeHall, NewDelhi, 2004.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, West Sussex, England, 2005.

3. B.Vegnanarayana, ” Artificial neural networks “, Prentice Halll of India P Ltd 2005.
4. Dr.R.P.Das, L.Sreedhar, “Neural Networks and Fuzzy Logic”, S.K. Kataria & Sons; 2012

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. Driankov,Hellendroonb, “Introduction to fuzzy control”, Narosa Publishers,2001.
5. LauranceFausett, Englewood cliffs, N.J., “Fundamentals of Neural Networks”, PearsonEducation, New Delhi, 2008.

OUTCOMES:

On completion of the course, students will be able to

1. To Expose the students to the concepts of feed forward neural networks
2. To provide adequate knowledge about feedback networks.
3. To teach about the concept of fuzziness involved in various systems.
4. To provide adequate knowledge about fuzzy set theory.
5. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
6. To provide adequate knowledge of application of fuzzy logic control to real time systems.

ECCX30 **ARTIFICIAL INTELLIGENCE**

L	T	P	C
3	0	0	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.

MODULE I INTRODUCTION TO AI 5

History of Artificial Intelligence, The AI problems, AI technique, philosophy and development of Artificial intelligence. Introduction to Bayes' Rule

MODULE II PROBLEM SPACES AND SEARCH 9

Search process and AI, Brute force, Depth first, Breadth first search techniques, Hill climbing, Best first search, AND/OR graphs, A* algorithm, Constraint satisfaction.

MODULE III AI AND GAME PLAYING 9

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.

MODULE IV KNOWLEDGE REPRESENTATION 8

Logic, Propositional logic, Tautology, Contradiction, Normal forms, Predicate logic - Rules of inference, Resolution, Unification algorithm, Production rules - Semantic networks. Frames – Scripts - Conceptual dependency.

MODULE V KNOWLEDGE ENGINEERING 7

Design and architecture of expert systems, Expert system life cycle, Knowledge acquisition, difficulties, strategies, major applications areas, Qualitative study of expert systems.

MODULE VI MACHINE LEARNING 7

Frame work for learning – Inductive learning –Supervised, Unsupervised learning – Parallel distributed processing – Genetic Algorithms .

Total Hours 45

TEXT BOOKS

1. Stuart Russel, Peter Norvig, “ Artificial Intelligence – a modern approach”, Prentice Hall, 2003.
2. Wolfgang Ertel, "Introduction to Artificial Intelligence", 2nd Edition, Springer 2011.

REFERENCES

1. Elaine Rich, Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 2003.

2. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley, 2000.
3. Luger George F and Stubblefield William A, “Artificial Intelligence : Structures and Strategies for Complex Problem Solving”, Pearson Education, 2002.

COURSE OUTCOMES:

On completion of the course the students will be able to

1. Demonstrate fundamental understanding of the history of artificial intelligence and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, and other machine learning models.
4. Demonstrate proficiency developing applications using AI tools.
5. Apply knowledge representation, reasoning, and machine learning techniques to real-world problems.
6. Compare various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms.

ECCX31 CHAOTIC SIGNAL PROCESSING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To define concepts of chaos in electronic circuits and in sugnal processing
- To illustrate linear and non linear systems using chaos
- To introduce the principles of periodic and chaotic behaviors
- To explain the basic concepts of autonomous chaotic circuits

PREREQUISITES:

- Basic knowledge on electronic circuits
- Characteristics and design constraints of operational amplifiers
- Knowledge on Phase Locked Loops

MODULE I OVERVIEW OF DYNAMICAL SYSTEMS AND CHAOS 8

Introduction- Definition and effects of non linearity-Linear and nonlinear oscillators- Linear superposition principle -- linear and non linear systems- Chaotic definition and behavior- periodic, quasi-periodic-Structural stability and bifurcation- dynamics of PLLs.

MODULE II CHAOTIC SYSTEMS 7

Bifurcations and Chaos-Chaotic Signals -Chaotic flows and maps-Lypunov Exponents-Conditions for occurrence of chaos-Chaos in non linear electronic circuits.

MODULE III CHAOTIC SIGNALS AND SIGNAL PROCESSING 8

Modeling and Representation of Chaotic Signals - Estimation and Detection - Self-Synchronization and Asymptotic Stability - Circuit Implementation and Experiments - Synthesizing Self-Synchronizing Chaotic Systems.

MODULE IV COMMUNICATIONS USING CHAOS 7

Generalization of waveform communications - Chaotic modulation schemes-Signal model for detection- Coherent detection algorithm-Chaotic in secure communications -chaotic communication system- chaotic synchronization.

TOTAL HOURS 30

TEXT BOOKS:

1. Lakshmanan M, Rajasekar S, “Nonlinear Dynamics Integrability Chaos and patterns, Springer International Edition, 2009
2. F C M Lau and C K Tse, “Chaos-Based Digital Communication Systems, Springer-Verlag Berlin Heidelberg 2003
3. Marcio Eisencraft, Romis Attux, Ricardo Suyama, "Chaotic Signals in Digital

Communications”, 1st Edition, CRC Press, 2017

4. Oppenheim, A.V. & Cuomo, K.M, “Chaotic Signals and Signal Processing”, CRC press, 2015.
5. Branislav Jovic, “Synchronization Techniques for Chaotic Communication Systems”, Springer-Verlag Berlin Heidelberg, 2011

REFERENCES:

1. Steven H. Strogatz, “Nonlinear Dynamics and Chaos”, Sarat Impressions, 2007.
2. Marcio Eisencraft (Editor), Romis Attux • Ricardo Suyama “Chaotic signals in digital communications”, CRC press, 2014.

OUTCOMES:

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

- Distinguish and describe linear and nonlinear system and its characteristics
- Describe various periodic, quasi-periodic and chaotic behaviors and apply them for signal processing.
- Explain various Nonlinear Dynamics and Chaos techniques and apply electronic systems.
- Describe various autonomous chaotic circuits and non autonomous chaotic circuits for signal processing.
- Analyze the performance issues of dynamic circuits for signal processing.
- Apply chaotic circuits to achieve secured communication.

ECCX 32 **DSP APPLICATIONS** **L T P C**

0 0 2 1

OBJECTIVES:

- Apply the concepts of DSP for real time applications
- To provide an understanding of how to design signal processing systems and process data in a software simulation.
- To introduce programming for real time DSP applications.

PRE-REQUISITES:

Basics of Digital Signal processing concepts.

LIST OF EXPERIMENTS:

AUDIO PROCESSING

1. Generation of Octave music
2. Real time Audio processing- Audio equalizer, Delayed audio playback, Audio reverberator, Concert hall simulation & Audio effects.

IMAGE PROCESSING

3. Histogram equalization
4. Implementation of transforms on images
5. Edge detection of Images
6. Pseudo color image processing

DIGITAL SIGNAL GENERATION AND DETECTION

7. Dual-tone Multi-frequency (DTMF) signals
8. Generation and analysis of ECG signal.

TOTAL HOURS 30

REFERENCES

1. Sen M. Kuo, Bob H. Lee, WenshunTian, "Real-Time Digital Signal Processing: Fundamentals, Implementations and Applications", Third edition,

Wiley publications,2013.

2. VinayK.Ingle, John G. Proakis, Digital Signal Processing Using MATLAB, Third Edition, Cengage Learning, 2012

OUTCOMES:

On completion of the course, students will be able to

7. Use DSP tools to analyze the real time signals.
8. Apply various transforms like DCT , FFT for real time signals
9. Validate the concept of digital signal generation and detection through real time systems.
10. Apply the modulation techniques for audio processing.
11. Differentiate the original audio and delayed audio effects.
12. Implement DSP concepts in image processing.

ECCX33 FUNDAMENTALS OF NANOTECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of Nano technology
- To illustrate the importance of various synthesis method.
- To enrich the knowledge in various fabrication and characterization techniques.
- To introduce various Nano devices

PRE-REQUISITES:

- Knowledge in organic and inorganic chemistry is mandate

MODULE I INTRODUCTION 7

Overview of nanotechnology, Historical background, Importance of Nan scale, Bottom-up approaches, Top-down approaches, Functional approaches - Difference between bulk and nano materials - Size dependent properties

MODULE II SYNTHESIS OF NANOMATERIALS 7

Fundamentals of film-Physical vapor deposition(PVD)-Chemical Vapor deposition(CVD)-Atomic layer deposition-sol gel films

MODULE III FABRICATION OF NANOSTRUCTURES 8

Lithography -Nano manipulation and nanolithography-Soft lithography-Assembly of nanoparticles and nanowires-other methods for micro fabrication

MODULE IV CHARACTERIZATION 8

Structural characterization –X-ray diffraction, Small angle X-ray scattering ,Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy- Chemical characterization – Optical spectroscopy, Electron spectroscopy, Ion spectroscopy-Physical properties of nanomaterials

MODULE V NANO DEVICES 7

Issues of miniaturization - Digital information processing – Quantum Computing – Electronic devices – Spintronic – Storage class memory – Photonic devices – Thermal devices

MODULE VI APPICATIONS OF NANOMATERIALS 8

Molecular Electronics and Nano electronics - Nanobots-Biological applications of 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 SinghH, "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

ECCX34 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.

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 Manolokis, "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.

ECCX35	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.

ECCX36 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, 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, 2007.
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

ECCX37	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 fromm 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. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann Elsevier Publishers, 1st edition, 1999.

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. Richard Y. Kain, “Advanced Computer Architecture a Systems Design Approach”, Prentice Hall, 1st edition, 2011.

OUTCOMES:

On completion of the course the students will be able to

- Know need of multicore architecture
- Compare various multicore processor architectures
- Analyze the architecture of Vector, SIMD and GPU architecture
- Develop parallel programming using MPI for DSM
- Develop programme for shared memory architecture using OpenMP
- Discuss the existing multicore architecture

ECCX38	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

- Performance evaluation of a processor.
- Compare different pipelining techniques.
- Efficiently draw time space diagram.
- The bottle necks for efficient processor design
- Evaluate memory related issues
- Performance evaluation of a processor.

ECCX39 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 Hardware verification and methodologies.
- To make productive RTL design, Build a complete verification environment function coverage

PRE-REQUISITES:

- Basic VLSI design.

MODULE I VERIFICATION GUIDELINES 6

Introduction, The Verification Process, The Verification Plan, The Verification Methodology Manual , Basic Test bench Functionality, Directed Testing , Methodology Basics , Constrained-Random Stimulus , What Should You Randomize, Functional Coverage , Test bench Components , Layered Test bench , Building a Layered Test bench , Simulation Environment Phases , Maximum Code Reuse , Test bench Performance , Conclusion .

MODULE II DATA TYPES 8

Introduction, 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 , Conclusion.

MODULE III PROCEDURAL STATEMENTS AND ROUTINES 8

Introduction, Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview , Routine Arguments , Returning from a Routine , Local Data Storage , Time Values , Conclusion.

MODULE IV BASIC OOP 8

Introduction , Think of Nouns, not Verbs , Your First Class , Where to Define a 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 , Conclusion.

MODULE V CONNECTING THE TESTBENCH AND DESIGN 8

Introduction, Separating the Testbench and Design , The Interface Construct , Stimulus Timing , Interface Driving and Sampling , Connecting It All Together , Top-Level Scope , Program – Module Interactions , SystemVerilog Assertions, The

Four-Port ATM Router, Conclusion .

MODULE VI RANDOMIZATION 7

Introduction, What to Randomize , Randomization in SystemVerilog , 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, Conclusion.

Total Hours –45

TEXT BOOK

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

- Learn Fundamental syntax of system verilog.
- Create a verification environment.
- Learn high level synthesis.
- Learn the fundamentals of OOPS.
- Learn various verification techniques.
- Evaluation of concepts of OOPS.

ECCX40	**IC TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To provide strong foundation in fundamentals of VLSI.
- To introduce the fundamental principles Integrated Circuit Fabrication.
- To familiarize with fabrication of Integrated circuits.
- To demonstrate design rules for layout and circuit characterization.
- To introduce the aspects, needs and standards of modern wireless communications

PRE-REQUISITES:

- Knowledge on Digital Electronics, Electron Devices and Circuits.

MODULE I INTRODUCTION TO CMOS CIRCUITS: 8

Introduction, NMOS and PMOS enhancement transistors , Threshold voltage and body effect, MOS device design equations, Basic DC equation ,Second order Effects, Complementary CMOS Inverter , DC characteristics ,Static load MOS Inverters.

MODULE II OPERATING PRINCIPLES OF MOS TRANSISTORS: 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 FABRICATION OF CMOS INTEGRATED CIRCUITS 7

An overview of silicon semiconductor technology, Wafer processing ,Oxidation, Epitaxy, deposition, ion-implantation and diffusion, Silicon gate process Basic CMOS Technology, Basic n–well CMOS process, P-well process.

MODULE IV INTERCONNECTIONS AND CONTACTS,PACKAGING 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 V CMOS PROCESS ENHANCEMENTS AND LAYOUT DESIGN RULES 8

Circuit elements, Layer representations,CMOS n-well rules, Latch-up, Technology- related CAD issues

MODULE VI CIRCUIT CHARACTERIZATION 8

Resistance estimation, Capacitance, estimation, switching characteristics, Analytic delay models, Gate delay ,CMOS-gate, Gate delay ,transistor sizing, power

Transmission, Scaling of MOS transistor dimensions

TOTAL HOURS : 45

TEXT BOOKS:

1. J. Plummer, Michael D. Deal and Peter B. Griffin, "Silicon VLSI Technology, fundamentals, practice and modeling" Pearson Education, 1st edition, 2009.
2. Richard C. Jaeger, "Introduction to Microelectronic Fabrication", Second Edition, Published by Prentice-Hall, Inc, 2002.

REFERENCES :

1. J. P. Uyemura, Physical Design of CMOS Integrated Circuits Using L-Edit, PWS Publishers, Boston, 1st edition, 1995.
2. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design A Circuits and Systems Perspective" 4th edition, Pearson Publication, 2010.

OUTCOMES:

On completion of the course, students will be able to

- Understand the principles of CMOS transistors.
- Learning lithography techniques and concepts of wafer exposure system, types of resists etc.
- Understand concepts of thermal oxidation and Si/SiO2 interface and its quality measurements.
- Learn concepts of IC Fabrication
- Understand back-end technology to define contacts, interconnect, gates, source and drain.
- Understand the IC fabrication process.

ECCX41 **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. Analyze and compare advanced analog ICs based on CMOS techniques, such as different types of current sources, amplifiers, filters and comparators.
3. Analyze and compare simple digital circuits based on different CMOS techniques.
4. Designing complex analog/digital systems starting from simpler analog/digital circuits

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

ECCX42	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 NODE AND NETWORK MANAGEMENT 8

Local Power Management Aspects, Dynamic Power Management, Basics of Time Synchronization, Time Synchronization Protocols.

MODULE VI LOCALIZATION AND SECURITY 7

Ranging Techniques, Range-Based Localization, Range-Free Localization, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks.

TOTAL HOURS 45

TEXT BOOKS

1. Waltenegus Dargie and Christian Poellabauer ,"Fundamentals Of Wireless Sensor Networks Theory And Practice", John Wiley & Sons Ltd.,1st edition, 2010.
2. Carlos de Morais Cordeiro and Dharma Prakash Agarwal, "Ad hoc and Sensor Network : Theory and Applications" , 2nd Edition, World Scientific Publishing Co,2011.

REFERENCES

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley and Sons, 2012.
2. G.Anastasi, Marco Conti, Mario Di Francesco and Andrea Passarella, "Energy Conservation in Wireless Sensor Networks: A Survey", Adhoc Networks, Elsevier Publications ,Vol.7, No.3 May 2009,pp.537-568.

OUTCOMES:

On completion of the course, students will be able to

14. Understand the state of art techniques in wireless sensor networks.
15. Learn the basics and challenges of wireless networking, the constraints of wireless sensor networks, the design of protocols to meet the challenges and constraints of a specific application and the development of a research project
16. Be able to apply the concepts of wireless sensor networks (WSN) to various application areas.
17. Get an overview of basic architectural framework.
18. Able to analyze performance characteristics of WSN and manage WSN.
19. Distinguish the methods in Localization tracking and security issues.

ECCX43	**ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To apply, identify and understand the basic knowledge of science in EMI & EMC in different environments.
- To select and apply appropriate coupling principles for EMI.
- To formulate and analyze different EMI measurements
- To understand the concepts of EMI control mechanisms which meets the specific needs with appropriate techniques.
- To select, apply and differentiate appropriate standards for EMI/EMC.
- To design, analyze and understand the process of creating EMC PCBs

PRE-REQUISITES:

- Knowledge in Electromagnetics
- Knowledge in Basic Electronics.

MODULE I EMI ENVIRONMENT 8

Concepts of EMI and EMC and definitions - Sources of EMI - Celestial Electromagnetic noise - Lightning discharge-Electrostatic Discharge-Electromagnetic Pulse - Electromagnetic emissions - Noise from relays and Switches - Nonlinearities in Circuits

MODULE II EMI COUPLING PRINCIPLES 8

Capacitive coupling - Inductive coupling- Common impedance ground coupling-Ground loop coupling-Transients in power supply lines- Radiation coupling, Conduction coupling- Common - mode and Differential mode interferences-Conducted EM noise on power supply lines.

MODULE III EMI MEASUREMENTS 7

Open area test site measurements-Measurement precautions - Open -area test site- Anechoic Chamber-TEM Reverberating TEM-GTEM cell – Comparisons

MODULE IV EMI CONTROL TECHNIQUES 7

EMC Technology- Grounding-Shielding-Electrical Bonding-Power line filter-CM filter - DM filter- EMI suppression Cables- EMC Connectors -Isolation transformer.

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-some 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,2 nd edition 2011.
2 C.R.Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 2 nd edition 2010.

REFERENCES

3 Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, New York,1988.
4 Bernhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, 1986.

OUTCOMES:

On completion of the course, students will be able to

1. Outline the basic knowledge of science in EMI & EMC in different environments.
2. Distinguish coupling principles for EMI.
3. Measure different EMI parameters
4. Apply EMI control mechanisms for specific needs with appropriate techniques.
5. Compare and discuss different standards for EMI/EMC.
6. Design and analyze the process of creating EMC PCBs

ECCX44 FUNDAMENTALS OF INTERNET OF THINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Provide an overview of concepts, main trends and the paradigm of Internet of Things.
- Develop skills to relate the IoT technologies for practical IoT applications.
- Develop the ability to use Internet of Things related protocols and connectivity methods.
- Provide the knowledge of data management business processes and analytics of IoT.

PRE-REQUISITES:

- Prerequisite: Fundamentals of computer network, wireless sensor network, communication & internet technology, web technology, information security.

MODULE I INTRODUCTION – CONCEPTS BEHIND THE INTERNET OF THINGS 6

The IoT paradigm - Smart objects - Bits and atoms - Goal orientation - Convergence of technologies - Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization - Overview of IoT architecture.

MODULE II IOT APPLICATIONS FOR VALUE CREATION 5

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT - Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT - Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

MODULE III OVERVIEW OF IOT CONNECTIVITY METHODS AND TECHNOLOGIES 9

Wireless 101 - RF 101 - ZigBee - RFID - Hardware, SoC, sensors, device drivers, IoT standards - Cloud computing for IoT - Bluetooth, Bluetooth Low Energy - IEEE 802.15.4, IEEE 802.15.4e, 802.11ah - Relay Access Point (AP) - Grouping of stations - Target Wake Time (TWT) - Real-time systems and embedded software - Cloud computing and storage - Augmented Reality.

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 8

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 4

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. OvidiuVermesan, 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 Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1 st Edition, VPT, 2014
5. Samuel Greengard, The Internet of Things, MIT Press, 2015.
6. 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.
- Understand 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.

ECCX45	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 – Torids – 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.,2 nd 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

- Understand the basic RF components Characteristics and resonant circuits.
- Design different types of filters for various applications.
- Identifyimpedance 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.

ECCX46	MICROWAVE & MILLIMETER WAVE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of microwave devices and systems.
- To train different millimeter wave transceivers architectures and illustrate their operation principle.
- To provide the design consideration of microwave and millimeter waves systems.
- To introduce the design consideration for antennas in the millimeter wave range.

MODULE I PASSIVE MICROWAVE NETWORKS 8

Lumped & Distributed elements, Two-port networks, S-parameters, impedance matching networks, Microwave Filters - Butterworth and Chebyshev Response, Transmission Line Filter.

MODULE II ACTIVE MICROWAVE DEVICES 8

Diodes, Microwave Transistors, Microwave FET, Power Amplifier Design – stability, Oscillator and Resonators Design.

MODULE III CHARACTERISTICS OF MILLIMETER WAVE 7

Millimeter Wave Characteristics, Channel Performance at 60 GHz, Gigabit Wireless Communications, Development of Millimeter Wave Standards, Coexistence with Wireless Backhaul. Review of modulations for millimeter wave, Orthogonal Frequency Division Multiplexing.

MODULE IV MILLIMETER WAVE TRANSCEIVERS 8

Millimeter Wave Link Budget, Transceiver Architecture, Transceiver Without Mixer, Receiver Without Local Oscillator, Millimeter Wave Calibration, Silicon-based transceivers.

MODULE V MILLIMETER WAVE ANTENNAS 7

Path Loss and Antenna Directivity, Antenna Beamwidth, Maximum Possible Gain-to-Q, Polarization, Beam Steering and Beam Forming, Millimeter Wave Design Consideration.

MODULE VI MILLIMETER WAVE MIMO 7

Spatial Diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise

Coupling in a MIMO System. Potential Benefits for Millimeter Wave Systems, Spatial and Temporal Diversity, Spatial and Frequency Diversity.

Total Hours – 45

TEXT BOOKS:

1. D.M.Pozar, “Microwave Engineering”, John Wiley & sons,Inc.,4th Edition, 2013
2. Kao-Cheng Huang, Zhaocheng Wang, "Millimeter Wave Communication Systems", 1st Edition, Wiley - IEEE, 2011.
3. George D. Vendelin ,ANTHONY M. Pavio, Ulrich L. Rohde, “Microwave Circuit Design Using Linear and Nonlinear Techniques”, 2nd Edition, Wiley Interscience, 2005.

REFERENCES:

1. D. Liu, U. Pfeiffer, J. Grzyb, B. Gaucher, “Advanced Millimeter-wave Technologies: Antennas, Packaging and Circuits”, John Wiley & Sons, 2009.
2. D. Liu, U. Pfeiffer, J. Grzyb, B. Gaucher, “Advanced Millimeter-wave Technologies:Antennas, Packaging and Circuits”, John Wiley & Sons, 2009.
3. J. Wells, “Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications”, Artech House, 2010.

OUTCOMES:

On completion of the course students will be able to

- Identify the active and passive microwave components
- Describe the characteristics of millimeter waves
- Apply the spatial and frequency diversity principles in designing MIMO systems.
- Evaluate the channel performance at frequencies above 40 GHz.
- Analyze the design of millimeter wave transceivers and antennas.
- Design antennas for specific microwave and millimeter wave applications.

ECCX47	ADVANCED ANTENNA DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To provide an in-depth understanding of modern antenna concepts
- Understanding of practical antenna design for various applications
- To discuss various types of antennas including the planar printed antennas
- To introduce the concept of smart antennas

MODULE I FUNDAMENTAL CONCEPTS 5

Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

MODULE II MICROSTRIP ANTENNAS 6

Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

MODULE III ANTENNA ARRAYS 6

Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays.

MODULE IV ADVANCED ANTENNA CONCEPTS & APPLICATIONS 7

Reconfigurable Antennas – Millimeter Wave Antennas – Concepts of Metamaterial Antennas - Antennas for medical applications - Antennas for MIMO / Full-Duplex Systems - Antennas for mobile communications

MODULE V BASIC CONCEPTS OF SMART ANTENNAS 6

Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming

MODULE VI ANTENNA MEASUREMENTS 5

Antenna ranges - Radiation patterns - Gain measurements - Directivity - Polarization measurements - Scale model measurements

Practicals:

1. Simulation of Rectangular Microstrip Antennas.
2. Simulation of Circular Microstrip Antennas.
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 – 30; T – 30; 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

- Understand 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.

ECCX48 INTRODUCTION TO 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 andparalle 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; POCAG Code using 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

ECCX49 SATELLITE IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain fundamental theories of satellite image processing
- To describe image enhancement techniques for remote sensing
- To identify image filters and transforms that suits for satellite images
- To analyze satellite images using image classification

PRE-REQUISITES:

Basic knowledge of image processing

- Basic knowledge of image transforms

MODULE I FUNDAMENTALS OF SATELLITE IMAGE PROCESSING 7

Satellite systems and data-Importance of Digital Image Processing in remote sensing-Representation of remote sensing image– Image sampling and quantization - Basic relationship between pixels-Different techniques of Image Acquisition, Image characteristics and different resolutions in remote sensing.

MODULE II SATELLITE IMAGE ENHANCEMENT 8

Color image representation and transformations-Image histogram–Types- Uni-variate& multi-variate image statistics – spatial statistics-Geo-referencing techniques.

MODULE III IMAGE FILTERS AND TRANSFORMS 9

Multispectral transform,Scatterplot,Principal Component analysis and Decorrelationsketch,Spatial filtering techniques,Frequency domain-Fourier transformation-Optimal Rotation Transformation – Scale-space transform, wavelet transform.

MODULE IV IMAGE COMPRESSION 7

Image file formats- Image Coding Fundamentals, Image Compression Model, Basic image compression techniques- Lossless Compression-Lossy Compression- JPEG, MPEG.

MODULE V SATELLITE IMAGE CLASSIFICATION 7

Introduction to image classification in remote sensing-Image classification techniques-Unsupervised, supervised and object based image analysis.

MODULE VI IMAGE ANALYSIS 7

Principles of image registration-Image fusion and mosaicking techniques-Applications of image analysis-Limitations and future of digital image processing in remote sensing.

TOTAL HOURS 45

TEXT BOOKS

1. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
2. Robert A. Schowengerdt, Techniques for Image Processing and Classifications in Remote Sensing, Academic Press, 02-Dec-2012
3. John.A.Richards ,Remote Sensing Digital Image Analysis: An Introduction ,5th Edition, Springer,2012
4. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.

REFERENCES

1 Remote Sensing and Digital Image Processing, Jarocińska, Anna, van der Meer, Freek D., Springer, 2016.

2 Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2002.

3. Dennis Roddy, Satellite Communications,4th Edition, McGraw Hill,2017

OUTCOMES:

On completion of the course, students will be able to

- Describe basics of satellite image processing.
- Explain about image enhancement techniques suitable for satellite images
- Recognize appropriate image filters and transforms for remote sensed images.
- Identify and use of image compression techniques for satellite images.
- Classify satellite images based on its characteristics.

ECCX50 **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 PHYand 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, Trade –offs in 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, 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, 05-Aug-2005
3. Tony .J. Rouphael , 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

ECCX51	GNU RADIO REALIZATION THROUGH PYTHON AND C++	L	T	P	C
		1	0	2	2

OBJECTIVES:

- Student will learn with about open source software with respect to digital communication in
- The 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”
2. Carl Laufer , “The Hobbyist's Guide to the RTL-SDR: Really Cheap Software Defined Radio”.
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:

- Student will learn how to build modules in gnu radio
- Use off the self-components to analyse different radio technology
- Will learn the system design aspect for SDR

ECCX52	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 convertor, 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. Jörg Eberspächer, Hans-Joerg Vögel, 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

- Student will have the basic understanding of control path & data path of the GSM stack.
- System capacity to handling multiple users

ECCX53 MOBILE TECHNOLOGIES

	L	T	P	C
	1	0	0	1

OBJECTIVES:

- To study the basics of Mobile networks and its generation.
- To understand the concepts of advanced network concepts.
- To identify existing mobile networks and future system standards.

PRE-REQUISITES:

- Fundamentals of mobile communication and computer networks.

MODULE I INTRODUCTION TO MOBILE NETWORKS 6

Introduction to mobile networks - IEEE technologies - Cellular networks – Generation of networks - Relevant features of LTE - HetNet in LTE Advanced – Small cell concepts - Transition of LTE advanced towards 5G – BLE and 3GPP standards.

MODULE II WPAN,WLAN, WMAN, WRAN AND IOT 5

WPAN and WiGig – WLAN and Wifi – WMAN and Wimax – WiMAX and Wifi integration - IEEE 802.22 – Sensor Networks – IOT in the home.

Experiments Using Matlab programming:

(i) Free space propagation model **2**
(ii) Outdoor propagation model **2**

TOTAL 15 HOURS

TEXT BOOKS

1. Khaldoun Al Agha, Guy Pujolle, Tara Ali-Yahiya, “Mobile and Wireless Networks”, Volume 2, Advanced Networks set, published by ISTE Ltd. and John Wiley & Sons Inc.

REFERENCES

1. Joh R. Vacca, “Wireless Broadband Networks Handbook 3G, LMDS and Wireless Internet” Tata McGraw-Hill, 2001
2. D.P. Agrawal and Qing-An zeng, “Introduction to Wireless and Mobile Systems” Thomson Learning, 2003. [Unit I, Chapter 13.1 to 13.7.7, Unit 2 13.7.8 to 13.9]

OUTCOMES:

On completion of the course, students will be able to

- Explain the functional principles of cellular networks.

- Compare the architecture and protocols of various networks.
- Describe the features, interconnections and applications of various IEEE standards.
- Illustrate the development of mobile networks and its future evolution.
- Understand, model, and design mobile networks.
- Understand existing mobile networks and future system standards.

ECCX54	STUDY ON NETWORK SIMULATORS	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To study network simulator 2 and its components.
- To analyze different topologies using network simulator ns-2
- To study various wireless networks using the network simulators
- To study various routing protocols using the network simulators

MODULE I

1. Study of network simulator 2 and its components
2. Simulation of 3 Node Point to Point network with duplex link.
3. Simulation of transmission of ping message over a network topology of n nodes and finding number of packets dropped due to congestion.
4. Simulation of TCP and UDP protocols.
5. Simulation of Internet Traffic such as FTP and TELNET over networks and analyzing throughput.
6. Simulation of Ethernet using n nodes with multiple traffic.
7. Simulation of WiFi using n nodes with multiple traffic.
8. Simulation of Distance Vector routing
9. Simulation of link state routing
10. Simulation of Open Shortest Path First algorithm.

Total Hours –15

REFERENCES:

1. Ajit kumar nayak, sathyanathnda champati,Rajib Mall, Computer network using NS2 ,CRC Press,2016.
2. Teerawat Issariyakul,Ekram Hossain , "Introduction to Network Simulator NS2", Second Edition,Springer,2008.

OUTCOMES:

On completion of the course the students will be able to

- Work with network simulator ns-2,
- Create nodes in the simulator and study the traffic.
- Analyze the TCP and UDP protocols
- Apply the knowledge of network parameters and able to calculate throughput in different networks
- Understand the effects of traffic and congestion in the networks
- Implement the routing algorithm in wired and wireless networks

ECCX55	MIMO & OFDM TECHNOLOGY	L	T	P	C
		1	0	0	1

OBJECTIVES:

The objective of the course is to provide students

- knowledge of OFDM technology.
- Understanding of MIMO communication

PRE-REQUISITES:

- Basic Concepts of Wireless Communications

MODULE I Orthogonal Frequency Division Multiplexing (Multi carrier Modulation) 7

Basic principles of orthogonality, Single vs multi carrier systems, OFDM block diagram and ITS explanation, OFDM signal mathematical representation, Selection parameters for modulation, Pulse shaping in 05 20% OFDM signal and spectral efficiency, Windowing in OFDM signal and spectral efficiency, Synchronization in OFDM, Pilot insertion in OFDM transmission and channel estimation, Amplitude limitations in OFDM, FFT points selection constraints in OFDM, CDMA vs OFDM, Hybrid OFDM, Other variants of OFDM

MODULE II MIMO Systems 8

Introduction, Space diversity and systems based on space diversity, Smart antenna system and MIMO, MIMO-Based system architecture, MIMO exploits multipath, Space-time processing, Antenna considerations for MIMO, MIMO channel modeling, channel measurement and channel capacity, Cyclic delay diversity (CDD), Space-time coding, Advantages and applications of MIMO in present context, MIMO applications in 3G wireless systems, MIMO-OFDM.

TOTAL HOURS 15

TEXT BOOKS

1. Wireless Communication by UpenaDalal, Oxford University Press
2. Wireless Communications and Networking by Vijay K. Garg, Morgan Kaufmann Publications

OUTCOMES:

On completion of the course, students can

- Describe the concepts of MIMO OFDM Wireless communicationsystems.
- Determine the capacity and bit error rate of MIMO OFDM system for a given power delay profile of the MIMO channel.
- Explain the fundamental concept of Software defined Radio and current 3-G and 4-G system

- Compare the operation SISO,SIMO,MISO and MIMO channels.
- Estimate and correct the timing and frequency offset in the signal received in the MIMO OFDM receivers.
- Analyze the performance of MIMO OFDM physical channel in WiMax/LTE wireless standards.

ECCX56	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 ARITHEMATIC 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, YannisTsividls, Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing' Prentice Hall, 1994.
4. 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

- Understand various algorithms that can be designed and applied on application specific VLSI architecture.
- Have knowledge on fast convolution algorithms and high speed multipliers.
- Gain minimum knowledge to find solution for any research queries on DSP processors.
- Apply the advantages retiming, unfolding and folding on pipelined and parallel processed architectures.
- Have the ability to develop advanced DSP filters and processors.
- Be able to develop optimized DSP designs by employing the advantages of VLSI concepts.

ECCX57 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

Ugltrasound 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.

ECCX58 COMPUTER VISION AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To review image processing techniques for computer vision
- To understand shape and region analysis
- To understand three-dimensional image analysis techniques
- To understand motion analysis
- To study applications of computer vision algorithms

PRE-REQUISITES:

- Basic knowledge of image processing
- Basic knowledge of image transforms

MODULE I BASICS OF IMAGE PROCESSING 7

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture analysis

MODULE II SHAPES AND REGIONS 8

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance,functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments-Object localization

MODULE III HOUGH TRANSFORM 9

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization –line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation

MODULE IV IMAGE COMPRESSION 7

Image Coding Fundamentals, Image Compression Model, types of image redundancies, fidelity criteria, Lossless Compression - variable length, bit plane, Lossless Predictive, Lossy Compression- Lossy Predictive, JPEG, MPEG, fractal image compression

MODULE V 3D VISION AND MOTION 7

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline based motion – optical flow – layered motion

MODULE VI APPLICATIONS 7

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians

TOTAL HOURS 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
3. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.

REFERENCES

1. D. L. Baggio et al., “Mastering Open CV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.

OUTCOMES:

On completion of the course, students will be able

- To implement fundamental image processing techniques required for computer vision To perform shape analysis
- To implement boundary tracking techniques
- To apply chain codes, other region descriptors
- To understand and implement suitable compression technique for images
- To apply 3D vision techniques
- To develop applications using computer vision techniques

ECCX59 SIGNAL DETECTION AND ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce basic theory of signal detection and estimation
- To review random variables.
- To analyze the deterministic signals using matched filter.
- To characterize random signals
- To evaluate non parametric detection
- To learn some practical detection and estimation techniques

PREREQUISITES:

- Signals and Systems, Probability theory and random processes

MODULE I REVIEW OF RANDOM VARIABLES AND STATISTICAL DECISION THEORY 9

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete time domain, Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

MODULE II DETECTION OF DETERMINISTIC SIGNALS 7

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

MODULE III DETECTION OF RANDOM SIGNALS 8

Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

MODULE IV NON PARAMETRIC DETECTION 6

Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

MODULE V ESTIMATION OF SIGNAL PARAMETERS 9

Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, Sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian Estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

MODULE VI SIGNAL ESTIMATION IN DISCRETE-TIME AND ARTIFICIAL INTELLIGENCE 6

Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.Introduction to Artificial Intelligence, Bayes networks.

TOTAL HOURS 45

TEXT BOOKS

1. Ralph D.Hippenstiel "Detection Theory:Applications and digital signal processing" CRC Press-2017
2. H.Vincent poor "Introduction to signal detection and Estimation",Springer-2013.
3. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
4. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.

REFERENCES

1. M. Hays, "Statistical Digital Signal Processing and Modelling", John Willey and Sons, 1996.
2. Steven.M.Kay, "Fundamentals of Statistical Signal Processing:" Volume I Estimation Theory, Prentice Hall, USA, 1998.
3. Steven.M.Kay, "Fundamentals of Statistical Signal Processing:" Volume I Detection Theory, Prentice Hall, USA, 1998

OUTCOMES:

On completion of the course, students will be able to

- Recall the basics of statistical decision theory used for signal detection and estimation.
- Analyze the deterministic signals using statistical models.
- Detect the random signals using parametric models
- Apply nonparametric methods to detect randomness of signals
- Estimate the signal parameters using optimal estimators.
- Analyze signal estimation in discrete-time domain using filters.

ECCX60 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 1, 1996
3. A. Jain, Fundamentals of Digital Image Processing. Information and System Sciences Series, Prentice Hall, 1989

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.

ECCX61 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

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

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

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

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

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.
3. P.M. Dufffieux, "The Fourier Transform and its applications to Optics", John Wiley and sons 1988

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.

ECCX62	**DIGITAL VLSI TESTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce different techniques for detection of faults in digital circuits.
- To develop a Generation of test vectors for combinational and sequential circuits
- To establish Self-testing methods

PRE-REQUISITES:

- Basics of digital circuits.
- Knowledge on VLSI design.

MODULE I BASICS OF TESTING 7

Introduction to Testing - Role of testing - VLSI Realisation process- VLSI Technology Trends Affecting Testing-Types of Testing -ATE -AC and DC parameters testing and yield.

MODULE II FAULT MODELLING AND SIMULATION 8

Functional Versus Structural Testing-Faults in digital circuits - Modelling of faults-Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation

MODULE III TESTING OF COMBINATIONAL CIRCUITS 8

Combinational logic circuits -test generation, Testable combinational logic circuit design

MODULE IV TESTING OF SEQUENTIAL CIRCUITS 8

Test generation for sequential circuits - design of testable sequential circuits.

MODULE V DESIGN FOR TESTABILITY 7

Design for Testability - Ad-hoc design - scan based design.

MODULE VI SELF TESTING 7

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures

Total Hours –45

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

- To comprehend the standard procedures and principles to test digital VLSI circuits
- Apply the 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.
- To apply the design for test (DFT) principles for designing digital systems.
- To generate test vectors using ATPG algorithms for combinational and sequential circuitsTo function in teams involving the testing of digital VLSI systems

ECCX63 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 9

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: 9

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 9

Device electrostatics, Double gate MOS system, Two-dimensional confinement

MODULE IV MOBILITY IN MULTIGATE MOSFETS: 9

Introduction, Double-Gate MOSFETs and FinFETs, Silicon multiple-gate nanowires

MODULE V MULTI-GATE MOSFET CIRCUIT DESIGN: 9

Introduction, Digital Circuit Design, Analog Circuit Design, SOC Design and Technology Aspects

TOTAL HOURS 45

TEXT BOOKS

1. FinFETs and Other Multigate Transistors. J. P. Colinge, Springer Publications ,2008
2. Nanoelectronic Circuit Design – Niraj K. Jha and Deming Chen, 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

ECCX64	**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.
3. Xiaocong Fan, “Real-Time Embedded Systems – Design Principles and Engineering Practices”, Newnes, 2015.
4. 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. Xiaocong 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.

ECCX65	**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 for real-time applications.
- 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.

MODULE V MICROC/OS-II 8

MicroC/OS-II -Introduction – Features and Goals of μC/OS – II – Requirements of μC/OS – II - Support Devices for μC/OS – II – File Structure in μC/OS – II - Task Management Functions – Creating a Task - Time Management Functions – OS

Delay Functions - Implementation of Scheduling and rescheduling.

MODULE VI APPLICATION OF RTOS 7

Comparison RT Linux, Vx Works, QNX and Basic Concepts of Android OS-RTOS for Image Processing – RTOS for fault Tolerant Applications – RTOS for Control Systems.

Total Hours –45

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “ Operating system concepts”, 9th edition, John Wiley and Sons Inc.,2012
2. Qing Li, Elsevier , “Real Time Concepts for Embedded Systems”, 2011
3. 3Jean J. Labrosse, “MicroC/OS – II The Real Time Kernel”, CMP Books, 2002.
4. Karim Yaghmour, “ Embedded Android: Porting, Extending, and Customizing”, O’Reilly March 2013.
5. Wang, K.C.Embedded and Real-Time Operating Systems-Springer 2018
6. Jonathan W. Valvano (Author Embedded Systems: Real-Time Operating Systems for the Arm Cortex micro controllers embedded systems-Fourth edition 2017 .ISBN 978-1466468863

REFERENCES:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH
2. Jim Cooling,Real-time Operating Systems: Book 1 - The Theory (The engineering of real-time embedded systems) ISBN-13: 978-1549608940 ,Lindentree Associates 2017
3. David. E. Simon, “An Embedded Software Primer”, Pearson Education, 2001.

OUTCOMES:

On completion of the course the students will be able to

- Describe various task assignment and scheduling methods of operating system and real time operating system.
- Solve the task synchronization problem using synchronization techniques.
- Describe the application of real time OS – Micro- C OS-2.
- 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.

ECCX66 **MECHATRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

- 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 Design‖, 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 18‖, 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, 200**8**

REFERENCES

1 Valvano Jonathan W., ―Embedded Microcomputer Systems: Real Time Interfacing‖, 3rd Edition, Thomson Asia, Singapore, 2011

2 Peatman John B., ―Design with PIC Microcontrollers‖, 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 and its applications in process control industries.
- 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.

ECCX67 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

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

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

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

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 NANOSTRUCTURES 8

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.
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

- Understand the fundamentals of nanotechnology
- Give a general introduction to different classes of nanomaterials
- Improve their knowledge on various synthesis methods of nanomaterials
- Understand characterization techniques involved in nanotechnology
- Familiarize themselves with nanotechnology potentialities
- Design circuits with quantum mechanics and nano systems

ECCX68 SYSTEM DESIGN WITH FPGA

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the Hierarchy, controller (FSM), meta-stability, synchronization.
- To know 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

- Sequential system design, processor datapath and control unit
- SPLD and CPLD architecture, timing, applications.
- 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 help students to acquire the properties and applications of conducting and semiconducting materials.
- To familiarize students with basic ideas about the properties of dielectric and magnetic materials and their applications.
- To familiarize students with basic knowledge of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- 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 concentration, 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 Ferroelectric Random Access Memory (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, graphene - nanocomposites – applications of nano materials.

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; P – 30; TOTAL HOURS – 60

REFERENCES:

1. William D. Callister, "Material Science and Engineering", Wiley Publications, 2006.
2. Raghavan, V., "Materials Science and Engineering", 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab. M.A, "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
4. Pillai, S.O., "Solid State Physics", New Age International, New Delhi, 2005.
5. Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
6. 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

- apply the concepts of conducting and semiconducting materials for solid state devices.
- comprehend the significance of properties of dielectric magnetic materials and derive these properties from synthesized materials.
- differentiate between the properties of the nanomaterials compared to bulk materials.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02	HEAT AND THERMODYNAMICS	L	T	P	C
		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 of 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 and available energy – temperature – entropy diagram for Carnot’s cycle - Third Law of thermodynamics (qualitative).

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 good conductor-Forbe's method
5. Determination of thermal conductivity of a bad conductor-Lee's disc method

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Mathur. D.S, “Heat & Thermodynamics”, S.Chand & Co., 2009.
2. Brijlal & Subramaniam, “Heat and Thermodynamics”, S.Chand & Co, Delhi, 2010.
3. Gupta. A.B and Roy. H, “Thermal Physics”, Books and Allied Ltd., 2002.
4. 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.
- apply the knowledge 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**

OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the synthesis and 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, grapheme - 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 lithograpy - nanoelectromechnical systems (NEMS) - nanoindentation principles.

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.

L – 30; P – 30; TOTAL HOURS – 60

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 7

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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 basic understanding of 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 10

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 6

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 7

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 of 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; P – 30; TOTAL HOURS – 60

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 concepts and applications of Dielectric and 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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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.

MODULE 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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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.
- apply the fundamental concept of photo elasticity 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.

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.
   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.

L – 30; P – 30; TOTAL HOURS – 60

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.
- know the low temperature systems and its applications.

PHCX 09	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L	T	P	C
		2	0	2	3

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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.

Chemistry Elective Courses
(To be offered II Semester)

CHCX01	ANALYTICAL INSTRUMENTATION	L	T	P	C
		2	0	2	3

OBJECTIVES:

To make the student conversant with

- principles, instrumentation and applications of different electroanalytical techniques
- different chromatographic techniques
- principles, instrumentation and applications of various types of absorption and emission spectroscopy
- different thermal analytical methods and their applications

MODULE I ELECTROANALYTICAL TECHNIQUES 7

Principle and applications: conductometric titrations – potentiometrIc titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry - polarography, amperometric titrations.

MODULE II CHROMATOGRAPHY 8

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

MODULE III SPECTROSCOPY 8

Absorption spectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy - Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

MODULE IV THERMAL ANALYSIS 7

Principle, instrumentation and applications: Thermo gravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

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.

L – 30; P – 30; TOTAL HOURS – 60

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:

The students should be conversant with the

- 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 coating

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 embritttlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embritttlement 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 repellant, 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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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:

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

		L	T	P	C
CHCX03	**ELECTRICAL MATERIALS AND BATTERIES**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

The students should be 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).

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.

L – 30; P – 30; TOTAL HOURS – 60

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:

The students should be 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 7

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.

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

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnakar, "Engineering Chemistry", Tata McGrow-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Willey 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.

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

L – 30; P – 30; TOTAL HOURS – 60

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, votalite 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:

The students will be 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.

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. *Kineticsoffirst and second order reactions.*
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitro toluene.

L – 30; P – 30; TOTAL HOURS – 60

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.

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).

L – 30; P – 30; TOTAL HOURS – 60

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.

CHCX08	ORGANIC CHEMISTRY OF BIOMOLECULES	L	T	P	C
		2	0	2	3

OBJECTIVES:

To make students conversant with the

- basic concepts in organic chemistry
- types and structure of carbohydrates and lipids
- formation of different structures of proteins from amino acid
- structure of nucleic acids

MODULE I BASIC CONCEPTS IN ORGANIC CHEMISTRY 8

Classification and IUPAC nomenclature of organic compounds – stereochemistry – optical, stereo and geometrical isomerism – types of reagents: electrophiles and nucleophiles – types of reactions: addition, substitution, elimination and rearrangement reactions.

MODULE II CARBOHYDRATES, LIPIDS AND VITAMINS 7

Structure and functions of carbohydrates: mono, di, oligo and polysaccharides – lipids: phospholipids, glycolipids, sphingolipids – cholesterol – steroids – Structure, functions and deficiency disorders of fat soluble vitamins: A, D, E & K - Water soluble vitamins B & C: Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

MODULE III AMINO ACIDS, PEPTIDES AND PROTEINS 7

Aminoacids: classification, properties - peptides – polypeptides – proteins: primary, secondary, tertiary and quaternary structure – glycoproteins – lipoproteins – Enzymes: classification and functions

MODULE IV NUCLEIC ACIDS 8

Nucleic acids – importance - structure of purines and pyrimidines – nucleotides – polynucleotides - RNA – types & structure - DNA – phosphodiester bonds – chemical, helical structure and functions – DNA replication – gene modification.

PRACTICALS

1. Qualitative tests to identify carbohydrates.

2. Quantitative estimation of carbohydrates.
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.

L – 30; P – 30; TOTAL HOURS – 60

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.

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.

L – 30; P – 30; TOTAL HOURS – 60

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

Maths Elective Courses
(to be offered in IV
Semester)

MACX 01	**DISCRETE MATHEMATICS AND GRAPH THEORY**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

The aims of this course are to

- introduce Logical and Mathematical ability to deal with abstraction.
- familiarize the basic mathematical ideas and terminologies used in computer science.
- translate real life situations into diagrammatic representations.

MODULE I PROPOSITIONAL CALCULUS 8

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments.

MODULE II PREDICATE CALCULUS 7+3

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

MODULE III FUNCTIONS 7+3

Functions – Classification of functions –– Composition of functions – Inverse functions – Binary and n–ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

MODULE IV ALGEBRAIC SYSTEMS 8+2

Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Basic notions of error correlation – Error recovery in group codes.

MODULE V GRAPH THEORY 7+3

Graphs – incidence and degree – subgraphs – isomorphism – complement of a graph – operations on graphs

MODULE VI PATH AND CIRCUIT 8+2

Walks, trails and paths – Eulerian graphs – Konigsburg bridge problem - Hamiltonian graphs

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

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.

REFERENCES:

1 Ralph.P.Grimaldi, "Discrete and Combinatorial Mathematics: An Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.

2 Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 2006.

3 C.L.Liu, D.P.Mohapatra, "Elements of Discrete Mathematics", 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

OUTCOMES:

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

- use the concepts of propositional calculus.
- use the concepts of predicate calculus.
- identify types of functions and their importance.
- decode and encode the messages using group theory concepts.
- apply the basic concepts of graph theory.
- represent some real life situations into diagrammatic representation.

MACX 02 PROBABLITY 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 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 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:

1. T.Veerarajan, “Probability and Statistics”, Tata McGraw-Hill Education, 2008.
2. Miller, I., Miller, M.,Freund, J. E., “Mathematical statistics”, 7th Edition, Prentice Hall International, 1999.
3. S.P.Gupta, “Applied Statistics”, Sultan Chand & Sons

REFERENCES:

1. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier.
2. S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematical Statistics” First edition, Sultan Chand and Sons.
3. Arora and Arora, “Comphrensive Statistical Methods”, S. Chand, 2007

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability and descriptive statistics.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- calculate point and interval estimates.
- apply some large sample tests and small sample tests.
- 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, Elesvier

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 ORDINARY DIFFERENTIAL EQUATIONS 7+3

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 ORDINARY DIFFERENTIAL EQUATIONS 8+2

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 DIFFERENTIAL EQUATIONS 7+3

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

- solve algebraic, transcendental and system of equations.
- apply interpolation techniques.
- carry out numerical differentiation and integration using different methods.
- solve first order ODE using single and multi step methods.
- solve second order ODE, initial and boundary value problems.
- 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

- formulate industrial problems as mathematical programming problems.
- solve linear programming problems by different methods.
- solve transportation problems by different methods.
- 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 INFERENCES 8

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

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

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

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

- develop and test hypothesis for different statistical tests
- design an experiment and case study the experiment with different data.
- analyze the industrial data using quality control design tools statistically.
- 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:

- 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:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
2. 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
3	0	0	3

OBJECTIVES:

The aims of the course are to

- provide basic idea of formation and use of Mathematical models for different purposes.
- 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:

1. G . Ledder , “Calculus, modelling , probability and dynamic systems”, Springer 2013
2. 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
3	0	0	3

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. Pondy 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)

		L	T	P	C
SSCXO1	**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:

1. Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
2. Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

1. Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
2. 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:

1. Giddens A. 1989. “Sociology” Cambridge: Polity Press.
2. Heald Haralambos, R.M(2014) . ‘‘Sociology Themes and Perspectives”, Oxford, New Delhi-92
3. Bhushan Vidya and D.R. Sachdeva (2012). ‘‘Fundamental of Sociology”, Pearson, Delhi.

REFERENCES:

1. Das Gupta, Samir and Paulomi Saha (2012), ‘‘An Introduction to Sociology”, Pearson, Delhi
2. 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:

1. Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
2. Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
3. Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
4. 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,

- Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
- Students will be sensitized to the various categories ,Inequalities and their challenges
- Students will be exposed to the social problems encountered in contemporary India.
- Students will gain knowledge about the various forms and trends of the social change.
- 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 SUSTAINABILITY 8

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 DEVELOPMENT 7

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.

SSCXO5	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:

1. Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
2. Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

- Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
- Students will be familiar with structure of authority, roles and responsibility in organizational settings.
- Students will imbibe leadership, communication and behavioral acumen to govern organization
- Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCXO6 LAW FOR ENGINEERS

	L	T	P	C
	2	0	0	2

OBJECTIVES:

- To understand the Constitution and Governance of our country.
- To apprise the students of human rights - local and international and redressal mechanism.
- To have an insight into the industrial, corporate and labour laws of our country.
- 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,

- Students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- Students will have gained knowledge in human rights, cultural, social and political rights.
- Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
- Students will have an overview of IPRs and laws related to Intellectual Property Rights.

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

GECX101	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management

MODULE I ENVIRONMENTAL HAZARDS 7

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS 7

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS 7

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

MODULE IV DISASTER MANAGEMENT 8

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT 8

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

L – 45; Total Hours –45

REFERENCES:

1. Satender, “Disaster Management in Hills”, Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), “Environmental Geography”, Heritage Publishers, New Delhi,1990.
3. Savinder Singh, “Environmental Geography”, Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., “The Environment as Hazards”, Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), “Disaster Management”, University Press, India, 2003.
6. Singh, R.B.,“Space Technology for Disaster Mitigation in India (INCED)”, University of Tokyo, 1994.
7. Bhandani, R.K., “An overview on Natural & Manmade Disaster & their Reduction”, IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., “Manuals on Natural Disaster management in India”, National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with 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, PDSA 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 Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS 7

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

L – 45; Total Hours –45

TEXT BOOKS:

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lidsay, “The Management and Control of Quality”, 5^{th} Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S., “Total Quality Management”, Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., “Quality Management – Concepts and Tasks”, New Age International, 1996.
5. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

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 COMBINED CYCLE PLANTS 8

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, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity of frames - Dynamic equations for sing, 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
GECX105 TRANSPORT MANAGEMENT	**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.

MODULE V MOTOR VEHICLE ACT 7

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE VI MAINTENANCE 7

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

L – 45; Total Hours –45

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCES:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date.

OUTCOMES:

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

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 APPLICATION OF CONTROL SYSTEMS 6

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

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters.

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

REFERENCES:

1. Michael D. Ciletti"Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010
2. J.Bhasker: Verilog HDL primer, BS publication, 2001.
3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002
4. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective," 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000
5. Douglas A Pucknell& Kamran Eshragian , "Basic VLSI Design" PHI 3rd Edition (original edition – 1994)

OUTCOMES:

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

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- Apply VLSI design concepts based on the requirements to conduct experiments or projects

GECX108	**PLANT ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**4**

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 MAIL SECURITY AND IP SECURITY 8

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, 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 Cyber security.
- 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,Incompatability, 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, Prientice 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.

GECX114 OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

MODULE I LINEAR PROGRAMMING PROBLEM 8

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 ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY 6

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships - rules of constructing the dual from primal.

MODULE III TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE 8

Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV NETWORK AND SEQUENCING PROBLEMS 8

PERT and CPM – Network diagram – Fulkerson's rule - CPM Probability of achieving completion date – Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines.

MODULE V QUEUING THEORY & SIMULATION 7

Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY 8

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:

3. Hamdy ATaha, “Operations Research an introduction”, 8th edition, Phil Pearson, 2007.
4. 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

- 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, SAFETY AND TOOLS 7

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 MAINTENANCE 8

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 CONDITIOING 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 Bonnick.

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 to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

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 ECONOMIC SYSTEMS 8

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.

L – 45; 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 relationship between sustainability and emergence of green building practices.
- Address the economic, environmental, and social concerns.

GECX202 APPROPRIATE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I BASICS CONCEPTS 7

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 7

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 7

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 8

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 8

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 8

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

L – 45; 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 use suitable technologies for various conditions for sustainable development.

GECX203 ENGINEERING SYSTEM MODELLING AND SIMULATION

	L	T	P	C
	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 Diagraming - 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 RECOMMENDATION 6

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

1. Formulate a real life situation as an optimization the problem.
2. Identify the appropriate solution methodology and provide a solution

GECX207 **MATLAB SIMULINK**

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:

1. Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
2. Write programs using first principles without automatic use of built-in ones.
3. 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.
4. 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.
5. Make use of Maltab visual capabilities for all engineering applications.
6. 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 and TOOLS 8

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 ”Tata McGraw-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 DEVELOPMENT 7

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

Maintenance.

MODULE V USABILITY AND MEASURING USER SATISFACTION 7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-El electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall,March 2007.

2.Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May 2008.

3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.

4. Rumbaugh et al, “Succeeding with Booch and Rambaugh Methods”, Addisson Wesley, second Edition, 1998.

5.Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

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:

1. To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
2. To develop certain basic skills for personality development through community development.
3. Understand the community in which they work and their relation
4. Identify the needs and problems of the community and involve them in problem-solving and
5. 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:

1. 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.
2. National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
3. 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, NOx, 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 ollutants 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, NOx, 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, NOx, 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

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX215	MOTOR VEHICLE ACT, INSURANCE & 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 arbour 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 convection- 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.cpvt 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

GECX216	PRINCIPLES OF COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To introduce the analog and digital modulation techniques.
To elaborate the working of communication receivers in the presence of noise.
To give an overview of various communication systems.

MODULE I LINEAR MODULATION 8

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

MODULE II ANGLE MODULATION 8

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

MODULE III SAMPLING AND PULSE MODULATION 7

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

MODULE IV DIGITAL COMMUNICATION 7

Digital baseband data, Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

MODULE V NOISE 8

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent Bandwidth.

MODULE VI COMMUNICATION SYSTEMS & NETWORK 7

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

L – 45; T – 0; Total Hours – 45

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

1. Identify various communication systems and the corresponding modulation schemes.
2. Predict the characteristics of various analog and digital modulation schemes.
3. Interpret the effect of noise and bandwidth in a communication systems
4. Apply the Nyquist criteria for a given baseband signals.
5. Evaluate the performance of communication receivers.
6. Demonstrate the applications of common communication systems.

GECX217	LEAN MANAGEMENT	L	T	P	C
		3	1	0	4

OBJECTIVES:

The objective of the Course to make the student know about

- The basics of lean production management,
- How lean principles are applied to the construction industry to improve the operation management and product development.

MODULE I **8**

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

L – 45; Total Hours –45

TEXT BOOKS:

1. The Toyota Way Fieldbook, 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. 720 pp.

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 learn 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

GECX218	**GEOSPATIAL MODELING & ANALYSIS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To equip the students with fundamental representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis.
- To focus is on 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 LANDFORMS 8

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.

L – 45; T – 0; 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.
- Students will have gained knowledge in spatial tools to make simulations and predictions of real life phenomena.
- Students will have synthesized knowledge about Apply, integrate, and develop models with geospatial data through a GIS.
- Students will have an overview of Evaluate models in terms of accuracy, sensitivity, and uncertainty.
- Students will have Use of a system-based approach for problem solving, with an emphasis on sustainability.