ANNAMALAI UNIVERSITY
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. (Four-Year Full Time) DEGREE PROGRAM
Choice Based Credit System

Regulations - 2022

Curriculum for Students Admitted in the Academic Year 2022-2023

HAND BOOK
2022

ANNAMALAI UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. E. (Four-Year) Degree Programme (FULL-TIME)

Choice Based Credit System (CBCS)

REGULATIONS 2022

1. Condition for Admission

Candidates for admission to the first year of the four year B.E. Degree programmes shall be required to have passed the final examination of the plus 2 Higher Secondary Course with Mathematics, Physics and Chemistry as courses of study and candidates who have passed the Higher Secondary Examination through vocational stream under Engineering, conducted by the Board of Secondary Education, Government of Tamil Nadu or an examination of any other authority accepted by the Syndicate of this University as equivalent thereto. They shall satisfy the conditions regarding qualifying marks, age and physical fitness as may be prescribed by the Syndicate of the Annamalai University from time to time.

Candidates who have passed the Diploma programme in Engineering of the State Board of Technical Education, Tamil Nadu will be eligible for admission to the second year of the four year degree programme in B.E. under the lateral entry scheme provided they satisfy other conditions.

2. Branches of Study in B.E.

BRANCH I - Civil Engineering
BRANCH II - Civil and Structural Engineering
BRANCH III - Mechanical Engineering
BRANCH IV - Mechanical Engineering (Manufacturing)
BRANCH V - Electrical and Electronics Engineering
BRANCH VI - Electronics and Instrumentation Engineering
BRANCH VII - Chemical Engineering
BRANCH VIII - Computer Science and Engineering
BRANCH IX - Information Technology
BRANCH X - Electronics and Communication Engineering
BRANCH XI - Computer Science and Engineering (Artificial Intelligence and Machine Learning)
BRANCH XII - Computer Science and Engineering (Data Science)

3. Courses of Study and Scheme of Examinations

The courses of study with respective syllabi and the scheme of Examinations are given separately.

4. Choice Based Credit System (CBCS)

The curriculum includes six components namely Humanities / Social Sciences /Management, Basic Sciences, Engineering Sciences, Professional Core, Professional/Programme Electives and Open Electives in addition to Seminar & Industrial Training and Project. Each semester curriculum shall normally have a blend of theory, practical and theory cum practical courses. The total credits for the entire degree Programme is **173 (132** for lateral entry students).

5. Eligibility for the Degree

A candidate shall be eligible for the degree of Bachelor of Engineering if the candidate has satisfactorily undergone the prescribed courses of study for a period of four academic years and has passed the prescribed examinations in all the four academic years. For the award of the degree, a student has toearn a minimum of 173 credits (132 for lateral entry students).

Serve in any one of the Co-curricular activities such as

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO) and
- Youth Red Cross (YRC)

For at least one year. The students enrolled in any one of the co-curricular activities (NCC / NSS / NSO / YRC) will undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid. While the training activities will normally be during weekends, the camp will normally be during vacation period.

(or)

Enrol as a student member of a recognized professional society such as

- Student Chapters of Institution of Engineers (India)
- Student Chapters of other Professional bodies like ICI, ISA, IIChE, IEEE, SAE, ASHRAE, CSI and IWS

5.1 B.E (Honours) Degree

A student shall be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. Thus the total credits are 193. Out of 193 credits(152 credits for lateral entry students), 20 credits must be earned by studying additional course offered by the same or allied Departments (listed in Annexure) in the sixth, seventh and eighth semesters.

5.2 B.E Degree with Minor Engineering

A student shall be eligible to get Under Graduate degree with additional Minor Engineering, if he/she completes an additional 20 credits. Out of the 193 credits, 20 credits must be earned from the courses offered by any one of the Departments (listed in Annexure) in the Faculty of Engineering and Technology in sixth, seventh and eighth semesters.

6. Assignment of Credits for Courses

Each course is normally assigned one credit per hour of lecture/tutorial per week and half credit for one hour for laboratory or practical or drawing course per week.

7. Duration of the Programme

A student is normally expected to complete the B.E. programme in four years but in any case not more than seven years from the time of admission.

8. Registration for Courses

A newly admitted student will automatically be registered for all the courses prescribed for the first, second and third semesters without any option.

Every other student shall enrol for the courses intended to be credited in the succeeding semester in the current semester itself by completing the registration form indicating the list of courses. This registration will be done a week before the last working day of the current semester.

A student is required to earn 173 (132 for lateral entry students) credits in order to be eligible for obtaining the degree. However the student is entitled to enjoy an option to earn either more or less than the total number of credits prescribed in the curriculum of a particular semester on the following guidelines:

8.1 Slow Learners

The **slow learners** may be allowed to withdraw certain courses with the approval by the Head of the Department and those courses may be completed by them in the fifth year of study and still they are eligible to be awarded with I Class. A student can withdraw a maximum of 2 courses per semester from IV semester to VII semester and take up those courses in the fifth year of study. However, courses withdrawn during odd semesters (V and VII) must be registered in the odd semester of fifth year and courses withdrawn during even semesters (IV and VI) must be registered in the even semester of fifth year.

8.2 Advanced Learners

The **advanced learners** may be allowed to take up the open elective courses of eighth semester in sixth and seventh semesters one in each to enable them to pursue industrial training/project work in the entire eighth semester period provided they should register those courses in the fifth semester itself. Such students should meet the teachers offering those elective courses themselves for clarifications. No specific slots will be allotted in the time table for such courses.

9. Project Work

The student typically registers for project at the end of seventh semester and completes it at the end of the eighth semester along with the courses prescribed for study in the eighth semester. However a student who has registered and successfully completed the courses of eighth semester by acquiring additional credits in the earlier semesters can attempt to spend his/her period of study in an industry and complete his/her project work, submit the project report and appear for viva-voce examination at the end of eighth semester.

10. Mandatory Induction program

A 3-week long induction program for the UG students entering the institution, right at the start is proposed. Normal classes start only after the induction program is over. The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- Physical Activity
- Creative Arts
- Imparting Universal Human Values
- Literary Activities
- Conduct of crash courses on soft skills
- Lectures by Eminent People
- Visits to Local Area
- Familiarization to Dept./Branch & Innovative practices

11. Electives

The elective courses fall under two basic categories: Professional Electives and Open Electives.

11.1 Professional Elective Courses

The Professional Elective courses are offered in the concerned branch of specialization and a student can choose the Professional Elective courses with the approval of the Head of the Department concerned.

11.2 Open Elective Courses

Apart from the various Professional elective courses, a student must study**five** open elective courses of which the student may opt to study either that offered by the Department concerned or from the open elective courses offered by any other Department in the Faculty of Engineering & Technology, with the approval of the Head of the concerned Department and the Head of the Department offering the course. In case the student opts to study an open elective offered by a neighbouring Department in the Faculty, it shall be handled by the faculty of that Department offering the chosen open elective.

A student may be required to choose Intellectual Property Rights (IPR) and Cyber Security as open electives anywhere between fifth and eighth semesters as part of the requirements of the study.

11.3 MOOC (SWAYAM) Courses

The student can be permitted to earn not more than 40 % of his/her total credits (that is 69 credits) by studying Massive Open Online Courses (MOOCs) offered through the SWAYAM Portal of UGC with the approval of the Head of the Department concerned and the Dean of the Faculty. The courses will be considered as equivalent to elective courses from the fifth to the eighth semesters and the credits earned through MOOC courses may be transferred and considered for awarding Degree to the student concerned.

A student who earns 3 or more credits from a 12 week MOOC course through SWAYAM portal (Syndicate Resolution No.:14 dated 10.05.2019) shall be exempted from studying the elective course and

permitted to transfer the credits. Besides the student may be permitted to claim for the conversion to the next higher grade in accordance with the Syndicate Resolution No.: 31 dated 09.09.2020

11.4 Value Added Courses

A student can study one or more value added courses being offered by the other Departments of Study either within the Faculty or any other Faculty in the University in any semester of the B.E degree programme except First Year, with the restriction that only one Value added Course can be registered at a time.

11.5 Extra One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Dean of the Faculty.

11.5.1 Industry Expert

For one credit courses, a relevant potential topic may be selected by a committee consisting of the Head of the Department concerned and the Board of Studies member from the Department and a senior faculty member from the Department concerned. An expert from industry familiar with the topic chosen may be accordingly invited to handle classes for the students. The details of the syllabus, time table and the name of the industrial expert may be sent by the above committee to the Dean for approval. The credits earned through the extra one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. Students can take a maximum of two extra one credit courses (one each in VI and VII semesters). They shall be allowed to take extra one credit courses offered in other Departments with the permission of Head of the Department offering the courses. A separate mark sheet shall be issued for extra one credit courses.

11.6 Skill Related /NaanMudhalvan

A student is required to study **Three** open elective courses One each in the fifth, sixth and seventh semester of study as part of acquiring skills in the specified field. The student shall pursue the open electives listed in the NaanMudhalvan portal against the respective semesters. However alternatively the student shall choose the open electives from the list tabled relating to the respective programmeswith the approval of the Head of the Department concerned and Dean of the Faculty.

12. Assessment

12.1. Theory Courses

The break-up of Continuous Assessment for the theory courses relates to evaluating the performance under the five Course Outcomes uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

The break-up of continuous assessment and examination marks for theory courses is as follows:

First assessment (Mid-Semester Test-I Covering Units I & II)	**:**	**8 marks**
Second assessment (Mid-Semester Test-II Covering Units III, IV & V)	**:**	**12 marks**
Third Assessment (Assignment Covering Units I, II, III, IV & V)	**:**	**5 marks**
End Semester Examination	**:**	**75 marks**

The break-up of Continuous Assessment for the theory course titled Basic Engineering in the II semester that involves two disciplines requires evaluating the performance under the five Course Outcomes, with 3 for one discipline and two for the other, uniformly with 5 Marks for each outcome spread over Two Mid-Semester tests and One Assignment, totalling to 25 Marks. Similarly the break-up mark for University End Semester exams involves evaluating the performance under the five Course Outcomes with 15 Marks for each Outcome, totalling to 75 Marks.

12.2 Practical Courses

The break-up of Continuous Assessment for the practical courses involves evaluating the performance under the five Course Outcomes uniformly with 8 Marks for each outcome spread over Two tests and Record work, totalling to 40 Marks. Similarly the break-up mark for University End Semester exams relates to evaluating the performance under the five Course Outcomes with 12 Marks for each Outcome, totalling to 60 Marks

The break-up of continuous assessment and examination marks for Practical courses is as follows:

First Assessment (Test-I Relating to Cycle I)	**:**	**15 marks**
Second Assessment (Test-II Relating to Cycle II)	**:**	**15 marks**
Maintenance of Record book	**:**	**10 marks**
End Semester Examination	**:**	**60 marks**

12.3 Theory cum Practical Course

The break-up of Continuous Assessment for the theory cum practical courses necessitates to evaluating the performance as being followed for the theory and practical courses individually and requires the students to clear each component separately. The average of the marks secured by the student in the theory and practical courses and the appropriate grade relating to the average shall be assigned to the student.

12.4 Project Work

The continuous assessment marks for the project work will be 40 and to be assessed by a review committee consisting of the project guide and a minimum of two members nominated by the Head of the Department. One of the committee members will be nominated as the Chairman by the Head of the Department. The Head of the Department may be a member or the Chairman. At least two reviews should be conducted during the semester by the review committee. The student shall make presentation on the progress made before the committee. 60 marks are allotted for the project work and viva voce examination at the end of the semester.

12.5 Industrial Internship

After attending the internship during the semester vacation of II / III year for a period of 4 weeks duration in each year, the student has to submit a report and appear for the viva-voce exam along with the V/VII semester end semester examinations.

13. Substitute Assessment

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the final examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the date of the third meeting of the respective class committees.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Dean / Head of the Department within a week from the date of the missed assessment.

14. Student Counsellors (Mentors)

To help the students in planning their course of study and for general advice on the academic programme, the Dean / Head of the Department will attach a certain number of students to a member of the faculty who shall function as student counsellor for those students throughout their period of study. Such student counsellors shall advise the students, give preliminary approval for the courses to be taken by the students during each semester and obtain the final approval of the Dean / Head of the Department.

15. Class Committee

For all the branches of study during the first two semesters, a common class committee will be constituted by the Dean of the faculty. From among the various teachers teaching the same common course to different classes during each semester of the first year, the Dean shall appoint one of them as course coordinator.

The composition of the class committee during first and second semesters will be as follows:

- Course coordinators of all courses.
- All the Heads of the Sections, among whom one may be nominated as Chairman by the Dean.
- The Dean may opt to be a member or the Chairman.

For each of the higher semesters, separate class committees will be constituted by the respective Head of the Departments.

The composition of the class committees from third to eighth semester will be as follows:

- Teachers of the individual courses.
- A seminar coordinator (for seventh semester only) shall be appointed by the Head of the Department
- A project coordinator (for eighth semester only) shall be appointed by the Head of the Department from among the project supervisors.
- One Professor or Associate Professor, preferably not teaching the concerned class, appointed as Chairman by the Head of the Department.
- The Head of the Department may opt to be a member or the Chairman.

The class committee shall meet three times during the semester. The first meeting will be held within two weeks from the date of class commencement in which the type of assessment like test, assignment etc. for the third assessment and the dates of completion of the assessments will be decided.

The second meeting will be held within a week after the completion of the first assessment to review the performance and for follow-up action.

The third meeting will be held after all the assessments but before the University semester examinations are completed for all the courses, and at least one week before the commencement of the examinations. During this meeting the assessment on a maximum of 25 marks for theory/40 marks for seminar/ industrial training, practical and project work will be finalized for every student and tabulated and submitted to the Head of the Department (to the Dean in the case of I & II Semester) for approval and transmission to the Controller of Examinations.

16. Attendance Requirements

The students with 75% attendance and above are permitted to appear for the University examinations. However, the Vice Chancellor may give a rebate / concession not exceeding 10% in attendance for exceptional cases only on Medical Grounds.

17. Temporary Break of Study

A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

If a student wishes to apply for break of study, the student shall apply to the Dean in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Head of the Department concerned to the Dean.

However, the student must complete the entire programme within the maximum period of seven years.

18. Procedure for Withdrawing from the Examinations

A student can withdraw from all the examinations of the semester only once during the entire programme on valid grounds accepted by the University. Such withdrawal from the examinations of a semester will be permitted only if the candidate applies for withdrawal at least 24 hours before the commencement of the last examination. The letter grade 'W' will appear in the mark sheet for such candidates.

19. Passing and Declaration of Examination Results

All assessments of all the courses on an absolute marks basis will be considered and passed by the respective results passing boards in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), and prepare the mark sheets.

90 to 100 marks	:	Grade 'S'
80 to 89 marks	:	Grade 'A'
70 to 79 marks	:	Grade 'B'
60 to 69 marks	:	Grade 'C'
55 to 59 marks	:	Grade 'D'
50 to 54 marks	:	Grade 'E'
Less than 50 marks	:	Grade 'RA'
Withdrawn from the examination	:	Grade 'W'

A student who obtains less than 30 / 24 marks out of 75 / 60 in the theory / practical examinations respectively or is absent for the examination will be awarded grade RA.

A student who earns a grade of S, A, B, C, D or E for a course, is declared to have successfully completed that course. Such a course cannot be repeated by the student.

A student who is detained for lack of attendance must re-register for and repeat the courses in the respective semester.

A student who obtains letter grade RA in the mark sheet must reappear for the examination of the courses except for Honours courses.

A student who obtains letter grade W in the mark sheet must reappear for the examination of the courses.

The following grade points are associated with each letter grade for calculating the grade point average and cumulative grade point average.

S - 10; A - 9; B - 8; C - 7; D - 6; E - 5; RA - 0

Courses with grade RA / W are not considered for calculation of grade point average or cumulative grade point average.

A student can apply for re-evaluation of one or more of his examination answer papers within a week from the date of issue of mark sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After the results are declared, mark sheets will be issued to the students. The mark sheet will contain the list of courses registered during the semester, the grades scored and the grade point average for the semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the semester, divided by the sum of the number of credits for all courses taken in that semester.

OGPA/CGPA is similarly calculated considering all the courses taken from the time of admission.

20. Awarding Degree

After successful completion of the programme, the degree will be awarded based on OGPA/CGPA.

The conversion of OGPA/CGPA (from I semester to VIII Semester) to the corresponding Percentage of marks may be calculated as per the following formula:

Percentage of marks = (OGPA/CGPA - 0.25) x 10

Where $OGPA/CGPA = \frac{\sum C_i GP_i}{\sum C_i}$

C_i- Credit hours of a course

GP_i - Grade Point of that course

20.1 Honours Degree

The student requires to earn a minimum of 193 credits within four years (152 credits within three years for lateral entry students) from the time of admission, pass all the courses in the first attempt from I

Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a OGPA/CGPA of 8.25 or above to obtain the Honours Degree.

The Student is required to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

However, if the student either does not clear the extra course(s) relating to become eligible for the Honours Degree or discontinues it in any of the semesters, then the student may revert to the category of the First Class with Distinction or First class, provided the student is eligible for that respective category. The student may claim for revised mark sheet, paying the stipulated fee in order that the unsuccessful appearance or discontinuity of the course(s) is not reflected in the new mark sheet.

20.2 First Class with Distinction

To obtain B.E Degree First Class with Distinction, a student must earn a minimum of 173 Credits within four years (132 credits within three years for lateral entry students) from the time of admission, by passing all the courses in the first attempt from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students) and obtain a CGPA of 8.25 or above.

20.3 First Class

To obtain B.E Degree First Class, a student must earn a minimum of 173 credits within ***five*** years (132 credits within ***four*** years for lateral entry students) from the time of admission and obtain a OGPA/CGPA of 6.75 or above for all the courses from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

20.4 Second Class

For Second Class, the student must earn a minimum of 173 credits within **seven**years (132 credits within **six** years for lateral entry students) from the time of admission.

20.5 B.E Degree with Minor Engineering

The student shall be given an option to earn a Minor Engineering Degree in another discipline of Engineering not related to his/her branch of study at the end of the first year provided the student clears all the subjects in the first year in the first attempt and secures a OGPA/CGPA of not less than 7.5

The student is required to earn an additional 20 credits starting from the third semester in the sense he/she requires to complete 6 elective courses, 2 each in the V, VI and VII semesters with a stipulation that 2 of the 6 courses need to be of 4 credits each, while the remaining 4 has to be of 3 credits each, thus totalling to 20 credits, the choice being approved by the Head of the Department concerned and the Dean of the Faculty.

The rules for awarding the B.E degree in First Class with Distinction or in First Class or in Second Class apply in the same manner for B.E Degree with Minor Engineering.

However the student who opts for Honours Degree is not entitled to pursue B.E Degree with Minor Engineering and vice-versa

21. Ranking of Candidates

The candidates who are eligible to get the B.E. degree with Honours will be ranked together on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates who are eligible to get the B.E. degree in First Class with Distinction will be ranked next after those with Honours on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The candidates passing with First Class will be ranked next after those with distinction on the basis of OGPA/CGPA for all the courses of study from I Semester to VIII Semester (III Semester to VIII Semester for lateral entry students).

The ranking of candidates will be done separately for each branch of study.

22. Transitory Regulations

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the courses of study and the syllabi from time to time.

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three consecutive times after implementation of the new syllabi in order to enable the

students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent courses, as per the new syllabi, on the recommendations of the Head of the Department concerned.

ANNEXURE

S. No.	Branch of Study in B.E	Honours Elective Courses from Same and Allied Departments of	Minor Engineering Courses from Other Departments of
1.	Chemical Engineering	1. Chemical Engineering 2. Pharmacy 3. Electronics and Instrumentation Engineering	1. Civil Engineering 2. Mechanical Engineering 3. Electronics and Instrumentation Engg. 4. Information Technology 5. Civil and Structural Engg. 6. Electrical Engineering 7. Electronics and Communication Engg. 8. Mechanical (Manufacturing) Engg. 9. Computer Science and Engineering 10. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 11. Computer Science and Engineering(Data Science)
2.	Civil Engineering	1. Civil Engineering 2. Civil and Structural Engg.	1. Mechanical Engineering 2. Electrical Engineering 3. Chemical Engineering 4. Computer Science and Engineering 5. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 6. Computer Science and Engineering(Data Science) 7. Mechanical (Manufacturing) Engg 8. Electronics and Instrumentation Engg 9. Information Technology 10. Electronics and Communication Engg.
3.	Civil and Structural Engineering		
4.	Computer Science and Engineering	1. Computer Science and Engg. 2. Information Technology 3. Electronics and Communication Engineering 4. Computer Science and Engineering(Artificial	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engg. 4. Civil and Structural Engg. 5. Chemical Engineering
5.	Computer Science and Engineering (Artificial Intelligence and Machine Learning)		
6.	Computer Science and Engineering (Data Science)		

		Intelligence and Machine Learning) 5. Computer Science and Engineering(Data Science)	
7.	Electrical and Electronics Engineering	1. Electrical Engineering 2. Electronics and Instrumentation Engineering 3. Electronics and Communication Engineering	1. Civil Engineering 2. Civil and Structural Engg. 3. Mechanical Engineering 4. Chemical Engineering 5. Mechanical (Manufacturing) Engg.
8.	Electronics and Communication Engg.		
9.	Electronics and Instrumentation Engg.		
10.	Information Technology	1. Computer Science and Engg. 2. InformationTechnology 3. Electronics and Communication Engineering 4. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 5. Computer Science and Engineering (Data Science)	1. Civil Engineering 2. Mechanical Engineering 3. Mechanical (Manufacturing) Engg. 4. Civil and Structural Engg. 5. Chemical Engineering
11.	Mechanical Engineering	1. Mechanical Engineering 2. Mechanical (Manufacturing) Engg.	1. Civil Engineering 2. Civil and Structural Engg. 3. Electrical Engineering 4. Chemical Engineering 5. Computer Science and Engineering 6. Computer Science and Engineering (Artificial Intelligence and Machine Learning) 7. Computer Science and Engineering (Data Science) 8. Electronics and Instrumentation Engg. 9. Information Technology 10. Electronics and Communication Engg.
12.	Mechanical (Manufacturing) Engg.		

DETAILS OF COURSE CODE

Code (First Two digits)	Details
00	Common Course for the faculty
01	Civil Engg. Course

Code (3rd and 4th Digits)	Details
HS	Humanities Theory
HP	Humanities Practical

02	Civil and Structural Engg. course	BS	Basic Science Theory
03	Mechanical Engg. Course	BP	Basic Science Practical
04	Mechanical Engg (Manufacturing). Course	ES	Engineering Science Theory
05	Electrical and Electronics Engg. Course	SP	Engineering Science Practical
06	Electronics and Instrumentation Engg. course	PC	Professional Core Theory
07	Chemical Engg. course	CP	Professional Core Practical
08	Computer Science and Engg. course	PE	Professional Elective Theory
09	Information Technology course	EP	Professional Elective Practical
10	Electronics and Communication Engg. course	ST	Seminar / Industrial Training
11	Computer Science and Engineering (Artificial Intelligence and Machine Learning)	OE	Open Elective Theory
12	Computer Science and Engineering (Data Science)	PV	Project and Viva-voce
YY	Code of the Program concerned (01 to 12)		

5th digit represents the semester and 6th and 7th digits represent the serial number of courses.

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To provide innovative, creative and technically competent Electronic and Communication Engineers for industry and society through excellence in Technical Education and Research.

MISSION

M1 To provide quality education in the field of Electronics and Communication Engineering through periodically updating curriculum, effective teaching-learning process, best laboratory facilities and collaborative ventures with the industries.

M2 To inculcate innovative skills, research aptitude, team work, ethical practices among students so as to meet the expectations of the industry as well as society.

M3 To adopt the best educational methods to improve teaching learning process continuously.

M4 To provide students with training on latest technology with supporting software.

M5 To facilitate effective interactions among faculty and students, and foster networking with alumni, industries and other institutions of repute.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

After graduation, the graduates of Electronics and Communication Engineering will be able to

PE01 Design and develop electronic circuits and systems, based on the existing as well as emerging technologies.

PE02 Pursue higher studies and research in Electronics and Communication Engineering

PE03 Work as a hardware and software professional in the industry of repute.

PE04 Become an entrepreneur by establishing startups to take projects for the societal and environmental cause.

PROGRAMME OUTCOMES (POs)

After the successful completion of the B.E. (Electronics and Communication Engineering) degree programme, the students will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the

consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B.E.(ECE)- PROGRAMME SPECIFIC OUTCOMES (PSOs)

Electronics and Communication Engineering graduates will be able to

PROGRAMME SPECIFIC OUTCOMES

PSO1 Apply the fundamental concepts of Electronics and Communication Engineering to design and analyze variety of components and systems for real time applications including Electronics, communication, wireless communication, microwave engineering, signal processing, embedded systems, VLSI.

PSO2 Solve Complex electronics and communication engineering problems using latest hardware and software tools along with analytical skills to arrive cost effective and appropriate solutions.

PSO3 Acquire social and environmental awareness along with ethical responsibility to have a successful career and address the real world applications using optimal resources as an entrepreneur.

B.E.(ECE)-POs CONSISTENCY WITH PEOs

PEOs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PEO1	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	
PEO2	✓	✓	✓	✓	✓							✓	✓	✓	
PEO3					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
PEO4						✓	✓	✓	✓	✓	✓	✓			✓

DETAILS OF COURSE CODE

Code (First Two digits)	Details
ET	Common course for the faculty
EI	Electronics and Instrumentation Engg. course

Code (3rd and 4th Digits)	Details
HS	HumanitiesTheory
HP	Humanities Practical
BS	Basic Science Theory
BP	Basic Science Practical
ES	Engineering Science Theory
SP	Engineering Science Practical
PC	Programme Core Theory
CP	Professional Core Practical
PE	Professional Elective Theory
EP	Professional Elective Practical
IT	Industrial Training
OE	Open Elective Theory
PV	Project and Viva-voce

5th digit represents the semester and 6th and 7th digits represent the serial number of courses.

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P/D**	**CA**	**FE**	**Total**	**Credits**
ETBS101	**BS-I**	Mathematics-I	3	1	-	25	75	100	4
ETBS102	**BS-II**	Physics	3	1	-	25	75	100	4
ETBS103	**BS-III**	Chemistry	3	1	-	25	75	100	4
ETES104	**ES-I**	Programming for Problem Solving	2	1	-	25	75	100	3
ETHS105	**HS-I**	Heritage of Tamils	1	-	-	25	75	100	1
ETHP106	**HSP-I**	Communication Skills and Language Laboratory	-	-	3	40	60	100	1.5
ETSP107	**ESP-I**	Engineering Workshop/Manufacturing Practices	-	-	3	40	60	100	1.5
ETSP108	**ESP-II**	Electrical Wiring and Earthing Practice Laboratory	-	-	3	40	60	100	1.5
								Total Credits	**20.5**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P/D**	**CA**	**FE**	**Total**	**Credits**
ETHS201	**HS-II**	English	3	1	-	25	75	100	4
ETBS202	**BS-IV**	Mathematics-II	3	1	-	25	75	100	4
ETES203	**ES-II**	Basic Engineering*	4	-	-	25	75	100	4
ETHS204	**HS-III**	Tamils and Technology	1	-	-	25	75	100	1
ETBP205	**BSP-I**	Physics Laboratory	-	-	3	40	60	100	1.5
ETBP206	**BSP-II**	Chemistry Laboratory	-	-	3	40	60	100	1.5
ETSP207	**ESP-III**	Computer Programming Laboratory	-	-	3	40	60	100	1.5
ETSP208	**ESP-IV**	Engineering Graphics	2	-	3	40	60	100	3
								Total Credits	**20.5**

- **Civil & Mechanical for Circuit Branches**
- **Mechanical & Electrical for Civil, C&S and Chemical**
- **Civil & Electrical for Mechanical & Manufacturing**

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS301	**BS-V**	Mathematics III	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
ETES303	**ES-IV**	Data Structures & Algorithms	3	-	3	25	75	100	4.5
ECES304	**PC-I**	Analog Electronics– I	3	-	-	25	75	100	3
ECPC305	**PC-II**	Network Theory	3	-	-	25	75	100	3
ECPC306	**PC-III**	Digital Electronics	3	-	-	25	75	100	3
ECSP307	**ESP-V**	Analog Electronics Lab– I	-	-	3	40	60	100	1.5
ECCP308	**PCP-I**	Network Analysis Lab	-	-	3	40	60	100	1.5
ECCP309	**PCP-II**	Digital Electronics Lab	-	-	3	40	60	100	1.5
						Total Credits			**25**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ECBS401	**BS-VI**	Probability Random Process and Numerical Methods	3	-	-	25	75	100	3
ECES402	**ES-V**	Electromagnetic Field Theory	2	-	-	25	75	100	2
ECPC403	**PC-IV**	Analog Electronics - II	3	-	-	25	75	100	3
ECPC404	**PC-V**	Microcontroller and its Interfacing techniques	3	-	-	25	75	100	3
ECPC405	**PC-VI**	Analog Communication Systems	3	-	-	25	75	100	3
ECPC406	**PC-VII**	Signals and Systems	3	-	-	25	75	100	3
ETHS407	**HS-IV**	Universal Human Values	2	1	-	25	75	100	3
ECCP408	**PCP-III**	Analog Electronics Lab - II	-	-	3	40	60	100	1.5
ECCP409	**PCP-IV**	Microcontrollers Lab	-	-	4	40	60	100	2
ECCP410	**PCP-V**	Analog Communication Systems Lab	-	-	3	40	60	100	1.5
			Total Credits						**25**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.									

SEMESTER V									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ECPC501	**PC-VIII**	Digital Communication Systems	3	-	-	25	75	100	3
ECPC502	**PC-IX**	Digital Signal Processing	3	-	-	25	75	100	3
ECPC503	**PC-X**	VLSI Design	3	-	-	25	75	100	3
ECPC504	**PC-XI**	Transmission Lines and Wave Guides	3	-	-	25	75	100	3
ECPE505	**PE-I**	Professional Elective I	3	-	-	25	75	100	3
ECPE506	**PE-II**	Professional Elective II	3	-	-	25	75	100	3
ECOE507	**OE-I**	Open Elective - I	3	-	-	25	75	100	3
ECCP508	**PCP-VI**	Digital Communication Lab	-	-	3	40	60	100	1.5
ECCP509	**PCP-VII**	Digital Signal Processing Lab	-	-	3	40	60	100	1.5
ECCP510	**PCP-VIII**	VLSI Design Lab	-	-	3	40	60	100	1.5
ETIT511	**IT-I**	Industrial Training / Rural Internship/Innovation /Entrepreneurship	Four weeks during the summer-[vacation at the end of IV Semester				100	100	4.0
						Total Credits			**29.5**

SEMESTER VI									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ECPC601	**PC-XII**	Embedded Systems	3	-	-	25	75	100	3
ECPC602	**PC-XIII**	Data Communication and Networks	3	-	-	25	75	100	3
ECPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
ECPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
ECPE605	**PE-V**	Professional Elective –V	3	-	-	25	75	100	3
YYOE606	**OE-II**	Open Elective - II	3	-	-	25	75	100	3
ECCP607	**PCP-IX**	Embedded Systems Lab	-	-	3	40	60	100	1.5
ECCP608	**PCP-X**	Data Communication and Networks Lab	-	-	3	40	60	100	1.5
			Total Credits						**21.0**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.

SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-III**	Engineering Ethics	2	-	-	25	75	100	2
ECPC702	**PC-XIV**	Microwave Engineering	3	-	-	25	75	100	3
ECPE703	**PE-VI**	Professional Elective-VI	3	-	-	25	75	100	3
ECPE704	**PE-VII**	Professional Elective-VII	3	-	-	25	75	100	3
YYOE705	**OE-III**	Open Elective - III	3	-	-	25	75	100	3
ECCP706	**PCP-XI**	Microwave Engineering Lab	-	-	3	40	60	100	1.5
ETIT707	**IT-II**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***VI Semester***				100	100	4.0
			Total Credits						**19.5**

SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ECOE801	**OE-IV**	Open Elective – IV	3	-	-	25	75	100	3
ECOE802	**OE-V**	Open Elective – V	3	-	-	25	75	100	3
ECPV803	**PV-I**	Project Work and Viva-Voce	-	**PR** 10	**S** 2	40	60	100	6
			Total Credits						**12**

L	No. of Lecture Hours	**TR**	No. of Hours for Discussion on Industrial Training
T	No. of Tutorial Hours	**S**	No. of Seminar Hours on Industrial Training/ Project
P	No. of Practical Hours	**PR**	No. of Hours for Discussion on Project work
CA	Continuous Assessment Marks	**FE**	Final Examination Marks
Credits	Credit Points allotted to that course	**Total**	Total Marks

S.NO	COURSE CODE	LIST OF PROFESSIONAL ELECTIVES
1.	ECPESCN	Information Theory and Coding
2.	ECPESCN	Antennas and Wave Propagation
3.	ECPESCN	Control Systems
4.	ECPESCN	Fiber Optic Communication
5.	ECPESCN	Cellular Mobile Communication
6.	ECPESCN	Electronic Measurements and Instrumentations
7.	ECPESCN	Digital Image Processing
8.	ECPESCN	DSP Processor Architecture and Programming
9.	ECPESCN	Mixed Signal Design
10.	ECPESCN	High Speed Electronics
11.	ECPESCN	Multimedia Compression Technique
12.	ECPESCN	Computer Architecture
13.	ECPESCN	Mobile Adhoc Networks
14.	ECPESCN	Wireless Sensor Networks
15.	ECPESCN	Digital Design Through Verilog
16.	ECPESCN	VLSI Fabrication Techniques
17.	ECPESCN	Nano Materials and Nano Electronics
18.	ECPESCN	Micro Electro Mechanical Systems
19.	ECPESCN	Fundamentals of Nano electronics
20.	ECPESCN	Fundamentals of IC Packaging, Assembly and Testing.
21.	ECPESCN	OFDM For Wireless Communication
22.	ECPESCN	Linear Integrated Circuits and Applications
23.	ECPESCN	Avionics Engineering
24.	ECPESCN	Satellite Communication
25.	ECPESCN	Wavelets
26.	ECPESCN	Radar and Navigational Aids
27.	ECPESCN	Information and Network Security
28.	ECPESCN	Mobile Communication Systems and Standards

S.NO	COURSE CODE	LIST OF OPEN ELECTIVES
1.	ECOESCN	Soft Computing Techniques
2.	ECOESCN	Programming in MATLAB and LabVIEW
3.	ECOESCN	Scientific Computing
4.	ECOESCN	RFID and Applications
5.	ECOESCN	Software Defined Radio
6.	ECOESCN	Cloud Computing
7.	ECOESCN	Micro fluidics and Bio MEMS
8.	ECOESCN	Quantitative Management Techniques
9.	ECOESCN	Introduction to Nano Electronics
10.	ECOESCN	Biomedical Electronics
11.	ECOESCN	Introduction to MEMS
12.	ECOESCN	NCC Studies (Army Wing) – I

S.NO	COURSE CODE	LIST OF HONOURS ELECTIVE
1.	ECHESCN	CMOS Analog IC Design
2.	ECHESCN	Speech and Audio Processing
3.	ECHESCN	Adaptive Signal Processing
4.	ECHESCN	Mobile Communication and Networks
5.	ECHESCN	Next Generation Mobile Communication
6.	ECHESCN	FPGA based System Design
7.	ECHESCN	Advanced Microprocessor and Microcontroller
8.	ECHESCN	Advanced VLSI System Design
9.	ECHESCN	Solar cell design and fabrication
10.	ECHESCN	Digital Integrated Circuit Design
11.	ECHESCN	Semiconductor Devices and Modelling

S.NO	COURSE CODE	LIST OF MINOR ENGINEERING ELECTIVE
1.	ECMISCN	Electronic Devices
2.	ECMISCN	Communication Engineering
3.	ECMISCN	Linear Integrated Circuits and Applications
4.	ECMISCN	Computer Networks and Architecture
5.	ECMISCN	Wireless Communication
6.	ECMISCN	Telecommunication Switching and Networks

S.NO	COURSE CODE	LIST OF ONE CREDIT COURSE
1.		PCB Designing Lab
2.		MAT Lab Programming
3.		Antenna Design Using HFSS
4.		MEMS and Sensor Design
5.		Real Time Operating Systems
6.		Communication Network Using NS/2
7.		Computer Hardware Trouble Shooting
8.		Signal & Image Processing Using MATLAB

S.NO	COURSE CODE	LIST OF VALUE ADDED COURSES
1.		Basic Electronic Engineering
2.		Basic Communication Systems
3.		Embedded System Design
4.		Solar cell design and fabrication

* One credit course shall be offered by a Department with the prior approval from the Dean, Faculty of Engineering and Technology.

SECOND YEAR

THIRD SEMESTER

ETBS301	MATHEMATICS III	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To learn partial and differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z transforms
- To gain Knowledge of the method to find the solution of difference Method.

UNIT I: Partial Differential Equations

Formation of Partial Differential Equations by Eliminating Arbitrary Constants and Arbitrary Functions-Solution of Standard Type of First Order Partial Differential Equations – Lagrange's Linear Equation - Linear Partial Differential Equations of Second Order with Constant Coefficients.

UNIT II: Fourier Series

Dirichle's Conditions - General Fourier Series - Odd and Even Functions - Half Range Sine Series - Half Range Cosine Series - Complex Form of Fourier Series - Parseval's Identity.

UNIT III: Boundary Value Problems

Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation (Without Derivation) - Fourier Series Solutions in Cartesian Co- Ordinates.

UNIT IV: Fourier Transform

Fourier Integral Theorem (Without Proof) - Fourier Transform Pair- Sine and Cosine Transforms - Properties - Transforms of Simple Functions – Convolution Theorem –Parseval's Identity.

UNIT V: Z- Transform and Difference Equations

Z – Transform – Elementary Properties- Inverse Z –Transform-Convolution Theorem-Solution of Difference Equation Using Z Transform.

TEXT BOOKS

1. Kandasamy P., Thilagavathy.K. and Gunavathy.K., "Engineering Mathematics" Series. S.Chand & Co.Ltd. New Delhi.2007.
2. Venkatraman M.K., "Engineering Mathematics" series, the National Pub Co., Chennai. 2003.

REFERENCES

1. Veerarajan T., "Engineering Mathematics" Series, Tata McGraw Hill Pub Co., Ltd. New Delhi, 2006
2. Singaravelu. A., "Engineering Mathematics" Series, Meenakshi Publication, Chennai, 2004

COURSE OUTCOMES

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

CO1. Solve first and second order linear partial differential equation.

CO2. Demonstrate a well-founded knowledge of Fourier series, their different possible forms.

CO3. Demonstrate a well-founded knowledge of Fourier series, their different possible forms.

CO4. Solve one dimensional wave and heat equations.

CO5. Solve difference equation by understanding the properties of Z transform.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2							2	2		
CO2	3												2		
CO3	3	2	2	2									2	1	
CO4	3											2	2		
CO5	3	2										2	2		

(3 –High Correlation 2- Moderate correlation 1- slight correlation)

ETES302	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To realize the importance of environment for engineering students.
- To understand the basis of ecosystems
- To make aware the student about global environmental problems and natural disasters.
- To give the ideas about advance technologies of Engineering that will useful to protect environment.

UNIT I: Introduction

Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness.

Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources - Equitable use of resources for sustain able life styles

UNIT II: Ecosystem

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem – Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem-Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT III: Diversity

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values-Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man- wildlife conflicts - Endangered and endemic species of India -Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT IV: Pollution

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution- Nuclear hazards-Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management: floods, earthquake, cyclone and landslides. Sustainable development-Urban problems related to energy-Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation – Consumerism and Waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of Environmental Legislation.

UNIT V: Social Welfare

Population growth, variation among nations - Population explosion –Family Welfare Programme - Environment and human health - Human Rights - Value

Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health –CaseStudies.

Field Work

Visit to a local area to document environmental assets river / forest / grassland / hill / mountain - Visit to a local polluted site - Urban / Rural / Industrial / Agricultural - Study of common plants, insects, birds -Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS

1. Agarwal, K.C. Environmental Biology, Nidi Publ. Ltd.Bikaner, 2001.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net(R).

REFERENCES

1. Brunner R.C., Hazardous Waste Incineration, McGraw Hill Inc.480p 1989
2. Clark R.B., Marine Pollution, Clanderson Press Oxford(TB) University Press; 4th edition (24 April 1997)
3. Gleick, H.P. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p 1993
4. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) OUP India (1 December 1986)
5. Heywood, V.H &Waston, R.T..Global Bio diversity Assessment. Cambridge Univ. Press1140p, 1995.
6. Sharma B.K., Environmental Chemistry. Geol Publ. House,Meerut 2001.
7. Survey of the Environment, The Hindu(M).
8. Wanger K.D., EnvironmentalManagement.W.B.Saunders Co. Philadelphia, USA499p. 1998.

COURSE OUTCOMES

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

CO1.Identify environmental problems arising due to engineering and technological activities and the science behind those problems.

CO2. Identify and relate about the renewable and non-renewable resources, their importance and ways of conservation to sustain human life on earth.

CO3. Comprehend the importance of ecosystem and biodiversity for maintaining ecological balance.

CO4. Describe the effects of pollution and contribute his learning's towards their prevention or mitigation.

CO5. Explain the social issues along with the trends of human population growth and the possible means to combat the challenges.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2				3	3					3			2
CO2						3	3					2			2
CO3						3	3					3			
CO4						3	3					2			2
CO5		2				3	3					2			3

ETES303	DATA STRUCTURES & ALGORITHMS	L	T	P	C
		3	0	3	4.5

COURSE OBJECTIVES

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of

fundamental data structures

UNIT I: Introduction

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space tradeoff.

Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT II: Stacks and Queues

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

UNIT III: Linked Lists

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

UNIT IV: Trees

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT V:Sorting and Hashing

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis

TEXT BOOKS

1. Horowitz, Sartaj Sahni, "Fundamentals of Data Structures",Illustrated Edition, Ellis Computer Science Press. Reprint edition (27 July 1988).
2. E.Balagurusamy, Data structures using C, Mc.GrawHill, 2013.

REFERENCES

1. Mark Allen Weiss, "Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition Addison-Wesley Publishing Company. Pearson; 1st edition (30 October 1995).
2. R.G.Dromey,"How to Solve it by Computer", 2nd Impression by Pearson Education 2009.

COURSE OUTCOMES

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

CO1. Describe an algorithm for computation complexity and justify the correctness.
CO2. Compare the various queue techniques.
CO3.Use appropriate data structures like linked lists, Stacks and queue to solve real world problem efficiently.
CO4. Manipulate data using nonlinear data structures like tree to design an algorithm for various applications.
CO5. Illustrate the various hashing techniques.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3					1					3		
CO2		2		2								2	3		
CO3	3	2										2	3		
CO4	3		3							1				2	
CO5			3	2	1									2	

ECES304	ANALOG ELECTRONICS - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about low and high frequency analysis of BJT and FET amplifiers
- To design large signal amplifiers, feedback amplifiers and oscillators
- To introduce Op-amp, data converters and Timer ICs.

UNIT I: Basics of Semiconductor and Diodes

Isolated atom-Energy levels-Energy band formation in solids-Classification of materials based on Forbidden energy gap-semiconductors-Intrinsic semiconductor-Thermal generation-Doping- Extrinsic semiconductors-Electron hole concentration-structure of p-n diode-formation of Depletion region-unbiased diode- Energy band diagram-Current-Voltage characteristics under Forward and reverse bias-static and dynamic resistance-Avalanche breakdown-Zener diode

UNIT II: Bipolar Junction Transistor

The Junction transistor- Transistor construction- Transistor current components-Transistor as an amplifier- Common Base, Common Emitter, and Common collector configurations-Input and output characteristics - α and β Parameters and the relation between them- equivalent circuit-BJT Hybrid Model-Analysis of single stage transistor amplifier : voltage gain, current gain, Input impedance and Output impedance-performance comparison of CB,CC,CE configured transistor amplifier

UNIT-III: Transistor Biasing and Stabilization

Need for biasing - the D.C and A.C Load lines- Operating point or Q-point-criteria for fixing Q-point- parameters responsible for bias stability –Collector current equation for CE transistor-Thermal effects on IC - Stabilization factors, (S ,S' and S") - Fixed bias- Collector to base bias -Self bias techniques for stabilization: voltage divider bias-Bias Compensation using diode and transistor , (Compensation against variation in VBE, ICO,) Thermal run away, Condition for Thermal stability.

UNIT IV: MOSFET

Ideal two terminal MOS structure and Different modes of operation: MOS structure under thermal equilibrium- MOS structure biased in accumulation , Depletion , Inversion and strong Inversion modes – Threshold voltage-MOSFET structure-qualitative analysis of MOSFET: operation and static characteristics-current equation-regions of operation-Common source amplifier-Analysis –voltage gain, input impedance and output impedance

UNIT V: Power Supplies and Opto Electronic Devices

Half wave and Full wave Rectifiers - Calculation of Ripple factor, Regulation, Rectification efficiency - Filters - L,C, L-section and Pi-section filters- Voltage Regulators – Zener regulator-Series and Shunt regulator - Current limiting and protection circuits- Opto Electronic Devices - Photo diodes - Photo Transistors – photovoltaic effect-solar cells -Group V semiconductors- LED -LASER diode.

TEXT BOOKS:

1. Adel S. Sedra and Kenneth C.Smith, "Microelectronic Circuits", Oxford University Press, 7th Edition, Oxford University Press ,2017
2. M. K. Achuthan , K. N. Bhat, "Fundamentals of Semiconductor Devices" ,Tata McGraw Hill, New Delhi, 2007.

REFERENCES:

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
3. Millman J. , Halkias C. C. "Electronic Devices and Circuits ", Tata McGraw Hill, New Delhi, 2011.

4. Floyd T. L "Electronic Devices and Circuits", Pearson Education., New Delhi, 2011
5. Boylestad, R. L. and Nashelsky, L. "Electronic Devices and Circuit Theory ", Pearson Education, Eleventh Edition,2015
6. David A.Bell "Electronic Devices and Circuits", Prentice Hall of India., 2008

COURSE OUTCOMES:

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

CO1: Apply the principle of solid state physics to study the parameters of semiconductor devices and its working

CO2: Investigate the working of transistors in different configuration and analyze the performance of BJT amplifiers in all three configurations

CO3: Explain the need for biasing and Choose appropriate biasing circuits for transistor amplifiers.

CO4: Describe the working of MOSFET and analyze the MOSFET amplifiers.

CO5: Design and analyze various circuits used in constructing Regulated power Supply.

CO6: Describe the working of Opto electronic devices.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	2	2												
CO3	3	2	2												
CO4	3	2													
CO5	3	2	2												
CO6	3														

ECPC305	NETWORK THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the basic concepts and behavior of DC and AC Circuits.
- To understand various methods of Circuit / Network analysis using network theorems.
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.
- To understand the concept of two port networks and resonance circuits.

UNIT I: DC analysis and Network Theorems

DC Circuits–Current and Voltage Sources– Ohms Law and Kirchhoffs Law– Mesh and Nodal Analysis - Resistive Circuits – Series and Parallel Reduction method – Voltage and Current Division – Source Transformation technique - Star delta transformation- Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation for DC Circuits and Tellegen's theorem as applied to AC circuits.

UNIT II: AC Circuits

AC Circuits –Inductors, Capacitors – Voltage - Current Relationship - Steady State Analysis of RL, RC, RLC Circuits with Sinusoidal Excitation – Phasor Diagram - Power Factor – Real, Apparent and Reactive Power.

UNIT III: Steady state Analysis

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values – Fourier transform and continuous spectra. (Steady state sinusoidal analysis using Phasor).

UNIT IV: Transient Analysis

Laplace transforms and properties: Partial fractions – singularity functions – waveform synthesis – analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions – Transient behaviour – concept of complex frequency.

UNIT V: Two Port Network and Resonant Circuits

Two port networks-Relationship of two port variables-impedance Parameters-Admittance Parameters-Transmission Parameters-Hybrid Parameters – Two port network and interconnections –Behaviours of series and parallel resonant circuits.

TEXT BOOKS

1. Hayt Jack kemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw-Hill Education, 9th Edition, 2018.
2. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
3. John D Ryder ; "Networks, Lines and Fields", Second Edition, Pearson Publication 2015.

REFERENCES

1. Sudhakar,A., Shyammohan,S.P.; Circuits and Network; Tata McGraw-Hill New Delhi,1994.
2. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education (4 August 2013).

COURSE OUTCOMES

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

CO1: Apply the basic concepts of circuit analysis and apply suitable networks theo
CO2: Analyse the concepts of AC circuits.
CO3: Analyse circuit in the steady state response.
CO4: Use Laplace Transform for transient analysis.
CO5: Analyse the two port circuit behavior.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	3		
CO2	3	2		1								3	2		
CO3	3	1										3	2		
CO4	3	2		1								3	3		
CO5	3											3	3		

ECPC306	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To present the Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.
- To introduce different logic families, semiconductor memories and related technology.

UNIT I – NUMBER SYSTEMS AND BOOLEAN ALGEBRA

Number Systems – Decimal, Binary, Octal, Hexadecimal and their inter conversions, Binary Arithmetic Operations - Boolean algebra- Postulates and theorems - Boolean

functions - Canonical and Standard forms - Minimization techniques: Karnaugh's map minimization – Don't care conditions - Tabulation method - Logic gates – Universal gates - NAND and NOR implementation.

UNIT II - COMBINATIONAL CIRCUIT DESIGN

Design procedure-Half adder - Full adder - Half subtractor - Full subtractor - Parallel binary adder - Carry look ahead Adder - Parallel adder/subtractor- BCD Adder - Binary multiplier-Code convertors - Magnitude comparator - Parity generator and checker – Decoders - Encoders-Priority encoder - Multiplexer and De-multiplexer-Implementation of combinational logic using Multiplexer.

UNIT III - SYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV - ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V - DIGITAL LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES

Characteristics of digital IC-logic families: RTL and DTL-TTL-ECL-MOS-CMOS-Comparison of various logic families-Semiconductor memories-ROM and RAM organization- Basic Memory cell - Memory decoding-Memory expansion-Static and Dynamic RAM.

TEXT BOOKS

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India, 2008.
2. William H. Gothmann, "Digital Electronics", 2nd Edition, Prentice Hall, 2001.

REFERENCES

1. R. AnandaNatarajan, "Digital Design", PHI, 2011.
2. R. P. Jain, "Modern Digital Electronics", 4thEdition, Tata McGraw- Hill Education, 2010.

COURSE OUTCOMES

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

CO1: Explain number system and Boolean postulates and Realize Boolean functions with minimum number of logics.

CO2: Construct various combinational circuits using gates and implement combinational logic using PLDs.

CO3: Analyse and design synchronous and asynchronous sequential circuits.

CO4: Describe the various logic families in digital ICs.

CO5: Describe semiconductor memory and related technology.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									2	3		
CO2	3	3	3	1								2	3		
CO3	3	3	3	1								2	3	2	
CO4	3	3	3									2	3	2	
CO5	3		3									3	3		

ECSP307	ANALOG ELECTRONICS LAB-I	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To verify the characteristics and applications of various semiconductor devices.

LIST OF EXPERIMENTS

1. Study of resistor, capacitance value identification and soldering practice.
2. Characteristics of P-N junction diode and Zener diode.
3. Zener diode voltage regulator design and performance evaluation.
4. Half wave and full wave rectifiers without filter
5. Half wave and full wave rectifiers with filter
6. Study of input and output characteristics of Bipolar Junction Transistor (BJT).
7. DC load line of fixed bias and self bias BJT circuits and Q point fixing
8. Bipolar junction transistor as a switch.
9. Characteristics of MOSFET
10. Characteristics of LDR, Photo Diode and Photo Transistor.
11. Testing and characterization of solar cell

COURSE OUTCOMES

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

CO1. Acquired the knowledge of different meters and instruments for measurement of electronic quantities

CO2. Demonstrate the characteristics of Diodes, BJT and MOSFET.

CO3. Apply principles and characteristics of diodes in designing simple application circuits.

CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2											2	3	2	
CO2	3	2											3		
CO3	3	2	3	2									3		
CO4								2	2	2		2	3		

ECCP308	NETWORK ANALYSIS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To verify basic laws on circuits and verify various network theorems.
- To understand Resonance concepts in AC circuits.
- To compute parameters for single and cascaded two-port Network.

LIST OF EXPERIMENTS

1. Validation of Kirchoff's Current and Voltage Law
2. Validation of Superposition Theorem
3. Validation of Thevinin's and Norton's Theorem
4. Validation of Maximum Power Transfer Theorem
5. Validation of Reciprocity Theorem
6. Study of AC circuits.

7. Study of Resonance Circuits
8. Computation of Network Parameters for Symmetric Network
9. Computation of Network Parameters for Asymmetric Network
10. Network Parameters for Cascaded Network.
11. Design of Attenuators.
12. Design of Equalizers.

COURSE OUTCOMES

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

CO1. Use passive components, DC power supply, Multimeter, CRO, Signal generator.

CO2. Verify the basic laws and theorems on Electric circuits.

CO3. Analyze resonance concepts in AC circuits and able to design the same for given specification.

CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3									3	1	3	
CO2	3		3									3		3	
CO3	3		3									3	3	3	
CO4	3		3						3	2	2				

ECCP309	DIGITAL ELECTRONICS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To study the functionality of logic gates and flipflops
- To Design and verify basic Combinational circuits
- To Design and demonstrate the simple sequential circuits

LIST OF EXPERIMENTS

1. Study of Logic Gates.
2. Design of unit Adders and Subtractors.
3. Design and Implementation of Binary Four-bit parallel adder.
4. Design of Code Convertors.
5. Design of Multiplexer and Demultiplexer.
6. Design of encoders and Decoders.
7. Study of FlipFlops
8. Construction of Shift Register
9. Design of Modulo Counters.
10. Design of Non Sequential Counter
11. Frequency Divider using IC7490
12. Design of Sequence Generator and Detector
13. Study of Fault Diagnosis in Combinational Circuits.

COURSE OUTCOMES

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

CO1. Analyze and test various logic gates and flip flops.
CO2. Design simple combinational logic circuits using gates and verify their functionalities.
CO3. Design sequential circuits such as counters, frequency dividers and shift registers.
CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	3									2	3	2	
CO3	2	2	3		3							2	3	2	
CO4								2	2	3					

ECBS401	PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to probability, random process, and statistical methods
- To contribute them to the process of making scientific judgments in the face of uncertainly and variation.
- To develop the skill of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of ordinary and partial differential equation.

UNIT–I: Probability and Random Variables

Definition – Types of Random Variables - Probability Distribution Function - Probability Density Function – Expectation and Moments – Moment Generating Functions – Joint Probability Distribution – Marginal Probability Distribution Function – Joint Probability Density Function – Marginal Probability Density Function - Conditional Probability Density Function.

UNIT–II: Random Processes

Classification of Random Processes – Methods of Description of a Random Process – Special Classes of Random Processes – Average Values of Random Process Stationary – Auto Correlation Function and its Properties – Cross Correlation Function and its Properties.

UNIT–III: Test of Significance

Hypothesis, Testing – Large Sampling Tests – Small Sampling Test Based on t, F and Chi Square Distributions – Interval Estimates of Mean, Standard Derivation and Proportion.

UNIT–IV: Interpolation, Numerical Differentiation and Integration

Gregory Newton Forward and Back Word Interpolation Formula; Sterling's Central Difference Formula; Lagrange's Interpolation Formula for Unequal Interval, Inverse Interpolation Numerical Differentiation; Using Newton Forward and Back Word Interpolation Formula, Numerical Integration; Trapezoidal Rule; Simpson's One Third and Three Eight Rule.

UNIT–V: Solution of Algebraic and Transcendental and Ordinary Differential Equations

Solution of Algebraic and Transcendental Equations; Bolzano's Bisection Method; Regulation - False Method; Newton – Raphson Method; Solution of Simultaneous Algebraic Equation; Gauss Elimination Method; Crout's Method;

Gauss – Seidel Iteration Method; Solution of Ordinary Differential Equations; Taylor

Series Method; Runge – Kutta Fourth order Method Miline's- Predictor Corrector Method.

TEXTBOOKS

1. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Probability and Random Process, S.Chand&Co.Ltd 2006.
2. Veerarajan. T., Probability theory and Random Process, Tata McGraw – Hill Co., Ltd. New Delhi 2005.
3. Venkataraman M.K.,Numerical method in science and Engineering, National publishing Co., Chennai -2003.

REFERENCE BOOKS

1. Lipschutz..S and Schiller. J, Schaum's outlines – Introduction to Probability and Statistics, McGraw Hill, New Delhi,1998.
2. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Numerical Methods, S.Chand&Co. Ltd., New Delhi, 2004.

COURSE OUTCOMES

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

CO1. Outline basic probability concepts and various functions associated with random variables.
CO2. Build a well – founded knowledge on random process
CO3. Test of significance for large and small samples
CO4. Apply interpolation techniques, numerical integration and differentiation in solving real time problems.
CO5. Solve algebraic and transcendental equations using different methods.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										3	3	2	
CO2	3	2										2	3		
CO3	3	2		2								1	3		
CO4	3	2	2	2								2	3	3	
CO5	3	2		2								2	3	3	

ECES402	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To introduce the different types of Coordinate systems.
- To encapsulate the students with Electric and Magnetic field terminologies.
- To make the students comprehend the various applications of Gauss law.
- To elucidate the different method of determining magnetic field occurring in a solenoid, toroid etc.
- To familiarize the various propagation techniques of waves and their polarization phenomenon.

UNIT–I : Electrostatic Fields

Electric Potential and Boundary Value Problems: Absolute Potential - Potential Difference - Calculation of Potential for Different Configurations - Potential Gradient - Electric Dipole - Energy Density in the Electrostatic Field. Laplace's Equation -Poisson's Equation - Solution of Laplace'sEquation in one Variable - Solution of Laplace's Equation in Two Variable Using Variable Separable Method - Solution of Poisson's Equation.

UNIT–II : Electric Fields

Vector Analysis: Nature of Scalars and Vectors -Vector Algebra, Vector Differential Operator - Gradient, Divergence and Curl Operators - Line, Surface and Volume Integrals - Cartesian,Cylindrical and Spherical Co-Ordinate Systems. Static Electric Fields: Coulomb's Law-Electric Field Intensity- Calculation of Electric Field Intensity due to Different Charge Configurations - Point Charge, Line Charge, Surface Charge and Volume Charge - Electric Flux Density - Gauss's Law - Application of Gauss's Law - Gauss's Divergence Theorem.

UNIT–III : Conductors and Dielectrics

Conductors and Dielectrics: Electrostatic Fields in Conductors and Dielectrics - Current and Current Density – Continuity Equation - Conductor Properties and Boundary Conditions - Method of Images - Nature of Dielectric Materials - Boundary Conditions for Perfect Dielectric Materials - Capacitance -Energy Storage in a Capacitor-Determination of Capacitance for Different Configurations – Parallel Plate Capacitor, Co-Axial Cable, Spherical Capacitor and Two-Wire Transmission Line.

UNIT–IV : Magnetic Fields

Steady State Magnetic Field: Biot-Savart's Law - Ampere's Circuital Law - Curl and Stoke's Theorem - Determination of Magnetic Field Due to an Infinitely Long Straight Filament Carrying Current, Finite Length Current Element and Current Loop - Determination of Field Using Ampere's Circuital Law for Symmetrical Current Distributions - Infinitely Long Filament, Solenoid of Finite Length, To roid and Coaxial Cable- The Scalar and Vector Magnetic Potentials - Magnetic Boundary Conditions - Potential Energy in the Magnetic Field.

UNIT–V : Electromagnetic Waves

Modified Ampere's Circuital Law – Maxwells Equations in Point and Integral Forms – Poyntings Theorem – Energy in Electromagnetic Field – Slepian Vector – Wave Equation – Characteristics Impedance – Wave Propagation – Depth of Penetration – Polarization – Reflection and Refraction – Plane Waves – Surface Waves.

TEXT BOOKS

1) William H. Hayt, "Engineering Electromagnetics",5th Edition, McGraw Hill Kogakusha Ltd, 1995.
2) David K. Cheng, "Field and wave Electromagnetics", 2nd Edition, Pearson Education, Asia 2002.

REFERENCE BOOKS

1. Gupta P.V., "Introduction to Electromagnetic Fields",Dhanpatrai and Sons, 1986.
2. Gangadhar K.A, "Field Theory", Khanna Publishers, 1987.
3. Skitek.G.G.,Marshall.S.V, "Electromagnetic Concepts and Applications", 3rd Edition, Prentice Hall, 1990.
4. Sathaiah. D and Anitha. M, "Electromagnetic Fields", Scitech Publications (India), Pvt. Ltd. Chennai, 2007.

COURSE OUTCOMES

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

CO1: Describe the properties of static charges and associated laws.

CO2: Discuss the basic concepts of Electric fields and use different types of coordinate systems for solving problems in Electric fields

CO3: Describe the behavior of electric fields in conductors and dielectric media.

CO4: Describe the behavior of Magnetic fields, their associated laws and boundary condition

CO5: Analyze the propagation of waves in different media.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3	2	2									2	2		
CO3	3	3	2	2								2	2		
CO4	3	2	2	2								2	3		
CO5	2	2	2	2								2	3		

ECPC403	ANALOG ELECTRONICS - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain knowledge about low and high frequency analysis of BJT and FET amplifiers
- To design large signal amplifiers, feedback amplifiers and oscillators
- To introduce Op-amp, data converters and Timer ICs.

UNIT I : Single Stage BJT and MOSFET Amplifiers

Transistor small signal hybrid π model equivalent circuit-Small signal analysis of single stage BJT Common Emitter, and Common Collector amplifiers- Small signal equivalent circuit models for MOSFET-Small signal analysis of single stage MOSFET Common Source, Common Drain -Common Gate amplifiers-BJT Internal capacitances and High frequency model-MOSFET Internal capacitances and High frequency model-High frequency analysis of BJT Common Emitter, MOSFET Common Source amplifier-Short circuit current gain, cut off frequency – fα, fβ, Unity Gain Bandwidth.

UNIT II : Single-Stage Integrated-Circuit Amplifiers

IC design philosophy-IC biasing using Current mirrors, Current sources, Current steering circuits – Common Source and Common Gate amplifiers with Active loads, High frequency response-Cascode amplifier – Current mirror circuits with Improved Performance: Cascode current mirror-wilson current mirror.

UNIT III : Feedback types and Oscillators

General Feedback Structure- Properties of Negative Feedback-Feedback Topologies: Voltage Amplifiers- Current Amplifiers- Transconductance Amplifiers- Transresistance Amplifiers-Positive feedback-Oscillators-General considerations- Ring oscillators, LC oscillators, Crossed-coupled oscillators, Colpitts oscillator, Voltage-controlled oscillators.

UNIT IV : Differential amplifiers

Single ended and differential operation - Basic differential pair – Qualitative analysis - Quantitative analysis - Common Mode response - Differential pair with MOS loads - Gilbert cell - Frequency response of Differential amplifiers - Common source stage.

UNIT V : MOSFET Operational Amplifiers

Performance parameters-One stage Op-amp-Basic topologies –Design procedure-Folded cascade Op amp and properties- Two-Stage CMOS Op Amp and Folded-Cascode CMOS Op Amp: Circuit-Input Common-Mode Range and Output Swing-Voltage Gain-Frequency Response-Slew Rate

TEXT BOOKS:

1. Adel S. Sedra and Kenneth C.Smith, “Microelectronic Circuits”, Oxford University Press, 7th Edition, Oxford University Press ,2017.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Edition, 2007.

REFERENCES:

1. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
2. Paul Gray, Hurst, Lewis, Meyer, "Analysis and Design of Analog Integrated Circuits", John Willey & Sons, 4th Edition, 2005
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015.
4. Millman .J. and Halkias C, "Integrated Electronics", McGraw Hill, 2001.

COURSE OUTCOMES:

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

CO1: Design and analyze discrete amplifier circuits using BJT and MOSFET.
CO2: Design and analyze biasing circuits and amplifiers used in Integrated circuits.
CO3: Design and analyze feedback amplifiers and oscillators.
CO4: Analyze MOS Differential amplifiers qualitatively and quantitatively.
CO5: Design and analyze one and two stage MOS Op-amp

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2												
CO2	3	3	2									3			
CO3	3	3	2									2			
CO4	3	3	2									2			
CO5	3	3	3									3			

ECPC404	MICROCONTROLLER AND ITS INTERFACING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn fundamentals of microprocessor and microcontroller architecture
- Acquire an in-depth knowledge on 8051 architectures, instruction set and programming concepts.
- Acquire an in-depth knowledge about On-Chip peripheral interfacing
- Provide deep insight Off-Chip peripheral interfacing.
- Learn about advanced microcontrollers.

UNIT I INTRODUCTION

Introduction to Microprocessor and Microcontroller – Evolution – Architecture of Microprocessor - Comparison of Microprocessor and Microcontroller – Overview of 8/16/32/64-bit Microprocessors and Microcontrollers – Applications of Microprocessors and Microcontrollers.

UNIT II MICROCONTROLLER ARCHITECTURE AND INSTRUCTION SET

Functional block diagram and pin diagram of 8051- Power supply, clock and reset circuit- Program Counter and ROM space in 8051-Program and Data Memory organization-addressing modes. Instruction Set: data transfer, arithmetic and logical, program branching instructions and Boolean variable manipulation.

UNIT III ON-CHIP PERIPHERALS AND PROGRAMMING TECHNIQUES

Parallel Port Structure and bit-manipulation programming, timer/counter-Operating Modes-Programming 8051 Timers - Counter Programming-Serial Communication: Basics of Serial Communication-UART-Operating Modes-RS232 Standards-8051 connection to RS232-Serial Port Programming. Interrupt: 8051 Interrupt- External and Internal Interrupts- Programming timer Interrupts, external hardware interrupts and serial communication interrupts -Interrupt Priority and Programming. Power Saving Modes.

UNIT IV OFF-CHIP PERIPHERAL INTERFACING AND PROGRAMMING

LED, 7-segment and LCD Interfacing, Push-to-On switch and Matrix Keyboard Interfacing, ADC and Sensor Interfacing, Relay Interfacing, DC Motor and Stepper Motor Interfacing Techniques.

UNIT V INTRODUCTION TO ADVANCED MICROCONTROLLERS

PIC 16F877 microcontroller – Architecture On chip ADC, Capture/Compare/PWM Module - I^2C – SPI – Watchdog timer – Architecture of ARM**:** RISC vs CISC - ARM7 Processor fundamentals- Registers – Pipelining - ARM Instruction set and Thumb Instruction set-– Exception and Interrupt handling –Memory System (Qualitative treatment only).

TEXT BOOKS:

1. Muhammed Ali Mazidi, Janice GillispieMazidi, Rolin D Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education India, New Delhi, 2011.
2. Muhammad Ali Mazidi, RolinD.Mckinlay, Danny Causery,"PIC Microcontroller and Embedded systems using assembly and C PIC18", Pearson international edition, 2008.
3. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer‟s Guide", 1st Edition, Elsevier, USA, 2005.

REFERENCES:

1.Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.

2.Douglas V.Hall, "Microprocessor and Interfacing, Programming and Hardware", Revised 2nd Edition, Tata McGraw Hill, Indian Edition 2007.

3.John B Peatman, "Designing with PIC Micro Controller", 1stEdition, Pearson, 2003.

4.K. J. Ayala, "8051 Microcontroller", Delmar CengageLearning, 2004.

5.R. Kamal, "Embedded System", McGraw HillEducation,2009.

COURSE OUTCOMES

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

CO1: Understand the fundamentals of microprocessor and microcontroller architecture

CO2: Discuss the 8051-instruction set with programming concepts

CO3: Explain the various on-chip peripheral interfacing techniques.

CO4: Develop program for interfacing off-chip peripherals.

CO5: Understand advanced microcontroller architecture.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										3		
CO2	3	3	3									3	3		
CO3		3	3	3	3				1	3	2	3	3		
CO4		3	3	3	3					3	2		3	2	
CO5	3	3	3	3	3	1			1	3		3	3	2	

ECPC405	ANALOG COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give a brief knowledge in random process and sources of noise in Communication Systems.
- To expose the concepts of basic communication in analog domain and Amplitude modulation/demodulation
- To familiarize the Angle modulation/demodulation
- To know the working knowledge of the fundamental pulse modulation

UNIT I : Introduction to Random Process and Noise Theory

Random Process Definition - Stationary Process – Mean – Autocorrelation - PSD of Stationary Process – Gaussian Process. Noise–Shot Noise, Thermal Noise, White Noise, Narrow Band Noise–Time domain representation of Narrow Band Noise - Signal to Noise Ratio, Probability of Error – Noise Band Width - Effective Noise Temperature- Noise Figure.

UNIT II : Amplitude Modulation

Introduction-communication system model-modulation-Need for modulation-Amplitude modulation- AM with carrier-DSB-SC-SSB-SC – VSB- Time and frequency domain representation-Bandwidth requirements and power relations- Generation and Detection of AM with carrier signal-Square Law Modulator, Square Law Detector, Envelope Detector-Generation and Detection of DSB-SC signal-Balanced Modulator, Ring Modulator, Coherent Detection-Costas Loop- Generation and Detection of SSB-SC signal-Phase discrimination method, Coherent detection-Comparison of AM systems-Frequency Division multiplexing.

UNIT III : Angle Modulation

Basic Definitions, Types of Angle Modulation, Relationship between PM and FM Frequency deviation–Types of FM–Single tone Narrow Band, Wide-Band FM, Remarks about PM – Multi tone Wide-Band FM – Transmission Bandwidth of FM Waves– FM Modulators–Parameter Variation Method (Direct Method), Armstrong method (Indirect Method) – FM Demodulators – Slope Detector, Balanced Slope Detector, Foster Seely Discriminator – Ratio Detector.

UNIT IV : Transmitters and Receivers

AM transmitter – low level transmitter, high level transmitter – AM Receivers – TRF receivers, Superheterodyne receivers– Noise in AMsystems. FM transmitter - Direct and Indirect Method of Frequency Modulation – FM Superheterodyne Receiver–Effect of Noise in Angle Modulated Systems – Threshold Effect in FM system - Threshold Improvement - Pre-emphasis and De- emphasis Circuits – Frequency Modulation with Feedback(FMFB).

UNIT V : Analog Pulse Modulation

Sampling of Band Limited Low Pass Signals-Pulse Amplitude Modulation- Generation and Detection-Time Division Multiplexing-Pulse Time Modulation- Generation and Detection of PTM Signals-cross talk in PTM-Bandwidth of PTM signals-performance of pulse modulation systems.

TEXT BOOKS

1. R.P.Singh and S.D. Sapre," Communication Systems Analog and Digital", 2nd Edition, Tata McGraw- Hill Publishing, 2007.
2. Kennedy G., Bernard Davis "Electronic Communication Systems", McGraw Hill, 5th Edn reprint, 2011.

REFERENCES

1. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”,Pearson Education 2006.
2. Wayne Tomasi, “Electronic Communication Systems-Fundamentals Through Advanced”, 5th Edition, Pearson Education, 2004.
3. SimonHaykins,“Communication Systems”, 4thEdition, John Wiley,2007.
4. Taub and Schilling, “Principles of Communication Systems”, 4thEdition McGraw Hill, 2013.
5. H P Hsu, Schaum Outline Series - “Analog and Digital Communications” 2ndEdn, TMH, 2006.
6. B. Carlson, “Introduction to Communication Systems”, 5thEdition, McGraw Hill, 2009
7. George Kennedy , Bernard David ,SRM Prasana “Electronic Communication Systems” McGraw Hill Education; Sixth edition (29 November 2017).

COURSE OUTCOMES

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

CO1. Discuss principles of different analog modulation Techniques.
CO2. Design AM and FM modulation and Demodulation circuits.
CO3. Explain the noise performance of AM and FM systems.
CO4. Describe various pulse modulation techniques.
CO5. Design a prototype model of Transmitter and Receiver Circuits.

Mapping of Course Outcomes with Programme Outcomes(Pos) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	2		
CO2	3	1										3		3	
CO3	3				3							3	2		
CO4	3				3							3		3	
CO5	3				3							3		3	

ECPC406	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The aim of the course is for

- Understanding the fundamental characteristics of signals and systems.
- Understanding signals and systems in terms of both the time and transform domains,
- Developmentofthemathematicalskillstosolveproblemsinvolvingconvolution, Filtering, modulation and sampling.

UNIT–I : Introduction to Signals and Systems

Signals – Continuous Time and Discrete Time Signals – Elementary Signals – Basic Operations on Signals - Classification of signals – Periodic and Aperiodic Signals - Energy and Power – Even and Odd signals – CT Complex Exponential And Sinusoidal Signals – DT Complex Exponential and Sinusoidal Signals-Representation of continuous time and Discrete time signals in terms of Impulses – Continuous Time and Discrete Time Systems – Properties of Systems – Sampling - Sampling Theorem for Lowpass and Bandpass Signals.

UNIT–II: Fourier Analysis

Fourier Series Representation of Continuous Time Periodic Signals – Properties of Continuous Time Fourier Series – Convergence of Fourier Series – Representation of Aperiodic Signals – Continuous Time Fourier Transform – Properties of Continuous Time Fourier Transform.

UNIT–III :Continuous Time LTI Systems

Convolution Integral Representation of LTI-CT Systems – Properties of LTI-CT Systems – Causal LTI systems described by Differential Equations – Solution of Differential Equations –Analysis and Characterization of LTI-CT system using Laplace transform.

UNIT–IV :DTFT and Z Transform

Discrete time Fourier transform (DTFT) – Properties of DTFT – Time and frequency shifting – Conjugation – Parseval's relation – Z transform and its properties – Region of Convergence – Pole-Zero Representation – Inverse Z-transform – Relationship between Z-transform and Fourier Transform.

UNIT–V :Discrete Time LTI Systems

Convolution Sum Representation of LTI-DT systems – Properties of LTI-DT systems – Causal LTI Systems described by Difference Equations – Solution of Difference Equation – Analysis and Characterization of LTI-DT system using Z-transform.

TEXT BOOKS

1. Alan V. Oppenheim, Alan S.Willsky and S. Hamid Nawab, "Signals and Systems",2nd Edition, Prentice Hall of India, 1997.
2. P. Ramesh Babu and R.Anandanatarajan, "Signals and Systems", 4th Edition, Scitech, 2011.

REFERENCE BOOKS

1. Simon Haykin, Barry Van Veen, “Signals and Systems” John Wiley and Sons (Asia) Pvt. Ltd., 1999.
2. Rodger E *Ziemer*, William H *Tranter* and D Ronald Fannin, “Signals and Systems: Continuous and Discrete”, 3rd Edition, Maxwell Macmillan, 1993.
3. Michel J *Robert*, “Signals and Systems Analysis Using Transformation. Methods and MATLAB”, 1stTata McGrawHill, 2003.
4. R.A. Gabel and R.A. Richard, "Signals and Linear Systems", John Wiley and Sons, 1987.
5. Gordan E Carlson, “Signals and Linear Systems Analysis”, Allied Publishers, NewDelhi, 1993.

COURSE OUTCOMES

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

CO1: Represent and classify Continuous Time (CT) and Discrete Time (DT) signals and systems.

CO2: Perform frequency domain analysis of periodic and a periodic signals using Fourier series and Transforms

CO3: Model linear time invariant CT system and Analyze and characterize the same using Laplace Transform.

CO4: State the properties, characteristics of DTFT and Z transform

CO5: Model linear time invariant DT system and Analyze and characterize the same using Z Transform.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	**Pos**												**PSOs**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**										**1**	**2**		
CO2	**3**	**3**		**2**								**2**	**2**	**2**	
CO3	**3**	**3**	**2**									**2**	**2**	**2**	
CO4	**2**	**2**										**2**	**2**		
CO5	**3**	**3**	**2**	**2**								**2**	**2**	**2**	

ETHS407	UNIVERSAL HUMAN VALUES	L	T	P	C
		2	1	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature /existence.
- Understanding (or developing clarity)of the harmony in the human being, family, society and nature /existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1.1 Purpose and motivation for the course, recapitulation from Universal Human Values-I

1.2 Self-Exploration–what is it? - Its content and process; Natural Acceptance and Experiential Validation- as the process for self- exploration.

1.3 Continuous Happiness and Prosperity-A look at basic Human Aspirations.

1.4 Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.

1.5 Understanding happiness and Prosperity correctly-A critical appraisal of the current scenario.

1.6 Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence)rather than as arbitrariness in choice based onliking-disliking

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself!

2.1 Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.

2.2 Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.

2.3 Understanding the Body as an instrument of 'I' (I being the doer, seerand enjoyer).

2.4 Understanding the characteristics and activities of 'I' and harmony in 'I'.

2.5 Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

2.6 Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease

UNIT-III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

3.1 Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.

3.2 Understanding the meaning of Trust; Difference between intention and competence.

3.3 Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

3.4 Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

3.5 Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life example, teacher- student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT-IV Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

4.1 Understanding the harmony in the Nature.

4.2 Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature.

4.3 Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4.4 Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V Implications of the above Holistic Understanding of Harmony on Professional Ethics

5.1 Natural acceptance of human values.

5.2 Definitiveness of Ethical Human Conduct.

5.3 Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

5.4 Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability toidentify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5.5 Case studies of typical holistic technologies, management models and production systems.

5.6 Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching

institutions and organizations.

5.7 Sum up. include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

TEXT / REFERENCES:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, NewDelhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, NewDelhi, 2004.
4. Annie Leonard "The Story of Stuff", Free Press; Reprint edition (22 February 2011).
5. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", Fingerprint! Publishing; First edition (1 January 2009)
6. E.F Schumacher, "Small is Beautiful", RHUK; Latest edition (16 September 1993).
7. Cecile Andrews, "Slow is Beautiful", New Society Publishers (1 October 2006).
8. JC Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan (1 January 2017).
9. Pandit Sunderlal, "Bharat Mein Angreji Raj", Prabhat Prakashan; First edition (1 January 2018).
10. Dharampal, "Rediscovering India", Stosius Inc/Advent Books Division (1 December 1983).
11. Mohandas K.Gandhi, "Hind Swaraj or Indian Home Rule", CreateSpace Independent Publis (1 January 2009).
12. Maulana Abdul Kalam Azad, "India Wins Freedom", Orient BlackSwan; 1st Edition (1 January 1988).
13. RomainRolland (English), "Vivekananda", Advaita Ashrama, India; Fourth Impression edition (30 March 2010).
14. RomainRolland (English), "Gandhi", Srishti Publishers & Distributors (2 January 2002).

COURSE OUTCOMES:

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

CO1. Become more aware of themselves, and their surroundings (family, society, nature);

CO2. More responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3. Have better critical ability.

CO4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										2					
CO2		3	3											3	3
CO3				2											
CO4						3			2						
CO5										2					

ECCP408	ANALOG ELECTRONICS LAB-II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To design BJT and MOSFET amplifiers and to study their frequency characteristics.
- To design Oscillators using discrete components and using MultiSim software.
- To study the characteristic of CMOS op amp.

LIST OF EXPERIMENTS

1. Frequency response characteristic of RC coupled BJT amplifier
2. Frequency response characteristic of common source amplifier.
3. Design and analysis of negative feedback amplifier.
4. Study of Current source/sink.
5. Experimental verification of the performance of a BJT/MOSFET based current mirror.
6. Common source amplifier with active load.
7. Design and Simulation of Hartley and Colpitts oscillators using MultiSim
8. Design of differential amplifier.
9. Characteristic of CMOS op amp.
10. Transfer characteristic of an op amp in open loop and closed loop configuration and estimating its differential gain.
11. Common source amplifier with current biasing using work bench.
12. Study of Voltage Controlled Oscillator.
13. Study of Gilbert cell.

COURSE OUTCOMES

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

CO1. Construct Amplifier and Oscillator circuits using discrete components.
CO2. Use MultiSim and work bench software for design and analysis of electronic circuits.
CO3. Construct circuits for various application using BJT and MOSFET.
CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3									2	3	2	
CO2	3	2	3									2	3		
CO3	2	2	3		3								3	2	
CO4								2	2	3			3		

ECCP409	MICROCONTROLLERS LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To study programming concepts of microcontrollers using assembly language program.
- To study various peripheral IC interfacing and programming.
- To study various programming concepts of arithmetic and logical operations.

LIST OF EXPERIMENTS

1. Data transfer/exchange between specified memory locations
2. Arithmetic operations using 8051 Controller.
3. Logical Operations using 8051 Controller.
4. Maximum /Minimum Value in an array.
5. Sorting given set of numbers in ascending and descending order using 8051 controller.
6. Code Conversion Programs using 8051 Controller.
7. Interfacing Switches and LEDs with 8051 controller
8. Interfacing 7 segment display with 8051 controller
9. Interfacing Stepper motor with 8051 controller
10. Interfacing LCD with 8051 controller
11. Interfacing ADC & DAC with 8051 controller
12. Serial data transmission using 8051 controller
13. Realization of Binary and BCD counters using 8051 controller.
14. Study of PIC Microcontroller.

COURSE OUTCOMES

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

CO1. Comprehend the instruction sets of 8051 microcontroller and to write assembly code for Data handling and arithmetic and logic operations.

CO2. Interface and Program various peripheral ICs.

CO3. Write program using Microcontrollers for real time applications.

CO4.Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3									3	3		
CO2		1	3	3	2							3	3	2	
CO3	2		3	3	2							3	3	2	
CO4			3	3					3	2	2				

ECCP410	ANALOG COMMUNICATION SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To investigate various analog modulation and demodulation circuits.
- To study and verify sampling theorem.
- To understand various pulse modulation techniques.
- To experimentally study characteristics of filter circuits.

LIST OF EXPERIMENTS

1. Amplitude Modulation and Demodulation.
2. DSB-SC Modulation and Demodulation.
3. SSB-SC Modulation and Demodulation.
4. Frequency Modulation and Demodulation.
5. Pre-emphasis and De-emphasis circuits.
6. Verification of Sampling Theorem.
7. Generation and Detection of PAM, PWM and PPM signals.
8. Time Division Multiplexing
9. Frequency Division Multiplexing.
10. Study of Receiver characteristics.
11. Study of Equalizer and attenuator.

COURSE OUTCOMES

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

CO1. Demonstrate various analog modulation and demodulation circuits.

CO2. Construct filter circuits for Receivers and able to analyze Receiver characteristics.

CO3. Demonstrate Various Pulse modulation and Demodulation circuits.

CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	3	2	
CO2	3		3									3		3	
CO3	3											3		3	
CO4	3		3						3	2	3				

THIRD YEAR

ECPC501	DIGITAL COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concept of information and coding theorem.
- To introduce different means of base band transmission and reception.
- To familiarize the students about the types of digital band pass transmission and to illustrate the concepts of synchronization.
- To provide basic knowledge about the use of various channel coding techniques.
- To understand the fundamentals of cryptography.

UNIT I Information Theory and Source Coding

Measure of Information – Information Rate, Entropy of Symbols, Conditional Entropies, Basic relationship among different Entropies, Mutual Information – Continuous and Discrete Communication Channels – Binary Symmetric Channel (BSC), Binary Eraser Channel (BEC) and their Capacities – Source Coding Theorem, Shannon Fano Code, Huffman Code, Shannon Hartley Theorem and its Implications

UNIT II Baseband Transmission and Reception

PCM, DPCM , Delta Modulation, ADM principles – PCM Waveform Types, ISI, Eye Pattern, Nyquist Criterion for Distortionless Transmission , Pulse Shaping – Correlative Coding – Detection of Signals in Gaussian Noise, Maximum Likelihood Detector, Matched Filter, Correlation Receiver – Error Probability Performance of Binary Signalling.

UNIT III Bandpass Modulation Schemes

Geometric Representation of Signals – Generation, Detection of BPSK, BFSK – BER Performance – M-ary Systems, Vectorial View of MPSK and MFSK – QPSK– MSK – QAM –Structure of Non-coherent Receivers – Principle of DPSK – Bit and Carrier Synchronization.

UNIT IV Error Control Coding

Types of Errors – Methods of Controlling Errors – Error Detection and Correction – Linear Block Codes – Single Error Correcting, Hamming Codes – Binary Cyclic Codes – Syndrome Calculation – Convolutional Codes, Viterbi Decoder.

UNIT V Encryption and Decryption

Model of Encryption and Decryption Process – System Goals – Threats – Ciphers – Perfect Secrecy – Practical Security – Substitution , Permutation, Product Cipher System – Data Encryption Standards – Stream Encryption – Key Generation using LFSR – Public Key Crypto Systems – Signature Authentication – RSA Scheme.

TEXT BOOKS

1. Bernard Sklar, "Digital Communication" 2nd Edition, Prentice Hall, Upper Saddle River, NJ, 2001.
2. S. P. Eugene Xavier, “Statistical Theory of Communication,” New Age International, 1997.
3. Simon Haykin, "Digital Communications", 4th Edition, John Wiley and Sons, 2016.

REFERENCES

1. B.P. Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2011.
2. Taub and Schilling, "Principles of Communication systems", 4th Edition, Tata McGraw Hill Co. India, 2015.
3. Bruce Carlson, "Principles of Digital Communication", McGraw Hill 5th Edition 2009.
4. Ziemer R.F and Tramer W.H., "Principles of Communication", Jaico Publishing House 1st Edition, 2000.

5. Shu Lin & Daniel J. Costello, "Error Control Coding Fundamentals and Applications," Pearson Education 2nd edition, 2011.

COURSE OUTCOMES

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

CO1. Define the concept of entropy and data compression techniques with varying efficiency as per requirements.

CO2. Interpret on modulation techniques and BER performance of base band digital transmission and reception and understand the concepts of Inter Symbol Interference.

CO3. Interpret on modulation techniques and BER performance of band pass digital transmission and Synchronization technique of digital systems.

CO4. Apply the various errors control coding schemes for detection and correction of channel errors.

CO5. Construct basic security algorithm required by any computer system.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2								2	3		
CO2	3	3	3	2								1	3	2	
CO3	3	3	2	2								2	3	2	
CO4	3	3	3	3								2	3	2	
CO5	2	2	2	1								2	2		

ECPC502	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study DFT and its computation
- To study the design structures of digital filters and Z-transform
- To study the design of Digital IIR filters
- To study the design of Digital FIR filters
- To study the fundamentals of digital signal processors.

UNIT–I: Discrete Fourier Transform

Discrete Signals and Systems – A Review – Introduction toDiscrete Fourier transform (DFT) –Properties of DFT –Circular convolution – Comparison between Linear convolution and Circular convolution – Fast Convolution Procedures - Overlap-save method, Overlap-add method – Fast Fourier Transform (FFT): Decimation-in-time (DIT) algorithm – Decimation-in-frequency algorithm – FFT radix-2 DIT, DIF implementation — IDFT using Direct FFT Algorithm.

UNIT–II : Design of Digital IIR Filters

Design of IIR filters: Analog filter approximation, Butterworth, Chebyshev and Elliptic filters – Frequency band transformation – Digital filter design equations low pass, high pass, bans pass and band stop – Impulse Invariant technique for IIR filter – Impulse Invariant pole mapping – Bilinear transformation – Bilinear transformation pole mapping.

UNIT–III : Design of Digital FIR Filters

Structure of FIR filters - Linear Phase FIR digital Filters – Minimizing design criteria (Fourier design technique) – Filter design using Windowing technique (Rectangular, Hamming, Hanning Window) – Kaisar Window.

UNIT–IV : Digital Filter Structures

Definition of digital filters – Properties of digital filters – Z transform - Definition – Properties – ROC – Transfer function – Poles and Zeros – Z-Transforms and Frequency

response relationships – Inverse Z-Transform – Realization of digital filters- direct form-Transposed form – Canonic – Cascade- Parallel and Ladder form - Quantization noise introduced by analog-to-digital conversion – Finite register length effects in the realization of IIR and FIR digital filters and in DFT computation.

UNIT–V: Digital Signal Processors

Generic DSP Architecture – Architecture of TMS 320C5X and TEXAS 5416 processor – memory and I/O Organization – CPU –Program control – Addressing modes – Assembly Language Instructions – On chip peripherals – Clock, watch dog and real time Interrupt, event manager units – Interface units – Simple Programs.

TEXT BOOKS

1. Proakis, J.G., Manolakis, D.G., "Digital Processing" Principles, Algorithms and Applications, Fourth Edition, Prentice Hall of India, 2007.
2. Ramesh Babu and C.Durai, "Digital Signal Processing", Laxmi Publications, 2005.

REFERENCE BOOKS

1. Mitra S.K., "Digital Signal Processing – A Computer Based Approach, Second Edition", Tata McGraw Hill, 2000.
2. Oppenheim A.Vand Schaffer, R.W., "Digital Signal Processing", Prentice Hall, 1st Edition, 2015.
3. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, New Delhi, 1994.
4. Venkatramani, B., and Bhaskar.M., "Digital Signal Processors", TMH, 2002.

COURSE OUTCOMES

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

CO1: Compute convolution of sequences and Compute DFT and IDFT of sequence using Fast Fourier Transform algorithms.

CO2: Design IIR filters in both analog and digital domains.

CO3: Design linear phase FIR digital filters using windowing technique.

CO4: Draw the implementation structure of IIR and FIR discrete time Filters and finite word length effects in digital filter.

CO5: Describe the architecture, instruction set of DSP Processors.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	3	2	2									2	3	2	
CO3	3	2	2									2	3	2	
CO4	3	3	2									2	3	2	
CO5	3	2										3	3		

ECPC503	VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the VLSI Design flow and MOS transistor theory.
- To understand NMOS and CMOS fabrication process and layout design.
- To offers a profound understanding of principle of operation of various Analog and Digital VLSI circuits
- To study programming technologies and architectures of FPGAs, CPLDs and to model a digital circuit using VHDL.

UNIT I : MOS Transistor Theory and VLSI Design Concepts

MOS Devices and Circuits: Review of MOSFET – Non ideal I-V Effects: Channel Length Modulation-Velocity Saturation and mobility degradation-Body Effect– Short channel effects-C-V characteristics-Complementary MOSFET-Static Characteristics of CMOS Inverter, Dynamic Behavior of CMOS Inverter-RC delay model Evolution of VLSI – VLSI Design Flow- Design Domains: Behavioral, Structural and Physical Design –VLSI Design Styles: Full Custom - Semi Custom approaches.

UNIT II : VLSI Fabrication Techniques

An Overview of Wafer Fabrication, Wafer Processing – Oxidation – Patterning – Diffusion – Ion Implantation – Deposition – CMOS Processes – N-well, P-well- Twin Tub, Silicon on Insulator – CMOS Process Enhancements – Interconnects.

Design Rules-Need for Design Rules-CMOS Lambda Based Design Rules-Stick Diagram and Layout for CMOS Inverter.

UNIT III : Logic Design

Combinational logic circuits : Static CMOS logic -Realization of simple and complex gates-Transistor sizing- Pseudo-nMOS- Pass Transistor logic - Dynamic CMOS logic - Sequential logic circuits - static and dynamic flip-flops

UNIT IV : Subsystem Design

Design of Shifters, Design of Adders: Ripple carry adders, Carry Select adder, Manchester Carry –Chain Adder, Carry Look- Ahead adder, Design of Multipliers: Serial, Parallel and Pipelined Multiplier Arrays- Booth Multiplier-Baugh wooley multiplier and Wallace Tree Multiplier.

UNIT V : Programmable ASICs and VHDL

Architecture and Programming technologies of CPLD and FPGA – VHDL - Hardware Modeling Issues –VHDL Code Structure: Library declaration, Entities and Architectures –Data Types- Operators-Concurrent and Sequential statements-Signals and Variables-Packages and Libraries - Introduction to Behavioral, Dataflow and Structural Modeling- Simple VHDL Code Examples.

TEXT BOOKS

1. Neil H.E.Weste,David Harris,Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Third Edition, Pearson Edition,2005.
2. Douglas A.Pucknell and Kamran Eshranghiaon. "Basic VLSI Design", Prentice Hall of India, New Delhi,Third Edition,2005.
3. Bhaskar. J. "A VHDL Primer", PHI, 1999.

REFERENCES

1. John P. Uyemura “Introduction to VLSI Circuits and Systems”, John wiley & Sons, inc, 2003.
2. Eugene D Fabricus., "Introduction to VLSI Design”, McGraw Hill International edition (February 1, 1990).
3. Jan Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “ Digital Integrated Circuits: A Design Perspective”, Pearson Second Edition, 2005.
4. Adel S. Sedra and Kenneth C.Smith, “Microelectronic Circuits”, Oxford University Press, 7th Edition, Oxford University Press, 2017.
5. Douglas Perry, “Circuit design with VHDL”, McGraw Hill International, Third Edition, 1999.

COURSE OUTCOMES

Upon completion of the course the students will be able to

CO1: Describe a VLSI Design flow for any complex circuit or system and demonstrate the understanding of MOS transistor theory.

CO2: Explain the fabrication steps in manufacturing NMOS and CMOS inverters and Draw the stick diagram and layouts.

CO3: Realize static and dynamic logic circuits using CMOS.

CO4: Construct combinational and sequential circuits using CMOS logic.

CO5: Construct digital circuits like shifters, adders and multipliers.

CO6: Describe architecture and programming technologies of FPGA and CPLD and model digital system components using VHDL

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2								2	2	2	2		
CO2	2	2										2	2	2	
CO3	3	3	2										3		
CO4	3	2	2										3		
CO5	3	2	2										3		
CO6	3	2	2		2							2	3	2	

ECPC504	TRANSMISSION LINES AND WAVE GUIDES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce basic concepts of transmission lines
- To learn the characteristics of low and radio frequency lines
- To study various impedance matching devices
- To learn Smith chart and its applications in transmission line problems
- To study waveguide theories

Unit I: Transmission Line Theory

Electrically short and long line concepts with distributed constants – Transmission line equation – Infinitive line. Transmission, reflection coefficient and standing wave ratio. Input and transfer impedance - Open and Short circuited lines – Reflection factor and reflection loss.

Unit II: Low Frequency Transmission Lines

Characteristics, distortion, condition for distortion less transmission – Loading – Lumped and distributed loading - Measurement of VSWR, wave length, characteristic impedance , propagation constant and primary constants.

Unit III: Radio Frequency Transmission Lines

Characteristics, parameter of open wire line and co-axial lines at radio frequencies – Standing waves, input impedances of a line terminated with a complex load – Transmission line as resonant circuit and reactive elements. Skin depth and promily effect – Equivalent T and TT models. Impedance matching quarter wave transformer – Single and double stub matching – circle diagram, smith chart and its uses.

Unit IV: Parallel and Rectangular Wave Guides

Wave between parallel planes – TE, TM and TEM waves and characteristics – Attenuation in parallel plane guide for TE, TM and TEM, waves – Wave impedance and characteristics impedances – Excitation methods for various modes for rectangular and circular wave guides – Impossibility of TEM, waves in wave guides – TE and TM waves in rectangular and circular wave guides – Transmission line analogy for wave guides – Attenuation factor and Q-factor of wave guides.

Unit V: Circular Wave Guides

Excitation methods for various modes for circular wave guides - TE and TM Waves in circular wave guides – Transmission line analogy for wave guides – Attenuation factor and Q-factor of wave guides.

TEXT BOOKS

1. Ryder JD., "Networks Lines and Fields" PHI New Delhi, 2nd Edition 2002.
2. Umesh Sinha, "Transmission Lines and Networks", Satya prakashan Publishers, 2010

REFERENCES

1. Ramo.S. and J.R. Whinnery "Fields and Waves in Communication Electronics", 3rd Edition, John Wiley,1994.
2. Jordan "Electromagnetic Waves and Radiating Systems", Second Edition, Darling Kindersley (India) Pvt Ltd., 2006.
3. David K. Cheing, "Field and Wave Electro magnetics" Second Edition, Pearson Education 2002

COURSE OUTCOMES

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

CO1. Outline transmission line parameters and interpret voltage and current distributions on the line.

CO2. Apply loading principles to reduce distortion in transmission lines.

CO3. Use Smith chart to compute line parameters and solve impedance matching problems

CO4. Explain propagation of EM waves in rectangular and circular waveguides.

CO5. Explain the working principle of waveguide elements such as attenuator, phase shifters, Directional couplers.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	3	2	2	2								2	3		
CO3			2		3									2	
CO4	3	2	3	2								3	3		
CO5	3											2	2		

ECCP508	DIGITAL COMMUNICATION LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To experimentally study various baseband and band pass digital modulations.
- To understand data coding and error control coding techniques.
- To use MATLAB software in simulation and performance analysis of digital modulation techniques

LIST OF EXPERIMENTS

1. Pulse Code modulation and demodulation.
2. Delta modulation and demodulation.
3. Adaptive Deltamodulation.
4. Companding.
5. Sigma delta modulation and demodulation.
6. Time division multiplexing and Demultiplexing.
7. Data coding and decoding techniques for Return to Zero format and Multilevel Binary Format.
8. Data coding and decoding techniques for Phase Encoded Format.
9. ASK, FSK,PSK modulation and demodulation.
10. QPSK modulation and demodulation.
11. Synchronization techniques in PCM.
12. DPSK modulation and demodulation using MATLAB.
13. QAM modulation and demodulation using MATLAB.
14. Performance Analysis of ASK, FSK, PSK modulation schemes.
15. Error control coding techniques using MATLAB.

COURSE OUTCOMES

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

CO1. Demonstrate various base band and band pass modulation techniques and analyze the output waveforms.

CO2. Experimentally verify various data coding and decoding techniques.

CO3. Use MATLAB software for the analysis and implementation of digital modulation techniques.

CO4. Work as a part of team effectively and communicate the technical information by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									3	3	3	
CO2	3	2	2		2							2	3	2	
CO3	3	3	3		2							2	3		
CO4								2	2	3		2			

ECCP509	DIGITAL SIGNAL PROCESSING LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To realize arithmetic, logical, data transfer and convolution operations on DSP processors using assembly code.
- To Design digital filters using DSP processors.
- To Develop simple algorithms for signal processing and test them using MATLAB.
- To analyze and design LTI-Digital systems using MATLAB.

LIST OF EXPERIMENTS

1. Perform the given Arithmetic Operations and Data Transfer using TMS320C50
2. Obtain the Linear and Circular Convolution usingTMS320C50
3. Design of IIR and FIR filter using TMS320C50
4. Waveform Generation using TMS320C50
5. Perform the arithmetic and logical operations using TMS320C5416 and TMS320F6713.
6. Generation and Simple Operations of Signals using MATLAB
7. Determine the Impulse Response and Step Response of a Causal LTI System
8. Frequency Response of First Order and Second Order System using MATLAB
9. Obtain the Convolution and Correlation of the given sequence using MATLAB
10. Design of IIR Filters using MATLAB
11. Design of FIR using Windowing Techniques using MATLAB
12. Simple Operations on Images using MATLAB.

COURSE OUTCOMES

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

CO1. Experiment concepts of Digital Signal processing and its applications using MATLAB.

CO2. Understand programming concepts of TMS320C50, TMS320C5416 and TMS320F6713 processors.

CO3. Develop digital filters using MATLAB and DSP processors.

CO4. Work as a part of team effectively and communicate the technical information by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3		3		2		3	3	3		
CO2	3	3			3	2	3			2	3	3	3		
CO3		3	3		3								3		
CO4				3	3							3	3		

ECCP510	VLSI DESIGN LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To gain expertise in design, development and simulation of digital circuits with VHDL.
- To implement digital circuits on FPGA/CPLD devices.

LIST OF EXPERIMENTS

1. Study of Xilinx simulation and synthesis tool.
2. Design of unit adders and subtractors
3. Design and testing of parallel adder-subtractor.
4. Design and testing of BCD adder.
5. Design and testing of multiplexer and demultiplexer.
6. Design and testing of four bit magnitude comparator.
7. Design and testing of array multipliers.
8. Design and testing of flip-flops.
9. Design and testing of synchronous counters.
10. Design and testing of asynchronous counters.
11. Design and testing of scrambler and descrambler.

COURSE OUTCOMES

Upon completion of the course the student will be able to

CO1. Demonstrate different styles of writing VHDL code and construct digital circuits using VHDL.

CO2. Use Xilinx tools in digital circuits modeling, simulation, and functional verification using VHDL

CO3. Implement and validate digital circuits on FPGA/CPLD board.

CO4. Work as a part of team effectively and communicate the technical information by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2										2	3	2	
CO2	3	2	3	2	3							2	2	3	
CO3		2	3		3							2		3	
CO4								2	2	2		2			

ECPC601	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a clear understanding on the basic concepts, Building blocks of Embedded System.
- To introduce the fundamentals of Embedded processor Modeling, bus Communication in processors, Input/output interfacing
- To introduce on processor scheduling algorithms , Basics of Real time operating system

UNIT I: Introduction to Embedded Systems

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Watchdog Timer, Real Time Clock.

UNIT II: Embedded Networking and Interrupts Service Mechanism

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS485 –USB – Inter Integrated Circuits (I2C) – interrupt sources, Programmed-I/O busy-wait approach without interrupt service mechanism- Introduction to Basic Concept of Device Drivers

UNIT III: High Performance RISC Architecture – ARM

Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers–Pipeline–Interrupts–ARM organization–ARM processor family–Co- processors – ARM instruction set- Thumb Instruction set – Instruction cycle timings– The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming – C programming – Optimizing ARM Assembly Code.

UNIT IV: Software Development Tools

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, Incircuit emulator, Target Hardware Debugging, need for Hardware-Software Partitioning and Co-Design. Overview of UML, Scope of UML modeling, Conceptual model of UML, Architectural, UML basic elements- Diagram- Modeling techniques - structural, Behavioral, Activity Diagrams.

UNIT V: RTOS Based Embedded System Design

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non- preemptive scheduling, Task communication- shared memory, message passing, Comparison of commercial RTOS features - RTOS Lite, Full RTOS, Vx Works, RT Linux.

TEXT BOOKS

1. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
2. Peckol, "Embedded System Design", John Wiley & Sons, 2010.
3. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, PEARSON, 2013

REFERENCES

1. Rajkamal, "Embedded system-Architecture, Programming, Design", TMH, 2011.
2. Shibu.K.V, "Introduction to Embedded Systems", TataMcgrawHill,2009
3. Lyla B Das," Embedded Systems-An IntegratedApproach",Pearson2013
4. EliciaWhite,"MakingEmbeddedSystems",O'ReillySeries,SPD,2011
5. Tammy Noergaard, "Embedded System Architecture, A comprehensive guide for Engineers and Programmers", Elsevier, 2006

COURSE OUTCOMES

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

CO1. Outline the concepts and building blocks of an embedded system
CO2. Describe the various protocols used for embedded networking.
CO3. Describe the architecture and programming of ARM processor.
CO4. Understand the concepts of Software Development Tool and Programming
CO5. Explain the basic concepts of real time operating system and model the real time applications.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3		3										3		
CO3	3		3										3		
CO4	3	2	3										3		
CO5	3	2	3									1	3		

ECPC602	DATA COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the concept of data communication system and digital data transmission and OSI reference model
- To comprehend the use of different types of digital data interfaces and modems and to understand the concept of network architecture and protocols
- To be familiar with the components required to build different types of networks and data link layer issues and to learn the flow control and congestion control algorithms
- To be exposed to the required functionality network and transport layer
- To utilize the application of top layer protocols for different requirements

Unit–I : Basic Concepts

Introduction – Data communication system – Data communication links: Point- to -Point- Multipoint-Topology-Digital data transmission – Digital data rates – Serial and Parallel data formats – Encoded data formats – OSI model – Protocols and Standards – Transmission modes – Categories of network.

Unit–II: Digital Data Interfaces and Modems

Interconnection devices - Inter connection issues - DTE – DCE interface – Other interface standards – Network Interface Cards - MODEMS – Cable modem – Unguided media – Transmission impairments performance- Interconnection of LANS- IEEE 802.6 man – X.25 packet switched protocols – ATM, Frame relay – IEEE 802.11 wireless LANS using CSMA/CD.

Unit–III: Data Link Layer

Logical link control Functions: - Framing, Flow control, Error control: CRC, LLC protocols: - HDLC. Medium access layer:- Random access, Controlled access, Channelization, Data link layer: Design issues – Service primitives – Stop and Wait - Sliding window protocols –Go-back N- Selective repeat protocols.

Unit–IV: Network and Transport Layers

Network layer: Design issues - Routing algorithm - Congestion control algorithms internetworking. Quality of Service. Transport layer: Design issues- The Transport Service - Elements of transport protocol- Connection management - Performance Issues.

Unit–V: Session, Presentation and Application Layers

Session Layer: Design issues -Remote procedure call – Abstract syntax notation Presentation Layer: Design issues - Data compression techniques-cryptography - Application Layer: DNS-(Domain Name System) - File Transfer, Access and Management - Electronic mail - Virtual Terminal -World Wide Web.

TEXT BOOKS

1. Behrouz A. Forouzan, “Data Communication and Networking”, Tata McGraw Hill, New Delhi, Second Edition, 2006.
2. Andrew S. Tanenbaum. "Computer Networks", 5th Edition, Prentice Hall of India, 2011.

REFERENCE BOOKS

1. William A.Shay, "Understanding Data Communication Networks", Books/Cole Thomson Learning, Singapore, First Edition, 2001.
2. William Stalling, "Data and Computer Communication", PHI, New Delhi, Fifth Edition, 2001.
3. Schwartz M., "Computer Communication", McGraw Hill, 2002.
4. Gerd E. Keiser," Local Area Networks", McGraw Hill Publication, 2nd edition, 2002.
5. Bertsekas D. and Gallagher R., "Data networks, 2nd Edition, Prentice Hall of India, 2004.

COURSE OUTCOMES

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

CO1. Summarize the basic concepts of data communication system and OSI Reference model.
CO2. Recognize the applications of digital data interfaces, Modems and packet switched protocols.
CO3. Interpret the design issues of Data link layer and multiple access protocol.
CO4. Identify the solution for improving quality of service and transport layer performance issues.
CO5. Choose the required functionality of application layer for given application.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2	3	3	2										3		
CO3	3	3	2									2	3		
CO4	3	3	2	1								2	3		
CO5	3				1							2	3		

ECCP607	EMBEDDED SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To expose the students to the fundamentals of embedded Programming.

LIST OF EXPERIMENTS

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Implementing Zigbee protocol with ARM.
7. Finding largest and smallest in an array using Embedded – C with RIDE package.
8. Sorting of an array using Embedded – C with RIDE package.
9. Simulation of led blinking and DC motor control using tinker cad.
10. Simulation of IOT applications using tinker cad
11. Study of RTOS.
12. Simple experiments using Arduino board.

COURSE OUTCOMES

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

CO1. Describe the instruction set of ARM Processor.
CO2. Develop assembly language for programs in ARM processor for different applications.
CO3. Develop C language programs for embedded system applications.
CO4. Work as a part of team efficiency and formalize the experiment procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								3		3		3		
CO2	3	2							3		3		3		
CO3	3	2							3		3		3		
CO4	3								3		3		3		

ECCP608	DATA COMMUNICATION AND NETWORKS LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To understand about basic network components and devices
- To familiarize TCL script to simulate and analyze various wireless communication networks.
- To simulate algorithms using MATLAB.

LIST OF EXPERIMENTS

1. Study of configuring network devices (router, switch, hub, modem)
2. Performance Study of CSMA protocol for data communication between nodes in a network.
3. Physical PC to PC communication in LAN.
4. Simulation of Multiple nodes using Network Simulator.
5. Implementation of Bus, star and Ring topologies using Network Simulator.
6. Implementation of hybrid topology using Network Simulator.
7. Study of Go-Back-N protocol and Stop & Wait Protocol
8. Simulation of shortest path between any two nodes using Distance Vector Routing Protocol and Link State Routing Protocol.
9. Implementation of Error control coding technique in MATLAB
10. Pseudo Noise sequence generator using MATLAB.
11. Data transmission using Blue tooth trainer kit.

COURSE OUTCOMES

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

CO1. Use Network simulator and MATLAB tool

CO2. Design and analyze various wireless networks using NS2.

CO3. Construct MATLAB codes for implementing Error control coding, PN sequence generation.

CO4. Work as a part of team effectively and formalize the experiment's procedures and results by writing a formal report.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3	3	2										3	2	
CO3	3	3	2										3		
CO4	3	3	2	1				2	2	2			3		

FOURTH YEAR

ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering
- To take balanced decisions.
- To understand the ethical problems and principles through theory, historical case studies and research and presentation.
- To allow students to explore the relationship between ethics and engineering
- To apply classical moral theory and decision making to engineering issues encountered in academic and professional careers

Unit I: Moral Reasoning and Ethical Theories

Senses of Engineering Ethics–Verity of Moral Issues–Types of Inquiry– Moral Dilemmas -Moral Autonomy – Kohlberg's Theory-Gilligan's Theory – Consensus and Controversy – Professions and Professionalism – Professional Ideas and Virtues - Uses of Ethical Theories.

Unit II: Engineering as Social Experimentation

Engineering as Experimentation - Engineering as Responsible Experiments – Research Ethics – Code of Ethics – Industrial Standards - A Balanced Outlook Law- The Challenger Case Study.

Unit III: Engineer Responsibility for Safety

Safety And Risk - Assessment of Safety And Risk – Risk Benefit Analysis –Red fusing Risk – The Government Regulator's Approach to Risk – Chernobyl Case Studies and Bhopal

Unit IV: Responsibility and Rights

Collegiality and Loyalty-Respect for Authority–Collective Bargaining–Confidently–Conflicts of Interest–Occupational Crime–Professional Rights–Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit V: Global Issues

Multinational Corporation - Business Ethics – Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Developments–Engineering as Managers–Consulting Engineers-Engineers as Expert Witness and Advisors – Honesty – Moral Leadership - Sample Code of Conduct.

TEXT BOOKS

1. Govindarajan, M, Natarajan.S. and Senthil kumar .V S. " Professional Ethics And Human Values." PHI Learning , New Delhi,2013.
2. Mike Mertin and Roland Schinzinger, "Ethics Engineering ", McGrawHill, New York, - 4th Edition,2005.

REFERENCES

1. Charles E Harries, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases," Thompson Learning, 4th Edition, 2004
2. Charles D Fleddermann, "Engineering Ethics," Prentice Hall, NewMexico,1999
3. John R Boatright, " Ethics and the Conduct of Business," Pearson Education,- 2003
4. Edmund G Seebauer and Robert L Barry," Fundamentals of Ethics for Scientists and Engineers".Oxford University Press , 2001
5. David Ermann and Michele S Shauf," Computers, Ethics and Society," Oxford University Press, Third Edition 2003.

COURSE OUTCOMES

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

CO1. Understand and build the relationship between the Engineer and the Society
CO2. Build the importance of codes in engineering practice.
CO3. To develop the knowledge on the legal, moral and ethical aspects in Engineering.

CO4. Construct the moral and ethical dimensions in engineering.
CO5. To Improve the Knowledge about Multinational Corporation.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					3	3	3							3
CO2	3					3	2	3							3
CO3	3			2		3	2	3							3
CO4	3					3	1	3							3
CO5	3					3	1	3							3

ECPC702	MICROWAVE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart the essential knowledge to the students to learn about the Microwave generators working with different kinds of Microwave Components.
- To enhance the students proficiency about microwave solid state devices and deriving scattering matrix.
- To provide sufficient Information about Noise analysis in Microwave Engineering.
- To accomplish a thorough idea about direct and indirect Microwave parameter measurements.

UNIT I: Microwave Linear Beam Tubes

Construction - Operation of Two Cavity Klystron Amplifier- Power Output and Efficiency Consideration-Multi Cavity Klystron Amplifier -Single Cavity Reflex Klystron Oscillator- Mode Characteristics - Power Output and Efficiency Consideration-Slow Wave Structure-Travelling Wave Tube (TWT)-Comparison of TWT and Klystron-Backward Wave Oscillator (BWO).

UNIT II: Microwave Crossed-Field Tube and Solid State Devices

Construction – Operation of Magnetron Oscillator, Hull Cut-Off Condition - Principles of Gunn Effect, Operation of Gunn Diode Oscillator and its Applications - Principles and Operation of IMPATT, TRAPATT, Parametric Amplifier.

UNIT III: Microwave Devices

Active Devices – Pi Equivalent Model of Radio Frequency Junction Transistors and Field Effect Transistors – Degeneration Circuits – Current Sinks -Micro Wave Hybrid Tees, E-Plane, H-Plane, E-H Plane Tees and its Application-Hybrid Ring- Directional Coupler – Attenuators-Phase Changers-Matched Termination-Corner, Bend, Twister-Slotted Section - Microwave Propagation in Ferrites, Faraday Rotation, Ferrite Devices, Gyrator, Isolator and Circulator.

UNIT IV: Microwave Network Analysis

Impedance and Admittance Matrices Scattering Parameter, Properties of S- Matrix, Shifting of Reference Plane in Two Port Network, Losses in Microwave Circuits- Insertion Loss, Transmission Loss, Return Loss, Reflection Loss, Conversion Between ABCD And S Parameter, S- Matrix of Some Two Port Networks- Multi Port Networks.

UNIT V: Microwave Measurements

Measurement of Voltage Stranding Wave Ratio, Double – Minimum Method - Measurement of Frequency, Wave Length, Attenuation, Power, Impedance- Measurement of Antenna Radiation Pattern- Measurement of Antenna Gain- Measurement of Beam Width – VSWR.

TEXT BOOKS

1. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, PHI, 2005.
2. Kulkarni. M, "Microwave and Radar Engineering", 3rd Edition, Umesh Publications, 2008.

REFERENCES

1. David, Pozar. M, "Microwave Engineering", 4th Edition Inc., John Wiley and Sons, 2008.
2. Collins. R.E., "Foundation of Microwave Engineering", McGraw Hill, 3rd Edition 2005.
3. Annapurna das, "Microwave Engineering", TMH, 2nd Edition 2006.
4. Sharma, K.K., "Fundamental of Micro and Radar Engineering", S. Chand & Co New Delhi, 2011.
5. Herbert Reich. J., Skolnik. J.G., Ordung. P.F. and Krauss. H.L., "Microwave Principles", Distributors, C.B.S Publishers- New Delhi -2004.

COURSE OUTCOMES

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

CO1: Describe the construction, working principle and characteristics of microwave Linear beam tubes as amplifiers and oscillators

CO2: Describe construction, working principle and characteristics of magnetron and solid state devices.

CO3: Describe Various Microwave Components and applications.

CO4: Restate the properties of S-parameters and make use of it in analysing microwave devices.

CO5: Describe the procedure for measuring different parameters like VSWR, impedance, frequency, power etc.,

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	3	2	2									2	2		
CO3	2	2		2								2	2		
CO4	3	3	2									2	3	2	
CO5	3	2		2									2	2	

ECCP706	MICROWAVE ENGINEERING LAB	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To Study the characteristics of microwave sources and microwave components.
- To Study the radiation characteristics of Horn and parabolic antennas.
- To study microwave measurements.

LIST OF EXPERIMENTS

1. Study of Microwave Components
2. VI Characteristics and Frequency Response of Gunn Oscillator
3. Mode Characteristics of Reflex Klystron Oscillator
4. Measurement of Attenuation, VSWR, Wave Length and Operating Frequency using Microwave Test bench
5. Characteristics of E, H and Magic Tee Plane using Microwave Test bench
6. Characteristics of Circulator using Reflex Klystron Oscillator
7. Measurement of Radiation Characteristics of Horn antenna.
8. Measurement of Radiation Characteristics of Parabolic antenna
9. Characteristics of Directional Coupler 3dB and 20dB using Microwave Test bench
10. Measurement of Unknown Impedance of Pyramidal Antenna using Gunn oscillator
11. Measurement of Dielectric Constant for the given solid using Microwave Test bench.

COURSE OUTCOMES

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

CO1. Demonstrate and interpret characteristics of Microwave sources and components.
CO2. Determine the radiation pattern for Microwave antennas.
CO3. Construct the experimental set up to measure Frequency, Impedance, Power, attenuation and VSWR.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	2	3											2		
CO3	2		3	2									2		

ECPV803	PROJECT WORK AND VIVA-VOCE	L	PR	S	C
		0	10	2	6

COURSE OBJECTIVES

- To practice the fundamental electronics engineering concepts and principles in addressing a real time situation independently or in a team
- To develop an ability to solve problem by making a literature review and finding a solution for the same.
- To train the students for facing presentations, preparing reports and appears for the viva voce sessions.

METHOD OF EVALUATION

- The student undergoes literature survey and identifies the topic of thesis and finalizes in consultation with Guide/Supervisor and prepares a comprehensive thesis report after completing the work to the satisfaction of the supervisor.
- The progress of the thesis is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
- A thesis report is required at the end of the semester.
- The thesis work is evaluated based on oral presentation and the thesis report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

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

CO1. Formulate a problem in the field of Electronics and Communication Engineering through literature survey and its reviews.
CO2. Identify the objectives of the project by understanding the source of a program.
CO3. Analyze the problem based on a methodology and tabulate the results.
CO4. Develop methodology using appropriate tools for the problem.
CO5. Conclude the results and prepares a report on the project.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				3			3				3		
CO2	3	3	3		3	3			3						
CO3	3	3	3	3	3				3			2	3	2	
CO4	3	3	3	3	3			2	3	2		2	3	2	
CO5		3	3	3		3		2	3	2			3		1

PROFESSIONAL ELECTIVES

ECPESCN	INFORMATION THEORY AND CODING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce to the students, the concept of information and entropy of information.
- To understand the mathematical foundation of compression.
- To acquire Knowledge in error control and security of information.

Unit I: Information Theory Basics

Information-Measure of information-Information rate-Entropy- Entropy of symbols- Continuous and discrete messages-Joint and conditional Entropies- Basic relationship among different entropy.

Unit II: Mutual Information and Coding Theorem

Entropy for Discrete Ensembles– Properties of Entropy of a Binary memory less source – Extension of a binary memory less source – Source Coding Theorem– Shannon Fanon coding - Huffman Coding-Uniquely detectable codes.

Unit III: Shannon's and Channel Coding Theorem

Channel Representations-Binary symmetric channel –Binary erasure Channel-Markov Sources- Shannon noisy and noiseless coding theorem – Properties – Channel capacity –Shannon Hartley Law –Channel coding theorem - Lempel-Ziv coding.

Unit IV: Linear and Cyclic Codes

Linear block Codes – Generator matrices – Parity check matrices –Encoder –Syndrome and error correction–Minimum distance–Error correction and Error detection capabilities – Cyclic codes.

Unit V: Other Coding Techniques

Convolution codes – Encoder – Generator matrix – Generator Polynomial- State diagram – Distance properties - Maximum likelihood decoding – Viterbi decoding – Sequential decoding –Hadamard matrices and Hadamard codes – BCH codes – Description, decoding – Reed Solomon code.

TEXT BOOKS

1. Ranjan Bose – Information Theory, Coding, and Cryptography – McGraw Hill, India – 2008 (2nd Edition) – ISBN:9780070669017.
2. Das, S.K.Mullick, P.K.Chatterjee, "Principles of Digital Communication", Wiley Easter Limited, 1986.
3. N.Abramson, Information and Coding, McGrawHill,1963.

REFERENCES

1. Thomas M. Cover, Joy A. Thomas - Elements of Information Theory – Wiley, and India – 2nd Edition (1 January 2013) – ISBN:9788126541942.
2. Shu Lin and D.J.CostelloJr. Error Control Coding, Prentice Hall,1983.
3. M.Mansurpur, Introduction to Information theory, McGraw Hill,1987.
4. R.B.Ash, Information Theory,PrenticeHall,1970.

COURSE OUTCOMES

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

CO1. Define the concept of information and entropy.

CO2. Design and analyze data compression techniques with varying efficiencies as per requirements.

CO3. State various theorems proposed by Shannon for reliable transmission and Calculation of Channel Capacity

CO4. Solve error detection and correction in linear block codes and develop encoding circuits for cyclic codes

CO5. Design an optimum decoder for various coding schemes used.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			3						2			2		
CO2		2	3	3				2					2		
CO3	2	2										2		3	
CO4			3	3				2		2				3	
CO5			3		1							2		3	

ECPESCN	ANTENNAS AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the students with antenna terminologies.
- To encapsulate the key topics of standard antennas, special types of antennas.
- To elucidate the various propagation techniques of waves.
- To introduce the students about antenna measurement techniques.

Unit–I: Antenna Fundamentals

Retarded Potential, Radiation from a Current Element - The Short, Monopole and Half Wave Dipoles, Power Density, Directivity and Gain, Radiation Resistance, Input Impedance, Radiation Patterns, Beam Width, Bandwidth and Polarization - Reciprocity Theorem - Effective Aperture Dipole and Aperture Antennas.

Unit–II: Linear and Array Antennas

Current Distribution - Radiation Field of Centre Fed Dipole - Near and Far Fields of Dipole Antennas, Fields for Small Loop Antennas and its Applications. Arrays of Two Point Sources - Linear Arrays with Uniform Current Distribution - Broad Side and End Fire Arrays, Binomial Array - Principle of Pattern Multiplication - Effect of Earth on Radiation Pattern - Introduction to Planar Phased and Adaptive Arrays.

Unit–III: Special Purpose Antennas

(Qualitative Treatment Only) Loop Antennas, Folded Dipoles, Travelling Wave Antennas, V and Rhombic Antennas, Horn Antennas, Reflector Antennas, Parasitic Elements and Yagi Arrays, Wideband Antennas, Log Periodic Antennas. Babinet's Principle - Slot Radiators, Parabolic Reflectors - Radiation Pattern, Aperture Distributions and Efficiencies - Feeding Techniques for Parabolic Antennas.

Unit–IV: Propagation

Factors Involved in The Propagation Of Radio Waves, The Ground Wave, Reflection of Radio Waves by The Surface of The Earth, Space Wave Propagation, Considerations in Space Wave Propagation, Atmospheric Effect in Space Wave Propagation, Ionosphere and its Effect on Radio Waves, Mechanism of Ionospheric Propagation, Refraction and Reflection of Sky Wave by the Ionosphere, Ray Paths, Skip Distance, Maximum Usable Frequency, Fading of Signal, Selective Fading – Diversity Reception.

Unit–V Measurements

Impedance, Field Pattern and Gain of Antennas, Radiation Pattern, Ionospheric Measurements - Vertical Incidence Measurements of the Ionosphere, Relation between Oblique and Vertical Incidence Transmission.

TEXT BOOKS

1. J.D. Kraus, Antennas, McGraw Hill,2001.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley,2005

REFERENCES

1. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill,1985.
2. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGrawHill, 1984.
3. I.J. Bahland P. Bhartia, Micro Strip Antennas, Artech House,1980.
4. R.E. Crompton, Adaptive Antennas, John Wiley.

COURSE OUTCOMES

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

CO1. Describe the fundamental concepts of antenna.

CO2. Analyse the radiation pattern of different types of antenna arrays.

CO3. Discuss the different types of antennas along with applications, right from wired type to Microwave antennas.

CO4. Explain the mechanism of the atmospheric effects on radio wave propagation.
CO5. Illustrate the techniques for measuring different parameters of antenna.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3		3									3		
CO3	1	2										2	2		
CO4	3	3											3		
CO5	3			2								2	3		

ECPESCN	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the elements of control system
- To analyze the time response, the frequency response, and the stability of systems

Unit I: System Modelling

Introduction to Control System -Basic Elements in Control Systems - Open Loop and Closed Loop Systems-Differential Equation Representation of Physical Systems - Transfer Function – Mathematical Modeling of Electrical and Mechanical Systems (Translational and Rotational Systems)-Block Diagram Representation of a System - Block Diagram Reduction Techniques - Signal Flow Graph.

Unit II: Time Domain Analysis

Standard Test Signals - Analysis of I Order and II Order Systems - Time Domain Specifications - Steady State Error - Generalized Error Coefficients – Effect of Adding Zero to System-P, PI, PD, and PID Compensation-Stability Analysis-Routh Hurwitz Criterion - Nyquist Stability Criterion -Root Locus Technique.

Unit III: Frequency Domain Analysis

Frequency Response - Frequency Domain Specifications –Correlation Between Frequency and Time Domain Specifications- Gain and Phase Margin- Bode Plot – Polar Plot -Constant M and N Circles -Nichols Chart-Series and Parallel Compensators-Lead, Lag, Lead and Lag Compensators.

Unit IV: Digital Control Systems

Introduction - Basic Digital Control System - Sampling - Sample and Hold Circuits – Open and Closed Loop Sampled Data System- Discrete Time Signal - Linear Discrete Time Signal - Pulse Transfer Functions - Z Transform Analysis Sampled Data Control Systems -Stability Analysis - Jury's Stability Criterion.

Unit V: State Space Analysis

Introduction - State Space Formulation - State Space Representation of Continuous and Discrete Time Systems - State Diagram - State Space Representation Using Physical, Phase and Canonical Variables –Diagonal Canonical Form-Jordon Canonical Form Diagonalization- Concept of Controllability and Observability.

TEXT BOOKS

1. NagrathJ. and Gopal M. “Control system engineering”, New Age International (p) Ltd., 5thEdition, 2008.
2. Kuo B.C., “Digital control systems”, 2nd Edition, Oxford University Press, 2002.

REFERENCES

1. Ogata K., “Modern control engineering”, 5thEdition, Prentice Hall,2010.
2. Gopal M., “Digital control and state variable methods”, Tata McGraw - Hill Education,2003.
3. R.Anandha natarajan, P.Ramesh babu “Control system engineering, SciTech Publication Pvt Ltd., 2013.

4. Kuo B.C., "Automatic control systems", John Wiley, 9thEdition -2003.

COURSE OUTCOMES

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

CO1: State the various control system components and their representations.
CO2: Analyze the system in time and frequency domain.
CO3: Test the stability of the system by applying various stability criterions in time and frequency domain.
CO4: Explain the concept of sampled data control system using Z-transform.
CO5: Use state space techniques for analyzing the control systems.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										3	1		
CO2	3	3										3		3	
CO3	3	3										3		3	
CO4	3	3	2		2							3		3	
CO5	3	3	2		2							3		3	

ECPESCN	FIBER OPTIC COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Be familiar with the operating principles of fiber optics and its characteristics.
- learn the basic elements of optical fiber transmission link, fiberglass modes configuration s and structures
- Describe modulation, multiplexing and de multiplexing in fiber optic systems.
- Understand different kinds of losses, signal attenuation in optical fibers and other dispersion factor and Perform noise and error analysis on fiber optic communication systems.
- Learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance and Understanding of optical network system components, variety of networking aspects, EDFA and WDM networks.

Unit I: Overview of Optical fiber Communications

Historical Background of Optical Communication, Electromagnetic spectrum, Optical Spectral bands, Evolution of fiber optic system, Multiplexing Techniques, Advantages & Applications of OFC, Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

Unit II: Optical fibers : Structures, Wave guiding and Fabrication

Different types of optical fibers, Comparison of Optical fiber Communication Systems With other Communication System, Optical laws and definitions, optical fiber modes and configurations, Mode theory, Step Index and Graded Index (GI) fibers, single mode and graded index fibers, Derivation for numerical aperture, Modal analysis of step index fiber-Signal degradation on optical fiber due to dispersion and attenuation-Fabrication of fibers and measurement techniques like OTDR.

Unit III: Optical Sources and Detectors

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, fiber-to-fiber joints, LED coupling to single mode fibers, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Unit IV: Overview of Optical Components

Nonlinear effects in fiber optic links- Optical couplers, Tunable sources and Filters, optical MUX/DEMUX Concept of self-phase modulation, group velocity dispersion and solution based communication.

UNIT V: Optical Amplifiers

Optical amplifiers-EDFA, Raman amplifier-Receiver operation ,Preamplifier types, receiver performance and sensitivity, Eye diagrams, Coherent detection, Specification of receivers, WDM and DWDM systems. Principles of WDM networks.

TEXT BOOKS

1. J. Kaisar, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013(Indian Edition).
2. Rajiv Ramaswami, Kumar N. Sivarajan, Optical Networks: A Practical Perspective (The Morgan Kaufmann Series in Networking), Second Edition, 20 Oct2001
3. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer- Verlag,1975.

REFERENCES

1. G. Agrawal, Nonlinear fiber optics, Academic Press, 2ndEd.1994.
2. G.Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York,1997F.C.
3. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).
4. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
5. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979.

COURSE OUTCOMES

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

CO1: Apply the fundamental principles of optics and light wave to design optical fiber communication systems and its components and the bandwidth advantages.

CO2: State various losses in optical fiber link Understand the properties of the optical fibers and optical components and investigate the fabrication of fibers and measurement techniques.

CO3: Design optical fiber communication links using appropriate optical fibers light sources, detectors.

CO4: Analyze system performance and design optical networks and understand non-linear effects in optical fibers.

CO5: Explore concept of designing, managing and operating principles of modern optical systems and networks with appropriate consideration.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1						3	3	
CO2	3	1		1						2			3	2	
CO3	3		2		1				1				3		
CO4	3		2		1	1				2			3		
CO5	3		2	1				1							

ECPESCN	CELLULAR MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To make students familiar with fundamentals of mobile communication systems.
- To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.
- To identify the requirements of mobile communication as compared to static communication.
- To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems. static communication.
- To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems.

Unit I: Introduction

Basic cellular system-Uniqueness of mobile radio environment- operation of cellular system-Cell site antennae and mobile antennae-Multipart fading-Delay spread-Coherence bandwidth-Models for predicting path loss-Cell coverage for signals and traffic-Real time co-channel interference-Non co-channel interference.

Unit II: Cellular System

Global system for mobile communication-Advanced mobile phone service- Digital cellular system-Cordless telephoning- Practical cellular mobile system. GSM Network and signaling-GSM short message services-International roaming- Administration and maintenance of GSM operation-Mobile number Portability- VOIP service for mobile

networks.

Unit III: Mobility Management

Frequency allocation-Cell splitting-Operational techniques and technologies-Mobile telephone switching office-Hand off- Hand off detection- Roaming management-Channel assignment techniques-Radio line transfer- Network signaling-Inter system hand off and authentication-PACS network signaling

Unit IV: Wireless Application Protocol

WAP model-WAP gate way-WAP protocol-WAP UAPROF and Caching- Wireless barrier for WAP-WAP developer tool kits-Mobile station applications- Execution environment.

Unit V: Mobile Communication Systems (Block diagram treatment)

Data links-Microwave antennas-Digital mobile telephony-Spread spectrum system to combat multipath-Radio paging-Trunk radio systems-Cordless Communication-Personal communication networks-Communication satellite systems-Third generation mobile services-Wireless enterprise networks.

TEXT BOOKS

1. Yi-Bing Lin and Imrichchlantae., "Wireless and Mobile Network Architecture " John wiley,2001
2. Lee W.C.Y.., "Mobile Cellular Telecommunication Systems "McGraw Hill International Edition,1990.

REFERENCES

1. Kanch Pallavan, Prahant krishnamoorthy.,"Principles of Wireless Networks" Pearson Education Publication,2001
2. Rappaport.,"Wireless and Mobile Communication",Pearson Education, 2001
3. Stephen W.Gibson., "Cellular mobile RadioTelephones" Prentice Hall Inc, Englewood cliffs, New Jersey 07632,1987
4. Jakes W.C.., "Microwave mobile communication" Wiley, NewYork,1975.
5. Paul Bedell, "Mobile Communication Wireless crash course"TMH-2001.

COURSE OUTCOMES

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

CO1. Explain wireless networks, architecture of wireless networks and cell acquisition.
CO2. Examine the call flow scenario in GSM environment.
CO3. Measure the practical applicability of mobility management concepts.
CO4. Illustrate wireless application protocols to develop mobile content application.
CO5. Explain the classification of mobile communication system.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			2								3	2		
CO2			3	2	3							3		3	
CO3			3		3					2				3	
CO4			3		3			1				3		3	
CO5	2	1	3							2			2		

ECPESCN	ELECTRONIC MEASUREMENTS AND INSTRUMENTATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide a brief knowledge of measurements and measuring instruments related to engineering.

Unit I: Measuring Instruments and Characteristics

Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding

Voltmeters, Specifications of Instruments.

Unit II: Bridges

DC bridges- Wheatstone's bridge, Kelvin's bridge, AC bridges-measurement of inductance-Maxwell's bridge, Hay's bridge, measurement of capacitance, Schering bridge, Wien bridge, errors and precautions in using bridges, Q-meter

Unit III: Display devices and Recorders

Cathode ray Oscilloscope: Principles and operation, applications of CRO, dual beam- dual trace oscilloscope, Storage Oscilloscopes, Digital Storage CROs. LCD- LED-Plasma displays. Recorders: Types of recorders- Strip chart recorders, XY recorders, Magnetic tape recorders.

Unit IV: Signal Generators and Analyzers

Signal Generators: Sinewave Generator: Sweep Generator, Pulse and Square Wave Generator, Frequency Synthesized Generator, Function Generator. Signal analyzer: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers.

Unit V: Transducers

Transducers-active and passive transducers-Resistance transducers, Capacitance transducers, inductance transducers, Strain gauges transducers, LVDT transducers, Piezo electric transducers, Resistance thermometers, Thermocouples, Measurement of physical parameters-flow measurement, liquid level measurement, data acquisition systems.

TEXT BOOKS

1. H.S.Kalsi, "Electronic instrumentation", McGraw Hill Education; 3rd edition, 2017.
2. A.D.Helbincs, W.D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI, 5th Edition,2003.

REFERENCES

1. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press India; Third edition ,2013.
2. B. M. Oliver, J. M. Cage, "Electronic Measurements and Instrumentation" TMH Reprint 1971.
3. Emest O. Doebelin and Dhanesh N Manik, "Measurement Systems" - McGraw Hill Education; 6th edition (1 July 2017).
4. K. Lal Kishore, "Electronic Measurements and Instrumentations" Pearson Education,2010.
5. T. R. Padmanabham, "Industrial Instrumentation", Springer2009.

COURSE OUTCOMES

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

CO1. Discuss the principle of operation and performance characteristics of measuring instruments.

CO2. Illustrate measurement of resistance, capacitance, inductance and frequency using bridge circuits

CO3. Describe the principle of operation and applications of display devices and recorders

CO4. Describe the principle of operation, working of signal generators and analyzers

CO5. Apply the complete knowledge of various transducers to measure the physical quantities.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	3		1										3		
CO3	2												2		
CO4	2	3	2		2								2	2	
CO5	3		2		2							2	3	2	

ECPESCN	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To comprehend the image processing fundamentals and enhancement techniques in spatial and frequency domain.
- To understand the various image processing techniques.
- To study the various image segmentation and morphology operations.
- To comprehend the basics of video processing and video coding.

Unit I: Digital Image Fundamentals and Image Transforms

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, 2D transforms - DFT, DCT.

Unit II: Image Enhancement

Definition-Spatial domain methods- Frequency domain methods -Histogram Processing - Histogram Modification Technique - Neighborhood Averaging - Median Filtering - Image smoothing in Spatial domain - Low Pass filtering - Image sharpening by differentiation and High pass filtering.

Unit III: Image Restoration

Image Restoration - degradation model, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

Unit IV: Image Encoding

Objective and subjective fidelity criteria - Basic Encoding Process- C-Mapping - Quantizer - Coder - Lossless Compression: Variable length coding – LZW coding – Bit plane coding – Predictive coding - Differential Pulse Code Modulation - Lossy Compression: Transform coding – Wavelet coding – Basic of image compression standard – JPEG, MPEG.

Unit V: Image Segmentation

The Detection of discontinuities; Point detection, Line detection, - Edge detection - Edge linking and Boundary Detection: Local Analysis - Thresholding: Global Thresholding techniques and Optimal thresholding - Basic formulation of Region oriented segmentation.

TEXT BOOKS

1. Refael C Gonzalez, Richard. E.Woods, Paul Wintz, "Digital Image Processing", Fourth edition, Pearson Education, 2018.

REFERENCE BOOKS

1. Anil K Jain., "Fundamentals of Digital Image Processing", Prentice Hall,1987.
2. Rosenfeld A, Kak A.C, "Digital Image Processing", Academic Press,1979.
3. William K.Pratt, "Digital Image Processing", John Wiley and Sons,1978.

COURSE OUTCOMES

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

CO1: Outline different transformation techniques used in image processing.

CO2: Describe different techniques used for image enhancement.

CO3: Restore degraded images by applying restoration techniques.

CO4: Apply coding techniques to compress the image.

CO5: Apply segmentation procedures to partition the image in to segments.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	3	2	
CO2	3	3	2	2	1							2	3	2	
CO3	3	3	2	2	1							2	3	2	
CO4	2	3	2	2	1							2	3	2	
CO5	3	2	2	2	1							2	3	2	

ECPESCN	DSP PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an exposure to the various fixed point and floating-point DSP architectures
- To understand the techniques to interface sensors and I/O circuits

Unit I: Fundamentals of Programmable DSP's

Review of Fixed-Point and Floating Point Numbers-Fixed-Point and Floating Point Arithmetic-Multiplier and Multiplier accumulator–Modified Bus Structures and Memory access in PDSP's–Multiple Access Memory –Multi Port Memory–VLIW Architecture – Pipelining – Special Addressing Modes in PDSP's – On Chip Peripherals.

Unit II: TMS320C54X Processor

Introduction - Architecture of 54X, 54X Buses, Internal Memory Organisation, Central Processing Unit-Data Addressing, Instruction Set, Pipeline Operation, Code Compressor Studio – Application Programs.

Unit III: DSP56XXX Processor

Freescale DSP56XXX Architecture and Programming - Introduction, Core Architecture Overview, Data Arithmetic Logic Unit, Address Generation Unit, Program Control Unit, PLL and Clock Generator, Debugging Support, Instruction Cache, External Memory Interface, DMA Controller, Operating Modes and Memory Spaces, Instruction Set, Benchmark Programs.

Unit IV: Filtering Using DSP56XXX

FFT and Filter Implementation using DSP56XXX - Implementation of FFT : Radix- 2 Fast Fourier Transforms – Block Floating Point Scaling – Optimized Radix- 2 DIT FFT-Leakage- Implementation of Digital Filters: Single and Double Precision FIR Filters – IIR Filters – Multirate Filters.

Unit V: TMS320C6X Processor

TMS320C6x Architecture: CPU Operation – Pipelined CPU- VelociTI – C64x DSP-Software tools: EVM – DSK Target C6x board – Assembly File – Memory Management-Compiler Utility- Code Initialization – Code Composer Studio – Interrupt Data Processing.

TEXT BOOKS

1. Randy Yates, "Technical Reference Fixed-Point Arithmetic: An Introduction", Digital Signal Labs, 2013.
2. Jean-Michel Muller, Nicolas Brisebarre, Florent de Dinechin, Claude-Pierre Jeannerod Vincent Lef´ever, Guillaume Melquiond, Nathalie Revol, Damien Stehl´e, Serge Torres "Handbook of Floating-Point Arithmetic", Birkhauser Boston,2010.

REFERENCES

1. B.Venkataramani, M.Bhaskar, "Digital Signal Processors, Architecture, Programming and Application", Tata McGraw Hill, New Delhi, 2011.
2. Nasser Kehtarnavaz and Mansour Keramat, "DSP System design using the TMS320C600" Prentice hall 2000.
3. Analog devices, DSP Division, "Digital Signal Processing Applications using the ADSP – 2100 Family, Volume1" Prentice Hall,1992.
4. Mohammed El-Sharkawy, Digital Signal Processing Applications with Motorola's DSP56002 Processor, Prentice Hall,1997.
5. Sophocles J.Orfanidis, " Introduction to signal processing" , Prentice Hall, 1996.

COURSE OUTCOMES

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

CO1. Discuss the architecture details of fixed-point DSPS.
CO2. Explain the architecture details of floating-point DSPs.
CO3. Show about the control instructions, interrupts, pipeline operations, memory and buses.
CO4. Illustrate the features of on-chip peripheral devices and its interfacing with real time application devices.
CO5. Implement the signal processing algorithms and applications in DSPs.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	2		3	2			1			3		
CO2	3		3			3	2		2				3		
CO3		1				3					1	2	3		
CO4			3		2								3		
CO5	3			2	2				2			2	3		

ECPESCN	MIXED SIGNAL DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the issues related to mixed signal design.
- To learn the concepts of mixed circuits like filters, capacitor switches, data converters and PLL.

Unit I: Basics of Mixed Signal Design

Review of MOSFET and its characteristics, Digital CMOS design and Analog CMOS design-Analog Signal Processing–Example of VLSI Mixed-Signal Circuit Design– Mixed-signal Layout – Interconnects and data transmission- Voltage mode signaling and data transmission-Current mode Signaling and data transmission.

Unit II: Integrator Based Filters

Low Pass filters ,active RC integrators, MOSFET-C integrators, Transconductor-C integrators, Discrete time integrators -Filtering topologies: Bilinear transfer function-Biquadratic transfer function-Filters using Noise shaping.

UNIT III: Data Converter Architecture

Digital –to-Analog Converter (DAC) Architectures-Voltage Scaling- R-2R ladder Networks- Current Steering- Charge Scaling DACs-Cyclic DAC and Pipeline DAC. Analog-to-Digital Converter (ADC) architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADCs, Successive Approximation ADC.

Unit IV: Data Converter Modeling

Sampling and Aliasing: A modeling approach – Impulse sampling – The sample and hold Quantization noise. Data converter SNR:–Clock Jitter–Improving SNR using Averaging Decimating filter for ADCs – Interpolating filter for DACs – Band pass and High pass sinc filters

UNIT V: Switched Capacitor Circuits and Frequency Synthesizers

Switch Capacitor Circuits: General Considerations- Sampling switches-Switched Capacitor Amplifiers- Switched Capacitor Integrator.

Frequency Synthesizers: Voltage Controlled Oscillators – Phase Locked Loops-Simple PLL- Charge Pump PLLs - Non-ideal Effects in PLLs- Delay locked loops- its Applications.

TEXT BOOKS

1. R. Jacob Baker, “CMOS Mixed-Signal Circuit design”, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi, “Design of analog CMOS integrated circuits”, McGraw-Hill, 2003.
3. R. Jacob Baker, “CMOS Circuit Design, layout and simulation”, Revised second edition, IEEE press,2008.

REFERENCES

1. Van de Plassche, Rudy J., “CMOS Integrated ADCs and DACs”, Springer, Indian edition,2005.
2. Arthur B. Williams, “Electronic Filter Design Handbook”, McGraw-Hill,1981.
3. R. Schauman, “Design of analog filters”, Prentice-Hall 1990 (or newer additions).
4. M. Burns et al., “An introduction to mixed-signal IC test and measurement”, Oxford University press, first Indian edition,2008.

COURSE OUTCOMES

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

CO1. Explain the Layout, Interconnect and signaling modes in Mixed Signal

circuit.

CO2. Analyze the characteristics of Integrator based CMOS analog and digital filters.

CO3. Construct various data converter architecture circuits with an understanding of the characteristics of each type of data converters

CO4. Explain various procedures employed to improve signal to noise ratio in data converters.

CO5. Describe the operations of switched capacitors and frequency synthesizers.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2									2	3		
CO2	3	3	2									2	3		
CO3	3	3	2									2	3		
CO4	3	3	2									2	3		
CO5	3	2										2	3		

ECPESCN	HIGH SPEED ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce transmission line basics and various parameters that affects the performance of High speed circuits.
- To give exposure on analysis and design of RF circuits and components.
- To introduce various techniques for fabricating printed circuit board and assembling printed circuit board.

Unit I: Basics

Transmission line theory (basics) crosstalk and non-ideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise. Noise Analysis: Sources, Noise Figure, Gain compression–Harmonic distortion–Intermodulation–Cross- modulation – Dynamic range.

Unit II: Passive and Active components

Passive components: RF behavior of Resistor, Inductor and Capacitor; Active RF components: RF diodes, BJT, MOSFET, High electron mobility transistor– Modelling Diodes and Transistors at Radio frequencies.

Unit III: RF Amplifiers

RF Amplifier Design – Stability – Low Noise Amplifiers – Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations – Cross-over distortion Efficiency RF power output stages.

Unit IV: RF Mixers and Oscillators

Mixers –Up conversion, down conversion – Conversion gain and spurious response. Oscillators, PLL, Transceiver architectures.

Unit V: Printed Circuit Board

Printed Circuit Board: Anatomy – CAD tools for PCB design – Standard fabrication – Micro via Boards. Board Assembly: Surface Mount Technology – Through Hole Technology – Process Control and Design challenges.

TEXT BOOKS

1. Thomas H. Lee, "Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 1998(2013 Reprint), ISBN: 9780521639224.
2. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", Wiley-IEEE Press,2000.
3. Reinhold Ludwig, Pavel Bretchko, "RF Circuit Design: Theory and Applications", Pearson Edition,2000,ISBN:9788131702437.

REFERENCES

1. Chris Bowick, "RF Circuit Design", Elsevier, U.S./India, 2007 (2nd Edition), ISBN:9780750685184
2. Behzad Razavi, "RF Microelectronics", Pearson India, 2014(2nd Edition), ISBN: 9789332518636.

COURSE OUTCOMES

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

CO1. Explain various factors that affect the performance of high speed circuits.

CO2.Describe the behavior of Passive and active components at Radio frequencies.

CO3.Design and analyze RF amplifiers for various applications.

CO4. Demonstrate the working of RF Oscillators and Mixers.

CO5. Demonstrate various techniques for fabricating and assembling PCB.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2								2	3		
CO2	3	3										2	3		
CO3	3	3	3	2								2	3		
CO4	3	3										2	2		
CO5	3		3	2	2							2	2	2	

ECPESCN	MULTIMEDIA COMPRESSION TECHNIQUE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To have a complete understanding of error–control coding.
- To understand encoding and decoding of digital data streams.
- To introduce methods for the generation of these codes and their decoding techniques.
- To have a detailed knowledge of compression and decompression techniques.
- To introduce the concepts of multimedia communication.

UNIT I : Introduction

Overview of information theory, redundancy - Taxonomy of compression techniques-Overview of source coding, source models, Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, scalar quantization, vector quantization, rate distortion theory, structure quantizers - Evaluation techniques-error analysis and methodologies.

UNIT II : Text Compression

Huffman coding - Arithmetic coding – Shannon - Fano coding and dictionary techniques - LZW family algorithms - Entropy measures of performance - Quality measures.

UNIT III : Audio Compression

Audio compression techniques-frequency domain and filtering-basic sub band coding-application to speech coding-G.722-application to audio coding-MPEGaudio, progressive encoding for audio - Silence compression, Speech compression techniques - Vocoders.

UNIT IV : Image Compression

Predictive techniques - PCM, DPCM, DM, Transform coding, Introduction to JPEG, JPEG-2000, JBIG standards, Study EZW, SPIHT algorithm.

UNIT V : Video Compression

Video signal representation - Video compression techniques-MPEG, Motion estimation techniques- Overview of Wavelet based compression and DVI technology, Motion video compression - PLV performance – DVI real time compression.

TEXT BOOKS

1. Sayood Khaleed, “Introduction to data compression”, Morgan Kauffman, London, 2006.
2. Gibson J D, Berger T, Lookabaugh T, D. Lindbergh, and R. L. Baker,” Digital Compression for Multimedia: Principles and Standards”, Morgan Kaufmann, 1998

REFERENCES

1. Watkinson J, “Compression in video and audio”, Focal press,London,1995.
2. Mark Nelson, “Data compression book”, BPB Publishers, New Delhi,1998.
3. Jan Vozer, “Video Compression for Multimedia”, AP professor, NewYork,1995.

COURSE OUTCOMES

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

CO1. Describe various multimedia compression parameters.
CO2. Describe compression and decompression techniques for text.
CO3. Analyze various compression techniques available for Image.
CO4. Discuss in detail about various audio and video compression techniques.
CO5. Apply the compression concepts in multimedia communication

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		1		2		2				2	2		
CO2	2	2	2							2			2		
CO3	2	2	2	2	1	2		2	2	2	1		2		
CO4	2	2	2		1	2		2	2	2	1		2	2	2
CO5	2	2	2	2	1			2	2		1		2	2	2

ECPESCN	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To conceptualize the organization and architecture of Digital computer.
- To introduce the design procedures for data path and control path in computer system.
- To introduce the hierarchical memory system including cache memories and virtual memory in computers.
- To impart knowledge of I/O devices and standard I/O interfaces.
- To introduce the basics of pipelining and parallel processing techniques.

Unit I: Basic Structure of Computers

Functional units - Basic operational concepts - Bus structures - Software performance – Memory locations and addresses – Memory operations – Instruction and instruction sequencing–Addressing modes–Assembly language – Basic I/O operations – Stacks and queues.

Unit II: Arithmetic Unit

Signed number representation– Fixed Point Representation – Floating Point number representation – Fixed point arithmetic: Addition, Subtraction– Multiplication: Robertson algorithm, booth’s algorithm –Division: Restoring and Non- Restoring division algorithm –Floating point arithmetic — ALU design (Combinational and Sequential).

Unit III: Processing Unit and Pipelining concept

Fundamental concepts - Hardwired control - Micro programmed control- Nano Programming - Pipelining - Basic concepts - Data hazards - Instruction hazards - Superscalar operation.

Unit IV: Memory Unit

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

Unit V: System Organisation

Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface circuits–Standard I/O Interfaces (PCI,SCSI,USB)–Parallel processing architectures and challenges.

TEXT BOOKS

1. Behrooz Parhami, “Computer Architecture: From Microprocessors to Super Computers”, Oxford,University Press India, 2012 1st Indian Edition.

2. Carl Hamachi, ZvonkoVranesic and SafwatZaky," Computer Organisation", McGraw Hill India, 2014 (5thEdition).
3. B. Govindarajulu, "Computer Architecture and Organization:Design Principles and Applications", Second Edition, Tata McGraw-Hill 2010.

REFERENCES

1. William Stallings, "Computer Organisation and Architecture: Designing for Performance", Pearson India, 2016(10thEdition)
2. John P. Hayes, "Computer Architecture and Organisation", McGrawHill India, 2012(3rdEdition)
3. David Patterson John Hennessy, "Computer Organisation and Design (MIPS Edition): The Hardware/Software Interface", Elsevier (Morgan Kaufmann) U.S./India, 2013(5thEdition).

COURSE OUTCOMES

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

CO1. Demonstrate the understanding of functional units of computer, bus structure and addressing mode
CO2. Apply algorithms to design arithmetic unit of a processor
CO3. Describe the working of single cycle and pipelined CPU
CO4. Acquired knowledge on various memory types and memory management techniques
CO5. Explain the concept of I/O organization and parallel processing techniques.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	3	3	2									2	3		
CO3	3	3	2									2	3		
CO4	2	3										2	2		
CO5	2	3		2								2	2		

ECPESCN	MOBILE ADHOC NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Students will get an introduction to Ad Hoc wireless network
- To study the introduction of protocols
- To understand the architecture of MANET
- Enable the students to know techniques involved to support mobility
- To motivate the students to do research on Issues of Ad hoc Networking.

Unit I: Introduction

Introduction to Ad Hoc Networks – Definition, Characteristics, Features, Applications of Ad Hoc Networks-Challenges and Advantages- Characteristics of Wireless Channel-Ad Hoc Mobility Models- Entity and Group-IEEE Standards: 802.11a, 802.11b, 802.11g, 802.15

Unit II: Routing Basics

Function of Network Layer - MAC Protocols- Design Issues, Goals and Classification- Routing Algorithms-Contention Based Protocols, Reservation Based Protocols- Distance Vector and Link State Routing Concepts.

Unit III: Ad Hoc Network Protocols

Designing A Routing Protocol for Ad Hoc Wireless Networks-Goals and Classification of Routing Protocols-Proactive Vs Reactive Routing-Ad Hoc on Demand Distance Vector Routing (AODV)-Destination Sequenced Distance Vector Routing (DSDV)-Hybrid Routing Algorithm-TORA-Multicast Routing Algorithms - Power-Energy Aware Routing Algorithm- QOS aware Routing.

Unit IV: End -To - End Delivery and Security

Transport Layer: Issues in Designing-Transport Layer Classification, AdHoc

Transport Protocols. Security Issues in AdHoc Networks: Issues and Challenges, Network Security Attacks, Secure Routing Protocols-MANET Simulation tools.

Unit V: Cross Layer Design and Quality of Service

Need for Cross Layer Design, Cross Layer Optimization, Parameter Optimization Techniques-QOS Routing Protocol-Predictive and Location Based QOS Routing Protocol-on Demand QOS Routing Protocol- Integration of Ad Hoc With Mobile IP Networks Research Issues of Adhoc Networking.

TEXT BOOKS

1. C.Siva Ram Murthy and B.S.Manoj, "Adhoc Wireless Networks Architectures and protocols", Second edition, PearsonEducation.2007
2. Charles E. Perkins, "Ad hoc Networking", Addison –Wesley,2000.

REFERENCES

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, "Mobile ad hoc networking", Wiley-IEEEpress,2004
2. Mohammad Ilyas, "The handbook of adhoc wireless networks", CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp.483–502.
4. FekriM. Abduljalil and Shrikant K. Bodhe, "A survey of integrating IP mobility protocols and Mobile Ad hoc networks", IEEE communication Survey and tutorials, v 9.no.1 2007.
5. V.T.Raisinhani and S.Iyer "Cross layer design optimization inwireless protocol stacks" Comp. communication, vol 27 no. 8,2004.
6. V.T.Raisinhani and S.Iyer,"ÉCLAIR; An Efficient Cross-Layer Architecture for wireless protocol stacks",World Wireless cong., Sanfrancisco,CA,May2004.

COURSE OUTCOMES

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

CO1. Describe the fundamental characteristics, Features and Applications of MANETs.

CO2. Analyze the performance of various routing protocols and its Goals and Classification

CO3. Ability to understand the routing mechanism of Proactive and Reactive Routing.

CO4. Familiar with the concept of cross layer design and simulation of routing protocols

CO5. Select the suitable routing protocol to be used based on therequirements and for improving network performance.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3						1			3	3	
CO2	3	2				3							3	2	
CO3	3	2	1	3		3		1				1	3		
CO4	3			3		3							3		
CO5					1		1								

ECPESCN	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the architecture and applications of wireless sensor networks
- To understand various protocols of WSN
- To understand operating system and execution environment for WSN

Unit I: Basics

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

Unit II : MANET

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

Unit III: WSN Protocols

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network- Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols

Unit IV: WSN Design

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

Unit V: WSN Operating Systems

Single-Node architecture, Hardware components and design constraints, Operating systems and execution environments, introduction to Tiny OS and nes C.

TEXT BOOKS

1. Waltenegus Dargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory and Practice", By John Wiley & Sons Publications, 2011
2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication.2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004

REFERENCES

1. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks":Technology, Protocols and Applications, Wiley-Inter science (1 January 2010).
2. Philip Levis, and DavidGay, "Tiny OS Programming", Cambridge University Press 2009

COURSE OUTCOMES

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

CO1. Explain the Fundamental Concepts and applications wireless sensor networks.

CO2. Describe enabling technologies and issues in wireless sensor networks.

CO3. Describe WSN protocols.

CO4. Design wireless sensor network

CO5. Discuss different aspects of operating systems and its prototypes.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	3	3	2									2	3		
CO3	3	3	2									2	3		
CO4	2	3										2	2		
CO5	2	3		2								2	2		

ECPESCN	DIGITAL DESIGN THROUGH VERILOG	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the constructs and conventions of the Verilog HDL programming language and various modeling styles supported by the language.
- To distinguish between the various modeling styles like structural, register-transfer (dataflow), and algorithmic (behavioral) and make use of various levels of abstraction for modeling simple digital systems.
- To develop advanced required skill set in the Verilog programming language to foster the needs of the industry.

Unit I: Introduction

VLSI/ASIC design flow–Role of HDL–Verilog as HDL–Emergence of HDLs–Capabilities of Verilog HDL– Levels of Design Description, Hierarchical Modeling Concepts – Verilog CONSTRUCTS AND CONVENTIONS: Introduction, Keywords, Identifiers, White

Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars, Vectors and Arrays, Memories, Expressions, Operands and Operators, Parameters, System Tasks, Compiler Directives – Modules and Ports–modeling Styles.

Unit II: Gate Level Modeling

Introduction, Gate Types–AND/OR Gates, BUF/NOT Gates, Tri-state Gates, Array of Instances of Gate Primitives, Net Delays and Gate Delays, Rise, Fall and Turn-off Delays, Min/Typ/Max Values, Delay Examples, Strengths and Contention Resolution, Verilog Design Examples Using Gate Level modeling.

Unit III: Data Flow and Switch level Modeling:

Data Flow modeling: Introduction, Continuous Assignments, Delays, Expressions, Operands and Operators, Operator Types, Verilog Design Examples Using Data Flow modeling. Switch Level modeling: Introduction, Switch-modeling Elements – MOS Switches, CMOS Switches, Bidirectional Switches, Power and Ground, Resistive Switches, Delay Specification on Switches, Verilog Design Examples Using Switch Level Modelling.

Unit IV: Behavioral Modeling

Introduction, Structures Procedures – Initial and Always Statements, Procedural Assignments, Timing Controls, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel Blocks, Generate Blocks, Procedural Continuous Assignments, Test Benches, Verilog Design Examples Using Behavioral Modeling.

Unit V: Tasks, Functions and User Defined Primitives (UDPs)

Differences between Tasks and Functions, Declaration and Invocation, Examples, UDP Basics, Combinational UDPs, Sequential UDPS

TEXT BOOKS

1. Samir Palnitkar – "Verilog HDL" – Pearson, U.S./ PHI, India – 2015 (2nd Edition).
2. Vaibbhav Taraate – "Digital Logic Design Using Verilog: Coding and RTL Synthesis – Springer", India, 2016.
3. T.R. Padmanabhan and B. BalaTripuraSundari, "Design through Verilog HDL – WSE", IEEE Press, 2004.

REFERENCES

1. Joseph Cavanagh – "Digital Design Verilog HDL and Fundamentals" – CRC Press, U.K./India –2008.
2. Zainalabedin Navabi – "Verilog Digital System Design" – McGraw Hill, India– 2008.
3. Charles Roth, Lizy K. John, ByeongKil Lee – "Digital Systems Design using Verilog – Cengage Learning", India – 2016 (1st Edition).
4. Michael D.Ciletti– "Advanced Digital Design with the Verilog HDL"–Pearson, India – 2011(2ndEdition).

COURSE OUTCOMES

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

CO1. Describe the role of hardware description language (HDL) in design flows and state the basic constructs and conventions of the Verilog HDL

CO2. Outline various gate primitives used in Verilog HDL to implement gate level modeling of Digital circuits.

CO3. Use data flow and switch modeling constructs in Verilog HDL to realize digital circuits

CO4. Use behavioral modeling constructs in Verilog HDL to realize digital circuits

CO5. Use tasks, functions and primitives in Verilog HDL.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2							2			
CO2	2	2	2									2	3	2	
CO3	2	2	2		2							2	3	2	
CO4	2	2	2		2							2	3	2	
CO5		2	2		2							2		2	

ECPESCN	VLSI FABRICATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basic concepts of micro systems and advantages of miniaturization.
- To teach the fundamentals of micromachining and micro fabrication techniques.
- To train the students on the design of micro sensors and actuators and fabrication flow process.
- To bring both circuits and system views on design together.
- To understand MOS transistor as a switch and its capacitance.

Unit-I: Properties of silicon

Crystal structure – Orientation effects – crystal defects – Impurities in Silicon – Properties of Silicon and Gallium Arsenide – Starting materials – Bridgeman techniques for crystal growth – Czochralski technique – Requirements for proper crystal growth.

Unit-II: Diffusion:

Nature of diffusion – Diffusion in a concentration gradient – Diffusion coefficient – Field aided motion – Impurities for Silicon – Substitutional Diffusers – Interstitial and Substitutional Diffusers – Diffusion equation – D-Constant case – Diffusion from a constant source – Diffusion from a limited source – Two step diffusion. Diffusion systems – Choice of dopant source – Diffusion systems for Silicon – Special problems in Silicon diffusion – Redistribution ohmic oxide growth – Emitter push effect.

Unit-III: Thermal oxidation of Silicon:

Oxide formation – Kinetics of Oxide growth – Initial growth phase – Doping dependence effects – Orientation dependence effects – Oxidation systems – Properties of thermal oxides – Anodic oxidation – Oxide growth in anodic oxidation – Properties of anodic oxides.

Unit-IV: Wet chemical etching:

Isotropic etching – Anisotropic etching – Etching of crystalline materials – Silicon etching using HNO3, KOH, TMAH and EDP etching – SiO2 etching – PSG etching – Silicon Nitric etching – Poly Silicon etching – Plasma etching – Wafer cleaning.

Unit-V: Lithographic Process:

Optical techniques – E-beam techniques – Printing and engraving – Optical printing – Lift-off techniques – Photo resist – Mask defects – Printing and engraving defect. Ion implantation: Penetration range – Nuclear stoping – Implantation domestic – Annealing – Ion implantation systems. PolySilicon deposition using LPCVD – PECVD techniques – Metallization – Process flow for BJT fabrication – Process flow for self aligned MOSFET fabrication – Process flow for SOI MOSFET fabrication.

REFERENCES

1. Sorab. K. Ghandhi, "VLSI Fabrication Principles", Wiley Inter Science Publication, New York, 1994.
2. Sami Franssila, "Introduction to Micro fabrication", John Wiley and Sons, 2004.
3. Sze. S.M, "VLSI Technology", McGraw Hill Publishers, 1988.
4. Sze. S.M, "ULSI Technology", McGraw Hill Publishers, 1996.

COURSE OUTCOMES

Upon completing the course, the students will be able to

CO1: Know the basic concepts of micro systems and advantages of miniaturization.

CO2: Understand the fundamentals of micromachining and micro fabrication techniques.

CO3: To be aware about the trends in semiconductor technology, and how it impacts scaling and performance.

CO4: Expertise the knowledge in design of micro sensors and actuators fabrication.

CO5: Able to learn Layout, Stick diagrams, Fabrication steps, Static and Switching characteristics of inverters.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)

Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2							2			
CO2	2	2	2									2	3	2	
CO3	2	2	2		2							2	3	2	
CO4	2	2	2		2							2	3	2	
CO5		2	2		2							2		2	

ECPESCN	NANO MATERIALS AND NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students about the basics of Nanotechnology and its applications.
- To provide adequate knowledge on Nano material properties, Quantum Mechanics and Nano electronics.
- To expose the knowledge on Nano electronics devices and its applications.

Unit–I

Introduction to nano materials - Preparation/Synthesis: History of nano materials - Influence on properties by "nano - structure induced effects" - Some present and future applications of Nano materials, Approaches for synthesis of nanostructures - Processes for producing ultrafine powders - Chemical Synthesis - Physical Synthesis – Bio mimetic processes.

Unit–II

Characterization and Properties of Nano materials: Structural Characterization - X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy - Mechanical - Introduction - Property changes due to nano structuring - Strengthening and Toughening Mechanisms – Chemical – Sensors – catalysis – Magnetic-Magnetic Properties of small atomic clusters – Why interest in nano-scale magnetic materials-Classifications of magnetic nanomaterial – Optical-Absorption of light in semiconductor materials - Optical properties of a translucid object.

Unit-III

Quantum Mechanics: Schrodinger – Time Dependent / Independent Equation- Electron to Electron Interactions-Differential to Matrix Equation-Choosing Matrix Parameters-Non-Equilibrium Green's Functions (NEGF)-Conductance Functions for Coherent Transport-Elastic Dephasing-Quantum of Conductance-2D Conductor as ID Conductors in Parallel.

Unit–IV

Fundamentals of Nano Electronics: The New Ohm's Law-The Bottom-Up Approach-Electrons Flow-Ballistic and Diffusive Transport-Diffusion Equation for Ballistic Transport-Conductivity, Drift-electrostatics- smart contacts. Nano transistors-current equation, physics of Ballistic MOSFET – characteristics.

Unit–V

`Carbon Nanotubes: Graphene band structure, properties. Synthesis of Carbon Nanotubes – The Structure of Carbon Nanotubes, Carrier Concentration – Electronic properties of Nanotubes – Electron Transport in ballistic conductor – 98 Carbon Nanotube Electronics: Theory of CNT P-N junction - Carbon Nanotube Transistors – density of states - Schottky Barrier – Ohmic Contacts– Schottky Contacts –Subthreshold Short- Channel Effects.

TEXT BOOKS

1. Guozhong Cao, "Nanostructures &Nanomaterial: Synthesis, Properties and Applications", Imperial College Press - World Scientific Publishing Co. Ltd, London - 2004.
2. SupriyoDatta, "Lessons from Nano electronics. A New Perspective on Transport", Purdue University, USA, 2012.

REFERENCES

1. Janos H. Fendler, "Nanoparticles and Nanostructured films: Preparation, Characterization and Applications", ISBN: 3527294430, Wiley VCH, 1998.
2. Kenneth J. Klabunde, "Nanoscale materials in chemistry", ISBN: 0471383953, John Wiley & Sons, 2001.
3. Zhon Ling Wang, "Characterization of Nano phase materials", ISBN:3527298371, Wiley-VCH Verlag GmbH, 2000.
4. William Andrew, "The physics of Carbon Nanotube Devices", ISBN: 978-0-8155-1573-9 François Léonard, 2009.

COURSE OUTCOMES

CO1: Will get to know the future of electronics and its applications. (Unit I, II & IV)

CO2: Updates the students with the recent advancements in the nanotechnology. (Unit I, II & IV)

CO3: To introduce the students the concepts of quantum mechanics for analysis of nano electronic devices. (Unit III)

CO4: To understand Nano-material (Unit V)

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	

ECPESCN	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to the fundamentals Micro electromechanical systems.
- To teach the fundamental concepts MEMS Fabrication process.
- To study the design concepts of MEMS devices.
- To compare types and Functionalities of various methods of micromachining.

Unit–I : Miniaturization of Systems

Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling in mechanical domain, Scaling in Electrostatic domain, Scaling in thermal domain.99

Unit–II : Micromachining Technology

Silicon as a material for micromachining-Crystal Structure , Silicon Wafer Preparation-Thin Film Deposition –Evaporation, Sputtering, CVD, Epitaxial Growth, Thermal Oxidation-Lithography – Photolithography , Lift-Off Techniques- Etching – Isotropic Etching, Anisotropic Etching, Etch Stops, Dry Etching – Silicon Micromachining – Bulk , Surface Micromachining – Specialized Materials for Microsystems-Polymers, Ceramic Materials- Advanced Process Of Micro fabrication- Wafer Bonding Techniques, Special Micro fabrication Techniques.

Unit–III : Silicon Capacitive Accelerometer

Overview, advantages of silicon capacitive accelerometer , typical applications, an example of a prototype, material used, fabrication process, principle of operation. Piezoresistive pressure sensor**:** overview, advantages of piezoresistive pressure sensor, typical applications, material used, fabrication process, principle of operation, An example commercial Products.

Unit–IV : Modelling of Solids in Microsystems

The simplest Deformable Element: a bar- Transversely deformable Element: a beam-energy methods for elastic bodies- Bimorph effects.

Unit–V : MEMS Actuators and their Applications

Actuation mechanisms – Electrostatic actuation – Electrostatic cantilever actuators – Electrostatic comb drives – Feedback stabilization of electrostatic actuators - lectrostatic micro grippers – Electrostatic relays and switches – Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation.

TEXT BOOKS

1. G.K.Ananthasuresh, K.J.Vinoy,S.Gopalakrishnan, K.N.Bhat,V.K.Aatre, "Micro and smart systems", Wiley 2019.
2. Tai-Ran-Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGrawHill, New Delhi, 2002.

REFERENCES

1. Stephen D. Senturia, "Microsystem Design", Springer International Edition,2001.
2. Chang Liu, "Foundations of MEMS, (ILLINOIS ECE Series)", Pearson Education International,2006.
3. S.M. Sze, "Semiconductor Sensors", John Wiley and Sons, 1994.
4. Gregory T.A. Kovacs, "Micro machined Transducers", WCB McGraw Hill, 1998.

COURSE OUTCOMES

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

CO1: The fundamentals of Micro electromechanical systems and their applications will be studied. (Unit I)

CO2: The fundamental concepts of MEMS Fabrication process will be gained. (Unit II)

CO3: The design concepts of MEMS devices will be developed. (Unit II, III & IV)

CO4: The Functionalities of various methods of micromachining involved in different MEMS devices will be studied. (Unit V)

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	

ECPESCN	FUNDAMENTALS OF NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the idea of quantum mechanics which is totally different from classical mechanics
- To impart knowledge of the structure of carbon nanotubes and its properties
- To make the students to understand principles, properties and applications of carbon nanotubes devices
- To study about generation of CNTFETs and its fabrication techniques
- To familiarize the students to model the nano electronic devices

Unit I: Quantum Mechanics

Principles of quantum mechanics – Wave Particle Duality - The Uncertainty Principle - Schrodinger – Time Dependent / Independent Equation- Electron in free space -The Infinite Potential Well -Extensions of the Wave Theory to Atoms: The One-Electron Atom- Formation of Energy Bands- The Kronig-Penney Model- The k-Space Diagram-The k-Space Diagrams of Si and GaAs.

Unit II: Carbon Nanotube (CNT)

The Structure of Carbon Nanotube s- Graphene band structure, properties. Synthesis of Carbon Nanotubes – electronic, vibrational, mechanical and optical properties of CNT-Applications of CNT. Fabrication of Fullerene (C60). Functionalization of Carbon Nanotubes: covalent functionalization of CNTs-non covalent functionalization of CNTs- modification of CNTs via mechnochemical reactions - electrochemical deposition, electroless deposition; plasma activation of CNTs.

Unit III: Carbon Nanotube devices

Carrier Concentration – Electronic properties of Nanotubes – Electron Transport in ballistic conductor – Carbon Nanotube Electronics: Theory of CNT P-N junction - Carbon Nanotube Transistors – density of states - Schottky Barrier – Ohmic Contacts– Schottky Contacts –Subthreshold, Short- Channel Effects.

Unit IV: CNT Transistors

Generation of CNTFETs – Bottom gate transistor- Top gate transistor – Cylindrical gate transistor, Fabrication Techniques : Di-Electrophoresis method - Solution deposition – Imprint Techniques.

Unit V: Modelling of Nano Conductors and Transistors

The New Ohm's Law-The Bottom-Up Approach-Electrons Flow-Ballistic and Diffusive Transport-Diffusion Equation for Ballistic Transport-Conductivity, Drift-electrostatics- smart contacts. Nano transistors-current equation, physics of Ballistic MOSFET – characteristics.

TEXT BOOKS:

1. Donald A. Neamen "Semiconductor Physics and Devices Basic Principles", Third Edition, McGraw-Hill, 2003.
2. Supriyo Datta "Lessons from Nanoelectronics. A New Perspective on Transport", Purdue University, USA,2012.
3. William Andrew "The Physics of Carbon Nanotube Devices", ISBN: 978-0-8155-1573-9 François Léonard, 2009.
4. Michael J. O'Connell, "Carbon Nanotubes: Properties and Applications, ISBN: 9780849327483, CRC Press, 2006

COURSE OUTCOMES

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

CO1: Understand the basics of quantum mechanics with reference to electron.

CO2: Gain in depth knowledge of the structure of carbon nanotubes and its properties
CO3: Understand principles, properties and applications of carbon nanotubes devices for Nanoelectronics.
CO4: Acquire the knowledge of CNTFETs and its fabrication techniques
CO5: Model and fabricate a CNT based nano electronic device using various fabrication techniques with the thorough knowledge of material and device properties.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	
CO5	3	2											3	2	

ECPESCN	FUNDAMENTALS OF IC PACKAGING, ASSEMBLY AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the importance on Integrated Circuit Packaging.
- To impart the knowledge on various manufacturing process technologies.
- To understand the design considerations on electrical, thermal and mechanical parameters.
- To test and analyse the performance characteristics of Integrated Circuit Packages.
- To study and understand various emerging technologies in the field of Integrated Circuit Packaging.

Unit I: Overview of IC Packaging Technology

IC Packaging Roadmap – Technology Driving Forces – Rent's Rule – Hermetic Vs Non – hermetic Packages – Multidiscipline Issues.

Unit II: Manufacturing Considerations

Die Attach Technology – Die Interconnect Technology – Die Coating – Plastic Package Manufacturing Process – Ceramic Package Manufacturing Process – Metal Can Package Manufacturing Process – Multichip Module – Environmental Control: ESD & Clean room Classification – Quality and Reliability Issues.

Unit III: Design Considerations: Electrical

Reflection Noise – Crosstalk Noise – Switching Noise Signal Attenuation and Dispersion – Thermal: Thermal Resistance – Heat Flow Mechanisms **–** Mechanical: Coefficient of Thermal Expansion (CTE) – Thermal Stress and Strain Distribution Management.

Electrical Test: Electrical Performance Testing – Electrical Test Methods – Electrical Analysis.

Unit IV: Emerging Technologies

Ball Grid Array, Chip – scale package (CSP) – Flip Chip, Direct Chip Attach (DCA) and Wafer Scale package (WSP) – 3D Packaging – Known Good Die.

REFERENCES

1. J.H. Lau, W. Nakayama, J. Prince and C.P. Wong, "Electronic Packaging: Design, Materials, Process, and Reliability", McGraw Hill, 1998.
2. G.D. Giacomo, "Reliability of Electronic Packages and Semiconductor Devices", McGraw – Hill, 1996.
3. J.C. Whitaker, "The Electronics Handbook", CRC Press, 1996.
4. Tummala, R.R. and Rymaszewski, "E.Micro electronics Packaging Handbook". Van Nostrand Reinhold, New York, 1989.

COURSE OUTCOMES

Upon completing the course, the student should have

CO1: Understood the importance and issues of Integrated Circuit Packaging.
CO2: Acquired the expertise in the manufacturing of various Integrated Circuit Packages.
CO3: Understood the design considerations on various physical parameters.
CO4: The ability to test and analyse the performance characteristics of Integrated Circuit Packages.
CO5: Acquired the knowledge of various emerging Integrated Circuit Package technologies.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO 2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	
CO5	3	2											3	2	

ECPESCN	OFDM FOR WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to understand basic knowledge about OFDM principles, OFDM signal processing and its Implementation.
- To understand coding and interleaving techniques to reduce channel effects various and synchronization procedures in OFDM.
- To understand various channel estimation techniques and PAPR reduction schemes in OFDM system.
- To describe multiple accesses in OFDM and gain knowledge on OFDM multiple access schemes
- To know about OFDMA applications and OFDMA based mobile wireless networks.

Unit I: OFDM Basics

Introduction Wireless OFDM – OFDM Principles – System Model – Generation of Sub Carrier Using IFET – Guard Time and Cyclic Extension, Choice of OFDM Parameters – OFDM Signal Processing.

Unit II: Coding and Modulation

Introduction – Forward Error Correction Coding – Interleaving – Quadrature Amplitude Modulation – Coded Modulation – Synchronization – Sensitivity to Phase Noise and Frequency Offset and Timing Errors – Synchronization Using Cyclic Extension and Special Training Symbols.

Unit III: Channel Estimation for OFDM System

Coherent and Differential Detection – Coherent Detection – One and Two Dimensional Channel Estimators, Special Training Symbols – Decision Directed Channel Estimation – Differential Detection – Differential Detection in the Time and Frequency Domain – Differential Amplitude and Phase Shift Keying.

Unit IV: Orthogonal Frequency Division Multiple Access

Frequency Hoping in OFDMA – Difference Between OFDMA and MC-CDMA, OFDMA System Description – Channel Coding – Modulation – Time and Frequency Synchronization, Initial Modulation Timing and Frequency Offset Synchronization Accuracy – Power Control – Random Frequency Hopping Operation – Dynamic Channel (Simple and Fast) – Capacity of OFDMA.

Unit V: Application of OFDM

Digital Audio Broadcasting – Front End Impairments in the OFDM Modem – System Simulation Tools – Analysis and Simulation of The Main Front End Effects – Terrestrial Digital Video Broadcasting – Magic Wand (Wireless ATM Project).

IEEE 802.11- Hyper LAN/@ and MMAC – Wireless LAN Standards – OFDM Parameters – Channelisation – OFDM Signal Processing – Training – Difference Between IEEE 802.11 - Hyper LAN/2 and MMAC.

TEXT BOOKS

1. Richard Van NEE and RAnjee Prased, "OFDM for Wireless Multimedial Communication", Artech House, 2000.
2. Mare Engels, "Wireless OFDM Systems" , Klumer Academinc Publishers, 2002.
3. Prasad.R "Universal Wireless Personnel Communication" , Artech House Publishers; Unabridged edition (31 October 2001).

COURSE OUTCOMES

On completion of this course the students will be able to

CO1: Describe the principles of OFDM and its Implementation.

CO2: Implement the coding and interleaving procedure to mitigate the channel effects.

CO3: Analyze synchronization techniques, channel estimation techniques and PAPR

reduction techniques in OFDM.

CO4: Describe multiple accesses in OFDM and various applications of OFDM.

CO5: Summarize the applications of OFDM in wireless networks.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	
CO5	3	2											3	2	

ECPESCN	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Working of operational amplifiers and various applications of op-amp such as Multi vibrators, Oscillators and filters.
- The theory of ADC and DAC and the concepts of waveform generation and some special Function ICs.
- Micro fabrication techniques of optical integrated circuits and optical wave guides, Opto electronic integrated circuits.

UNIT I: Introduction to Linear IC'S

Integrated circuits – monolithic integrated circuits – active and passive components of IC - fabrication of monolithic IC" s -ideal op-amp - practical op-amp - Various stages of an operational amplifier - simplified schematic circuit of op-amp 741 – op-amp characteristics - offset current and offset voltage - frequency response of an op-amp - noise analysis - slew rate.

UNIT II: Applications of Op – Amp

DC amplifier–AC amplifier-Inverting and Non-inverting Amplifiers-Summing, scaling and Averaging amplifiers - Logarithmic Amplifiers - antilog amplifier - Instrumentation Amplifiers - Differential Amplifiers -Voltage to Current Converters - Current to Voltage Converters – Integrators –Differentiators.

UNIT III: Active Filters & Oscillators

Active filters - Butterworth filters: First order and Second Order Low-Pass filters -First order and Second Order High-Pass filters – Band-Pass filters: wide band-pass filters - narrow band-pass filters – Band-reject filters: wide band-reject filters and narrow band-reject filters - Oscillators: Oscillator Principles, Oscillator types - phase shift Oscillator - Wien Bridge Oscillator - voltage–controlled oscillator.

UNIT IV: Comparators and Converters

Basic Comparator: Comparator characteristics - Zero Crossing Detector – Schmitt Trigger – high speed and precision type comparators - window Detector – Voltage to Frequency converter - Frequency to Voltage converter - D/A converters - A/D Converters - Clippers and Clampers – positive and negative clippers – small- signal and half-wave rectifier – positive and negative clampers - Peak Detector – sample and hold circuit.

UNIT V: Waveform Generators and Other Linear IC'S

Square wave generator – triangular wave generator - saw tooth wave generator – Switched capacitor filter - The 555 Timer –555 Timer as an astable, bistable, monostable multi vibrators– power amplifiers - voltage regulators - Three Terminal fixed and adjustable Regulators-switching regulators-Operation of the basic PLL- Monolithic PLL – 565 PLL Applications.

TEXT BOOKS

1. Gayakwad R.A."Op amp and Linear Integrated circuits", Second Edition, PHI.1988.
2. Roy choudhury and shail Jain "Linear integrated circuits" Wiley Eastern1999.

REFERENCES

1. Jacob millman and Arvin Grabel, "Micro electronics" (2nd edition), McGraw Hill - 1987.
2. Gray and Meyer, "Analysis and design of analog IC's", Wiley International -1996.
3. Paul R. Gray, Paul J. Hurst, Robert G. Meyer, Stephen H. Lewis, "Analysis and design of analog integrated circuits", 4theducation 2018 .

COURSE OUTCOMES

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

CO1. Outline the fabrication steps of integrated circuits
CO2. Design linear application circuits using OP-amp.
CO3. Design of filters and oscillators using Op-amp.
CO4. Describe the operation of data converters using OP- amp.
CO5. Design timer and wave form generation circuits using 555 timer IC.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3	2	
CO2															
CO3	2	2	2										2		
CO4	2	2	2										2		
CO5		2	2												

ECPESCN	AVIONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- provide knowledge in the basic concepts of aerospace engineering including Aerodynamics, Aircraft performance, stability & control, Aircraft Structures and Propulsion.
- provide knowledge on analysis of longitudinal/lateral/directional motions.

Unit I CONFIGURATION OF AIRPLANE AND BASICAERODYNAMICS

How an Airplane flies - Components of an airplane and their functions - Airfoils and streamlines - Forces acting on an airplane - Lift and drag – Types of Drag– Speed and power – International Standard Atmosphere. Wind Tunnel Testing Techniques for Forces and Moments.

Unit II AIRCRAFT PERFORMANCE

Straight and level flight– Conditions for minimum Drag and minimum power–Climbing and gliding –Range and Endurance – Take off and Landing – V-n diagram.

Unit III: STABILITY AND CONTROL

Concepts of static and dynamic stability and control– Yaw and sideslip – Dihedral effect – Rudder requirements – Directional and spiral divergence – Dutch roll– Autorotation and spin.

Unit IV: AIRCRAFT STRUCTURES

Introduction to Aircraft structures - Loads - Types of construction - Design feature of Aircraft materials.

Unit V: PROPULSION

Aircraft propulsion, Rocket propulsion, power plant classification, Principles ofoperation, Areas of their application.

TEXT BOOKS:

1. Kermode, A.C, "Mechanics of Flight' English Book Store", New Delhi, 1982.
2. Van Sickle Neil, D "Modern Airmanship VanNostr and Reinhol", New York,1985.
3. Megson T.H. "Aircraft Structures for Engineering Student's" II Edition, Edward Arnold, Kent, U.S.A. 1990.

REFERENCES:

1. Cary R .Spitzer, "The Avionics Handbook" , CRC Press, 2000.
2. Collinson R.P.G. "Introduction to Avionics" , Chapman and Hall, 1996.
3. Middleton, D.H. "Avionics Systems , Longman Scientific and Technical", Longman Group UK Ltd., England, 1989.
4. Jim Curren, "Trend in Advanced Avionics" , IOWA State University, 1992.

COURSE OUTCOMES

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

CO1: Understand the fundamentals of aircrafts
CO2: The students will explain the available basic concepts of aeronautical engineering to

the engineers and the necessary mathematical knowledge that are needed in modeling physical phenomena involved.

CO3: The students will also have an exposure on various topics such as Lift, Drag, aircraft performance, structure and propulsion and will be able to deploy these skills effectively in the understanding of concepts relating to an aircraft.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2									1			3	3	2
CO2	2							1					3	3	3
CO3			3	3	2								3	3	3

ECPESCN	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the principles of satellite and its architecture.
- To learn about the link establishment of satellite.
- To learn different satellite services.

UNIT I : Introduction to Satellite Communication

Principles and architecture of satellite Communication, Brief history of Satellite systems, Advantages, disadvantages, applications and frequency bands used for satellite communication. Satellite Construction, Satellite obits, Telemetry, Tracking, command and monitoring (TTC & M), Attitude and orbit control system(AOCS), Communication sub-system, and power sub-systems.

UNIT II : Orbital Mechanics

Kepler's laws, Orbital equations, orbital parameters, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity of a satellite, concepts of Solar day and Sidereal day, Eclipse,sub satellite point, sun transitoutage Launching procedures and Launch Vehicle.

UNIT III : Satellite Link Design

Basic Transmission theory, satellite uplink and downlink analysis, Calculation of System noise temperature for satellite receiver, noise power calculation, drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Propagation characteristics and frequency considerations.

UNIT IV : Access Techniques

Types- FDMA concepts –Inter modulation and back off-SPADE system, TDMA concept - Frame and burst structure , Satellite switched TDMA, CDMA concept - VS and SH CDMA system, Random multiple access techniques – Packet switching, Transmit- Receive Earth stations.

UNIT V : Satellite Services

Fixed satellite services - Broadcast satellite services - Satellite TV systems - Domestic satellite systems(INSAT,INTELSAT series), Mobile satellite services –GSM, Global positioning satellite systems, INMARSAT,VSAT, ATM over satellite, Role of future satellite networks.

TEXT BOOKS

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: “Satellite Communications”: Wiley India. 2nd edition2002
2. Tri T. Ha: “Digital Satellite Communications”: Tata McGraw Hill,2009
3. Dennis Roddy: “Satellite Communication”: 4th Edition, McGraw Hill,2009.

REFERENCES

1. Pritchend and Sciulli,"Satellite Communication Systems Engineering" PHI1986.
2. Robert M.Gagliendi., "Satellite Communication" John wiley and sons,1988.
3. Richharia M, "Satellite Communication System Design and Analysis" McGraw- Hill Professional; 2nd edition,1999.
4. Agarwal B.N., "Design of Geo Synchronous Space craft" Prentice Hall,1986.

COURSE OUTCOMES

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

CO1. Describe the architecture of satellite systems as a means of high speed, high range communication system.

CO2. State various aspects related to satellite systems such as orbital equations,

CO3. Solve numerical Problems related to orbital motion.

CO4. Design link budget for the given Parameters and conditions.

CO5. Illustrate earth station technology and multiple access schemes

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2									1			3	3	3
CO2	2							1					3	3	3
CO3			3	3	2								3	3	3
CO4			3	3	2								3	3	3
C05			3	3								1	3	3	3

ECPESCN	WAVELETS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Able to perform frequency domain analysis for signals.
- To understand the principles and property of various wavelets transform.
- To understand the Biorthogonal wavelet transforms.
- Apply wavelet transform for engineering application.

UNIT I : Signal Representation in Fourier Domain

Fourier series, Orthogonality, Orthonormality and the method of finding the Fourier coefficients Complex Fourier series, Orthogonality of complex exponential bases, Mathematical preliminaries for continuous and discrete Fourier transform limitations of Fourier domain signal processing.

UNIT II : Introduction to Wavelet Transform

The origins of wavelets, Wavelets and other wavelet like transforms, History of wavelet from Morlet to Daubechies via Mallat, Different communities and family of wavelets, Different families of wavelets within wavelet communities.

UNIT III : Continuous and Discrete Wavelet Transform

Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Discrete time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Properties of wavelets used in discrete wavelet transform Continuous versus discrete wavelet transform.

UNIT IV : Biorthogonal Wavelets

Biorthogonality in vector space, Introduction to Biorthogonal Wavelet Systems, Signal Representation using Biorthogonal Wavelet System, Concepts of Multi- Resolution Analysis (MRA) and Multi-rate signal processing.

UNIT V : Wavelet Packets

Wavelet Packet Analysis: Signal representation using Wavelet Packet Analysis, Selection of best basis, Introduction of M-Band wavelet system, Signal representation using M-Band wavelet systems. Applications of wavelets in signal and image processing and other related engineering fields.

TEXT BOOKS

1. Y.T. Chan, “Wavelet Basics”, Kluwer Publishers, Boston,1993.
2. C. K. Chui, “An Introduction to Wavelets”, Academic Press Inc., New York,1992.
3. Gerald Kaiser, “A Friendly Guide to Wavelets”, Birkhauser, New York,1995.
4. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall, New Jersey,1993.

REFERENCES BOOKS

1. K. P. Soman, K. I. Rmachandran, N. G. Resmi, "Insight into Wavelets: From Theory to Practice, (Third Edition)", PHI Learning Pvt. Ltd.,2010.
2. A.N. Akansu and R.A. Haddad, "Multi resolution signal Decomposition: Transforms, Subbands and Wavelets", Academic Press, Oranld, Florida,1992.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Prentice Hall, 2007.
4. RaghuveerM.Rao and AjitS.Bopardikar, "Wavelet Transforms: Introduction to Theory & Applications", Pearson Education Asia, New Delhi,2003.

COURSE OUTCOMES

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

CO1. Estimate Fourier and wavelet transform with its terminology.
CO2. Construct the concept of wavelets to practical problems.
CO3. Mathematically analyze the systems or process the signals using appropriate wavelet functions.
CO4. Discuss bi orthogonal wavelets and multirate signal.
CO5. Design certain classes of wavelets to specification and justify the basis of the Application of wavelet transforms to different fields.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3		3	2			1			3		
CO2	3		3			3	2		2				3		
CO3	3	3	3	3		3					1	2	3		
CO4	3	3	3		3								3		
CO5	3	3	3	3	3				2			2	3		

ECPESCN	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart the essential knowledge to the students in the area of Radar and Navigational aids.
- To provide knowledge of about RADAR equation and conquer the knowledge of calculating object distance.
- The students are expected to acquire knowledge about concepts different types of Radar, such as CW, FMCW, MTI Radar, Tracking radar
- To provide sufficient knowledge about radar clutters & Different Navigational systems.

UNIT–I : Basic Concepts and Radar Equations

Introduction to Radar, Basic Radar Block Diagram and Operation, Simple Form of Radar Equation - Bi- Static Radar Equation, Radar Frequencies, Applications of Radar, Merits and De-Merits of Radar.

Detection of Signals in Noise, Receiver Noise and Signal to Noise Ratio, Radar Cross Section of Targets, Pulse Repetition Frequency and Range Ambiguities,Unambiguos Range, Radar System Losses.

UNIT–II : Doppler and MTI Radar

Doppler Effect – Simple CW Doppler Radar Block Diagram and Operation, Basis Principles and Operation of Frequency Modulated CW Radar (FMCW).

MTI Radar Block Diagram – Delay Line Cancellers – Multiple or Staggered Pulse Repetition Frequency - Digital MTI Processing, Pulse Doppler Radar.

UNIT–III : Tracking Radar

Tracking Radar and its Types - Sequential Lobing - Block Diagram of Conical-Scan Tracking Radar.Monopulse Tracking Radar – Amplitude Comparison Monopulse Tracking – Phase Comparison Monopulse Tracking.

UNIT–IV : Radar Clutter and Basic Navigational Radar System

Introduction to Radar Clutter – Types – Surface Clutter Radar Equations, Angel Echoes.

Introduction – Four Methods of Navigation - Radio Direction Finding – Loop Antenna - Adhoc Directional Finder- Automatic Directional Finders- VHF Omni Directional Range (VOR).

UNIT–V : Advanced Navigational System

Hyperbolic System of Navigation – Loran (Long Range Navigation) and Decca Navigation System - DME (Distance Measurement Equipment) and TACAN (Tactical Air Navigation).Omega Navigation System - Satellite Navigation System – Navstar Global Positioning System.

TEXT BOOKS

1. Merrill I. Skolnik, "Introduction to Radar Systems", Third Edition, Tata McGrawHill, 2003.
2. G.S.N.Raju, "Radar Engineering and Fundamentals of Navigational Aids", I.K International Publishing House Pvt. Ltd.,2010.

REFERENCE BOOKS

1. Brookener, "Radar Technology", ArtechHons, 1986.
2. Peyton Z. Peebles, "Radar Principles", John WileyInc., 2004.
3. Nagaraja, N.S., "Elements of Electronic Navigation", McGraw Hill Education, 2004.

COURSE OUTCOMES

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

CO1: Explain about basic radar system and its range performance.
CO2: Describe about CW, FMCW and MTI radar system.
CO3: Explain the types of tracking radar system
CO4: Describe the concepts of radar clutter and basic navigation systems
CO5: Explain about various types of advanced navigation systems

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2								2	3	3	
CO2	3		2		2		2						3	3	
CO3	3	2		2								2	2	2	
CO4	3	2	2	2								2	3	3	
CO5	3	2	2	2								2	3	3	

ECPESCN	INFORMATION AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology

UNIT I : Introduction to cryptography

Information Security concepts - Security Services, Security Mechanisms, Attacks- Types of Attacks, Model for network security, Policy-Types of Policies- Cryptography - Plain text and Cipher Text, Key Range and Key Size, Substitution cipher techniques- Transposition cipher techniques, Block Cipher, Stream Cipher.

UNIT II : Symmetric Key Algorithms

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), Differential and linear cryptanalysis, hash functions.

UNIT III : Public Key Cryptosystems

Brief history of Asymmetric Key Cryptography, Overview of Asymmetric Key Cryptography, RSA algorithm, Knapsack Algorithm, Elliptic curve cryptography, ElGamal, key management, Diffie Hellman key exchange, Digital Signatures and authentication protocols-DSS.

UNIT IV : Network Security

Network Security: IP security overview - IP security architecture - authentication header - encapsulating security payload - combining security association - key management- web security considerations - secure socket layer and transport layer security - secure electronic transaction - security in GSM - security in 3G and 4G

UNIT V : Security Practice and System Security

Authentication Service, Certificate-based, Biometric Authentication– Kerberos, X.509 Authentication services - E-mail security –PGP, IP security - Web security- SSL and TLS, SET. System security-Intruder, Intrusion detection system – Virus and related threats – Virus Countermeasures – Firewalls design principles – Trusted systems.

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security", 8th Edition, Pearson Education, 2009.
2. Behrouz Forouzan, "Cryptography and Network Security", Tata McGraw Hill, 2008.

REFERENCES

1. AtulKahate, "Cryptography and Network Security", Tata McGraw Hill, 2006.
2. Michael E Whitman, Herbert J Mattord, Cengage Learning," Principles of Information Security" 2010.
3. Wolfgang Osterhage, "Wireless Security", CRC Press, 2011.
4. Mark Stamp, "Information Security Principles and Practice" Wiley, Second Edition, 2011.
5. Matt Bishop, "Computer Security: Art and Science", Second Edition, Pearson Education, 2012.

COURSE OUTCOMES

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

CO1: Construct basic security algorithms required by any computing system

CO2: To Interpret knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.

CO3: Estimation of possible security attacks in complex real time systems and their effective counter measures

CO4: Elaborate security threats related to wireless network

CO5: Design a simple secure cryptosystem for an application

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2					2				3	3	1
CO2	3	3	2	3					2				3	3	1
CO3	3	3	3	2					2				3	3	2
CO4	3	3	3	3					2				3	3	1
C05	3	3	3	2					2				3	3	1

ECPESCN	MOBILE COMMUNICATION SYSTEMS AND STANDARDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To make familiar with fundamentals of mobile communication systems.
- Knowledge on mobility support in cellular system.
- Details of advanced mobile communication standards.
- Developments in the current and next generation mobile technologies.
- To identify the applications in mobile communication systems.

UNIT I – INTRODUCTION (12 hours)

Basic cellular system– Uniqueness of mobile radio environment– operation of cellular system-– Cell site antenna and mobile antenna-Multipath fading –Delay spread– Coherence bandwidth- Cell coverage for signals and traffic-Real time co-channel interference– Non co-channel interference.

UNIT II – 2GAND3G CELLULAR SYSTEMS (12 hours)

GSM Architecture – Air interface – Protocols and Signaling - GPRS Architecture – Signaling –Mobility and location management - Interfaces and Protocols – Overview of IS95 – UMTSArchitecture–InterfacesandProtocols-MobilityManagement-Handover and security procedure.

UNIT III– ADVANCED MOBILE COMMUNICATION STANDARDS (12 hours)

IEEE 802.11 WLAN standard and its variants – PHY layer technologies – MAC mechanism –Security, Qos and handover Issues – IEEE 802.15 WPAN standard – Bluetooth Architecture and Protocol stack – IEEE 802.16 Wireless broadband access standard– PHY and MAC layer overviews– WiMAX network architecture– Initialization and handover procedures.

UNIT IV–LTE (12 hours)

HSPA and LTE – Architecture – Radio interface and channels – Resource mapping – Session, mobility and security procedures–LTE Advanced–HeterogeneousNetworks– Internetworking–IPbasedcouplingArchitecture -Historical trend and evolution of LTE technology to beyond 4G.

UNIT V– MOBILE NETWORK,TRANSPORT & APPLICATION LAYERS(12 hours)

Mobile IP–Packet delivery process–Routing optimization – Mobile ad-hoc networks and routing protocols– Mobile TCP–Wireless Application Protocols.

TEXT BOOKS

1. JochenSchiller,“MobileCommunications”,PearsonEducation,SecondEdition, 2012.
2. ItiSaha Misra, “Wireless Communication and Networks – 3G and Beyond”, McGraw Hill Education, Second Edition, 2013.
3. Lee W.C.Y.., "Mobile Cellular Telecommunication Systems" McGraw Hill International Edition,2000.

REFERENCE BOOKS:

1. Rappaport."Wireless and Mobile Communication", Pearson Education, 2001.
2. G.Sasibhushana Rao, "Mobile Cellular Communication", Pearson, 2013.
3. Andreas F. Molisch “Wireless Communications”, Wiley, Second Edition,2014.
4. E.Dahlmanet.al.“3GEvolution:HSPA and LTE for Mobile Broadband”, Elsevier, Second Edition,2008.

COURSE OUTCOMES

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

CO1: Understand and discuss the cellular system design and its technical challenges.

CO2: Examine the call flow scenario in GSM and UMTS environment.

CO3: Measure the practical applicability of mobile communication standards.

CO4: Apply the 4G schemes and its application.

CO5: Illustrate wireless application protocols to develop mobile content application.

Mapping of Course Outcomes with Programme Outcomes(POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			2									2		
CO2			3	2	3									3	
CO3			3		3									3	
CO4			3		3									3	
C05	2	1	3										2		

ECOESCN	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce soft computing techniques and artificial intelligence.
- To learn architecture, functions and various algorithms of neural networks.
- To introduce Fuzzy Logic, various fuzzy systems and their functions.
- To optimize systems using Genetic algorithms.

UNIT I : Artificial Neural Networks

Motivation for the development of neural networks- biological neural networks- artificial neural networks – Fundamental Concepts - weights - biases and thresholds - common activation functions. McCulloch-pitts neuron: Architecture, algorithm - Hebb Net- Architecture - algorithm - Perceptron – Architecture- algorithm- applications- Linear separability - Perceptron learning rule convergence theorem - Deltarule

UNIT II : Neural Network Architecture and Algorithms

Back propagation Neural Net: Standard back propagation - architecture - algorithm - number of hidden layers - Discrete Hopfield neural net-architecture - algorithm – Competitive Neural Networks -Fixed-weight competitive nets – Kohonen self-organizing Maps – Adaptive Resonance Theory- Basic architecture - Algorithm - Introduction to Neuro controllers - Case Studies.

UNIT III : Fuzzy Logic

Fuzzy sets - Properties of Classical and Fuzzy sets- Operations on Fuzzy sets- Fuzzy relations- Linguistic variables - Linguistic Hedges- Fuzzy statements- Assignment statements- Conditional statements- unconditional statements- Fuzzy rule base- Canonical rule formation- Decomposition of compound rules.

UNIT IV : Fuzzy Logic Controller

Fuzzy logic controller: Functional diagram - Fuzzification - Membership value assignments using intuition - Membership functions- Defuzzification: Max-Member ship principle – centroid method – weighted average method-Inference Engine – Knowledge Base -Rule base -Case studies

UNIT V : Genetic Algorithm

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – reproductions – Cross over – mutation – fitness function –fitness scaling.

TEXT BOOKS

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley Publications, 2ndEdition,2011.
2. S, Rajasekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications”, PHI Publication, 1st Edition,2009.
3. George J Klir, Bo Yuan, “Fuzzy sets & Fuzzy Logic,Theory & Applications”, PHI Publication.

REFERENCES

1. N.K.Bose, Ping Liang, “Neural Network fundamental with Graph, Algorithms & Applications”, TMH, FirstEdition,1998

2. Bart Kosko, "Neural Network & Fuzzy System", PHI Publication, First Edition, 2009.

3. Rich E, Knight K, "Artificial Intelligence", TMH, Third Edition, 2012

4. Martin T Hagen, "Neural Network Design", Nelson Candad, SecondEdition,2008

COURSE OUTCOMES

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

CO1. Learn about soft computing techniques and their applications.
CO2. Knowledge about different neural networks, their architecture and training algorithm
CO3. Concept of Fuzzy logic, Fuzzy Sets, fuzzy rules and fuzzy reasoning
CO4. Exposure to the applicability of neural networks and fuzzy logic
CO5. Analyze the concept of Evolutionary Algorithm and genetic algorithm and their applications.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								1		1		3	3	
CO2	3	1	1	1	3								3	2	
CO3	3		1		3			1		1			3		
CO4	3				3	1							3		
C05	3			1											

ECOESCN	Programming in MATLAB and LabVIEW	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand basic representation of Matrices and vectors in MATLAB; To learn various programming structures in MATLAB; To study built in and user defined functions in MATLAB;
- To become conversant with 2D as well as 3D graphics in MATLAB and to make a Graphical User Interface (GUI) in MATLAB to achieve inter activity
- To understand the basics of Virtual Instrumentation and Graphical Programming Language LabVIEW

UNIT-I : Introduction to MATLAB

Introduction: The MATLAB Environment, Help feature, Type of files in MATLAB, Uses of MATLAB. Constants, Variables and Expressions: Character set, Data Types, Constants and Variables, Operators: arithmetic, relational and logical, Hierarchy of Operations, Built-in Functions.

Vectors & Matrices: Creating Vectors and Matrices, Operations on Vectors, Element-by-Element Array Operations, Binary Matrix Operations, Unary Matrix Operations, Multidimensional Array, Structure arrays, cell arrays, String handling, Input& Output Statements.

UNIT-II: Program Writing and Control Structures

Program Writing: MATLAB editor, Types of M-files, Function subprograms, errors and warnings, Debugging.

Control structures: Branch control structures- if, if else, nested if, if- else if-else, switch, try & catch, break, continue, error. Loop control structures- for -while - nested for.

UNIT-III: Plots in MATLAB

Basic 2D plots- plot, figure, label, Grid, Axis, entering Text, Line style, Markers, Subplot, Multiple plots, log-log, semilog, polar, comet, fplot, ezplot, ezpolar, stem, bar, hist, pie, Graph plotting in MATLAB using data of a text file or excel file. 3D plots- plot3, bar3, pie3, stem3, mesh, surf, contour and contour3.

UNIT-IV: Simulink and GUI

SIMULINK- Modelling, Simulating a model, Using variables from MATLAB, Data Import & Export, Creating subsystems. GUI- Creating apps with GUIDE, adding components, applications of components, writing call back for the components.

UNIT IV: Introduction to LabVIEW

Introduction to Virtual Instrumentation – Graphical Programming Language LabVIEWVs Traditional programming Languages– Numeric, Boolean, String functions – Arrays & Clusters, Various Structures in programming such as WHILE, FOR, CASE – Graphs & Charts – Local & Global variables – development of SUBVI - Integration of Math-script in LabVIEW – Building of Virtual Instruments in LabVIEW

TEXT BOOKS

1. Rudra Pratap, "Getting Started with MATLAB" ,7th Edition, Oxford University Press, 2016.
2. Stephen J Chapman, "MATLAB programming forEngineers", 5th edition, Cengage Learning, 2016.
3. R.K Bansal, Manoj Sharma, A.K. Goel, "MATLAB and Its Applications in Engineering", Pearson Eduction, 2009.
4. Holly Moore, "MATLAB for Engineers",4th edition, Pearson,2012.
5. Dr.Jovitha Jerome ,"Virtual Instrumentation Using Lab view" 2010.

REFERENCE BOOKS

1. Stephen J Chapman, "Essentials of MATLAB Programming" ,3rd edition, Cengage Learning, 2018.
2. William J Palm III , "Introduction to MATLAB for engineers",3rd edition, McGraw Hill Education, 2010.
3. Agam Kumar Tyagi, "Matlab and Simulink for Engineers", OUP India,2011
4. Jeffrey Travis and Jim Kring "LabVIEW for Everyone: Graphical Programming Made Easy and Fun" Prentice Hall; 3rd edition (27 July 2006).

COURSE OUTCOMES

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

CO1. Explain the various programming structures, functions and data types in MATLAB.
CO2. Write script and function programs in MATLAB.
CO3. Generate various types of plots in MATLAB.
CO4. Create Simulink models and GUIs in MATLAB.'
CO5. Use Virtual Instrumentation and Graphical Programming Language Lab VIEW

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3		3								3		
CO2		2	3		3								3		
CO3		2			2		1						3		
CO4			3	3									3		
C05			3	3	2								3		

ECOESCN	SCIENTIFIC COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the significance of computing methods, their strengths and application areas.
- Perform the computations on various data using appropriate computation tools.

Unit I: Introduction

Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Computer Arithmetic

Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

Unit II: System of liner equations

Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for

Linear Systems

Linear least squares

Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Unit III: Eigenvalues and singular values

Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD.

Unit IV: Nonlinear equations

Fixed Point Iteration, Newton's Method, Inverse Interpolation Method Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

Interpolation

Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

Unit V: Numerical Integration and Differentiation

Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler'sMethod, Taylor Series Method, Runge-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods,Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication,Wavelets, Random Numbers and Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

TEXT BOOKS

1. Heath Michael T., "Scientific Computing: An Introductory Survey",McGraw- Hill, 2nd Ed.,2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed.,2007
3. Xin-sheYang (Ed.).,"Introduction to Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008.

REFERENCES

1. Kiryanov D. and Kiryanova E., "Computational Science", InfinityScience Press, 1st Ed.,2006
2. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing with MATLAB And Octave", Springer, 3rd Ed.,2010.

COURSE OUTCOMES

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

CO1. Discuss the significance of computing methods.
CO2. Categorize the strengths of the computing methods.
CO3. Discuss the platform and design the application areas.
CO4. Perform the computations on various data using appropriate computation tools.
CO5. Perform the computation on modern usage of tools.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		3		3	2			2				3	
CO2	3		3			3	2		1					3	
CO3	3	3	3	3		3					1	2		3	
CO4	3	3	3		3									3	
C05	3	3	3	3	3							2		3	

ECOESCN	RFID AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Get acquainted with basics of RFID, RFID readers and tags.
- To introduce various protocols and standards associated with RFID and tags its applications.

Unit I: RFID Basics

History and Practice of RFID – RFID Systems and Terminology – Types of RFID– Frequency Bands for RFID – Tags-Passive, Semi passive, and Active Tags. Radio Basics for UHF RFID -Signal Voltage and Power – Information – Modulation, and Multiplexing – Backscatter Radio Links – Link Budgets – Effect of Antenna Gain and Polarization on Range – Propagation in the Real World.

Unit II: Readers and Tags

UHF RFID Readers: Radio Architectures and Components – RFID Transmitters and RFID Receivers – Digital-Analog Conversion and Signal Processing Packaging and Power UHF RFID Tags: Power and Powerlessness – RF to DC – Getting Data – Talking Back – Tag IC Overall Design Challenges – Packaging

Unit III: RFID Antennas

Reader Antennas: Antennas for Fixed Readers – Antennas for Handheld or Portable Readers – Nearfield Antennas – Cables, and ConnectorsTag Antennas: Practical challenges of Tag antenna – Impedance Matching and Power Transfer – Dipoles and Derivatives – Tags and the (local) Environment – Near-field and Hybrid Tag Antennas.

Unit IV: RFID Protocols

EPC global Generation 1-EPC global Class 0, EPC global Class 1 Generation 1 –ISO 18000-6B (Intellitag), ISO 18000-6C (EPC global Class 1 Generation 2)

Unit V: RFID Security, Standards, and Applications

RFID Security: Confidentiality, Integrity, Availability, Threats, Cryptography, and Threat Modelling RFID Standards, Laws, Regulations, Policies, and Guidelines: EPC global–ISO/IEC Item Management–Contactless Smart Cards– Animal Identification – FCC Rules for ISM Band – Identity Standards – and Guidelines for Securing RFID Systems.

TEXT BOOKS

1. Daniel M. Dobkin, "The RF in RFID: UHF RFID in Practice", Elsevier/Newness, U.S./India, 2012(2nd Edition), ISBN: 9780123945839.
2. Jari-Pascal Curty, Michel Declercq, Catherine Dehollain, Norbert Joehl, "Design and Optimization of Passive UHF RFID Systems", Springer, 2007, ISBN:9780387352749.

REFERENCES

1. TomIgoe, "Getting Started with RFID: MAKE-OBJECTS", O'Reilly/Make: makezine.com, 2012, ISBN: 9781449324186
2. Amin Rida, Li Yang, Manos M. Tentzeris, "RFID-Enabled Sensor Designand Applications", Artech House, 2010, ISBN: 9781607839811

COURSE OUTCOMES

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

CO1. Explain the basic components of RFID systems CO2. Analyze and characterize RFID readers

CO3. Analyze various antennas and protocols used in RFID systems

CO4. Analyze various RFID protocols

CO5. Design RFID systems with an understanding of guidelines to be followed for security and privacy.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2		3												3	
CO3		3												3	
CO4	2	3												3	
C05		3	2		2								3	3	

ECOESCN	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge of fundamental and state-of the art concepts in software defined radio.

Unit-I: SDR Introduction

Introduction to Software Defined Radio- the Need for Software Radios, Characteristics and benefits of a Software Radio- SDR concepts, history and Design principles.

Unit-II: SDR Architecture

Ideal SDR architecture- SDR Based End to- End Communication. 2G Radio Architectures Hybrid Radio Architecture- Basic SDR Block Diagram- Digital Frequency Conversion Partitioning- Operating Environment (OE).

Unit-III: Front end technology

Radio Frequency translation, Transmitter and Receiver specifications & Architecture, - Architecture, considerations- Front end Implementation-Data Conversions-Zero IF receivers, Preselect Filters.

Unit-IV: Hardware Requirements

Digital hardware choices- Key hardware elements, DSP processors and FPGA, Trade-offs in using DSPs, FPGAs, and ASICs and its combination, Power management issues.

Unit-V: Smart antenna systems for SDR

ADC and DAC conversion Parameters of ideal data converters and its architectures, Techniques to improve data converter performance, - Antenna requirements - Benefits of smart antennas, Structures for beam forming systems. Smart antenna algorithms, Diversity and Space-Time adaptive signal processing (STAP), Algorithms for transmit STAP, Hardware implementation of smart antennas.

TEXT BOOKS

1. J H Reed, “Software defined Radio”, PrenticeHall,2002
2. Dr. Walter Tuttlebee: “Software Defined Radio-Enabling Technologies”, Wiley 2002.
3. John J.Rouphael,“RF and Digital Signal Processing for Software Defined Radio” Elesiver, Newness Publications 2009.

REFERENCE BOOKS

1. Bard, Kovarik: “Software Defined Radio, The Software Communications Architecture”, Wiley 2007, 3rd Edition.
2. Joseph Mitola “Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering” Wiley Interscience; 1st edition 2000.

COURSE OUTCOMES

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

CO1. Explain the Characteristics and benefits of a Software Radio

CO2. Analyze basic SDR architectures and functions

CO3. Explain analog RF components as front end block in implementation of SDR

CO4. Investigate and identify Digital Hardware Choices Key Hardware Elements, DSP Processors, FPGA

CO5. Summarize the need of smart antennas for SDR

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	
CO5	3	2											3	2	

ECOESCN	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- Gives the idea of evolution of cloud computing
- Provides knowledge about cloud services available today
- Helps to the design and development of simple cloud service.
- Focused on some key challenges and issues around cloud computing.

UNIT I : Introduction

Cloud-Definition, Benefits, Usage Scenarios, History of Cloud Computing-Cloud Architecture - Types of Clouds - Business Models Around Clouds – Major Players in Cloud Computing - Issues in Clouds - Eucalyptus - Nimbus - Open Nebula, Cloud Sim.

UNIT II : Cloud Services

Types of Cloud Services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as Services. Service Providers - Google, Amazon, Microsoft Azure, IBM, Sales Force.

UNIT III : Collaborating Using Cloud Services

Email Communication over the Cloud-CRM Management-Project Management- Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networksand Groupware.

UNIT IV : Virtualization for Cloud

Need for Virtualization – Pros and Cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine Monitor – Virtual Machine Properties - Interpretation And Binary Translation, HLL VM - Hypervisors – Xen, KVM , VMware, Virtual Box, Hyper-V.

UNIT V : Security, Standards and Applications

Security in Clouds: Cloud Security Challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed Management Task Force – Standards for Application Developers – Standards for Messaging – Standards for Security, End User Access to Cloud Computing, Mobile Internet Devices and The Cloud.

TEXT BOOKS

1. John Rittinghouse & James Ransome, “Cloud Computing, Implementation, Management and Strategy”, CRC Press, 2010.
2. MichaelMiller, “Cloud Computing: Web-Based Applications that change the way You Work and collaborate”, QuePublishing, August2008.

REFERENCES

1. David E.Y. Sarna “Implementing and Developing Cloud Application”, CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, “Draft cloud computing synopsis and recommendation”, May 2011.
3. Anthony TVelte,TobyJVelte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill2010.
4. Haley Beard, “Best Practices for Managing and Measuring Processes for On- demand Computing, Applications and Data Centers in the Cloud with SLAs”, Emereo Pty Limited, July2008.
5. G.J.Popek, R.P.Goldberg, “Formal requirements for virtualizable third generation Architectures, Communications of the ACM”, No.7 Vol.17, July1974.

COURSE OUTCOMES

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

CO1. Explain the cloud computing paradigm.
CO2. Identify the appropriate cloud services for a given applications.
CO3. Design and development of simple cloud service.
CO4. Implement suitable virtualization concepts using cloud.
CO5. Understand security and standards in cloud computing.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3								2		3	
CO2	2		2	3						3			2		
CO3					2	1				3			2		
CO4		3		3	2							2		3	
CO5		3	2							3				3	

ECOESCN	MICROFLUIDICS AND BIOMEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart knowledge on microfluidics and fluidic sensors.
- To educate on the design of micropumbs.
- To provide an overview on chemical sensors and transducers.
- To introduce the concept of work function based sensors
- To give an overview of the sensors application in the field of biology.

Unit I: Fluidics Fundamentals

Basic fluid properties and equations – Types of flow – Bubbles and particles in microstructures – Capillary forces – Fluidic resistance – Fluidic inductance – Bulk micro machined channels – Surface micro machined channels.

Unit II: Fluidic channel application

Mixers – Laminating mixers – Plume mixers – Active mixers – Diffusion based extractors – Fluidic amplifiers and logic. **Fluidic Sensors:** Flow sensors – Viscosity sensors – Valves – Passive valves – Active valves – Pneumatic valve action – Thermopneumatic valve actuation – Phase change valve action – Solid expansion valve actuation – Piezoelectric valve actuation – Electrostatic valve actuation – Electromagnetic valve actuation – Bistable valve actuation.

Unit III: Micropumps

Membrane pumps – Diffuser pumps – Rotary pumps – Electro hydro dynamic (EHD) pumps – Injection type and non-injection type EHD – Microfluidic system issues – Interconnect packing and system integration – Design for disposable or reuse.

Unit IV: Passive chemical sensors

Chemiresistors – Chemicapacitors – Chemomechanical sensors – Calorimetric sensors–Metal Oxide gas sensors.

Unit V: Work function based Sensors

ADFET gas sensors – Platinide based hydrogen sensors – Ion sensitive FETS (ISFETS and CHEMFETS).

Unit VI: Electrochemical Transducers

Ionic Capacitance – Charge transfer – Resistive mechanisms – Spreading resistance and Warburg impedance – Basic electrode circuit model – Electrochemical sensing using micro electrodes.

Unit VII: Biosensors

Resonant biosensors – Optical detection biosensors – Thermal detection biosensors – ISFET biosensors – Other pH based biosensors – Electrochemical detection biosensors – CMOS compatible biosensor process – Enzyme based sensors – Protein based sensors – Immuno sensors – DNA probes and array – DNA amplification.

REFERENCES

1. Gregory Kovacs T.A., “Micromachined Transducers”, WCB McGraw Hill, 1998.
2. Marc Madou, “Fundamentals of Microfabrication, The Science of Miniaturization Series”, Second Edition, CRC Press, 2002.
3. Albert Folch, “Introduction to BioMEMS”, 1st Edition, CRC Press, (August 21, 2012).
4. Nam – Trung Nguyen and Steve Wereley, “Fundamentals and Applications of Microfluidics”, 2nd Edition, Artech House (1 July 2006).
5. Terrence Conlisk, “Essential of Micro and nanofluidics: with applications to biological and chemical sciences”, Cambridge University Press, 2012.

COURSE OUTCOMES

Upon completing the course, the student should

CO1: Understand the basic properties of micro fluids.
CO2: Acquire the working concepts of fluidic sensors.
CO3: Understand the concepts and structure of micro pumbs.
CO4: Acquire the working knowledge of Passive chemical sensors, Work function based Sensors, Electrochemical Transducers.
CO5: Understand the application of sensors for various biological applications.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2												2		
CO3	3		2										3	2	
CO4		3		2									2	2	
CO5	3	2											3	2	

ECOESCN	QUANTITATIVE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understood the basic of the quantitative techniques.
- Learnt the feasible solution and optimum solution for the resource management.
- Learnt the time estimation and critical path for project.
- Learnt about the application of probability techniques in the decision making
- Learnt the various inventory models and simulations in the resource planning and management.

Unit–I : Introduction

Development of Scientific Management - Application of Operations Research – Classification of Operation Research (OR) Models – Procedures to Obtain Optimum Solution–Scope for Management Information Systems (MIS)-Classification of MIS

- Cost Volume and Profit (CVP) Analysis-Relationships-Various Approaches– Limitation of CVP Analysis.

Unit–II : Probability Analysis

Decision Making: Analysis for Decision Making - Cautions About Use of Decision Making Under Uncertain Future Conditions - Review of Probability Techniques and Applications - Calculation of Conditional and Expected Profits - Expected Value with Perfect Information - Use of Marginal Analysis - Utility as a Decision Criterion. Probability Distributions –Normal Distribution and Cost, Volume, Profit Analysis-Unit– Monetary Values with Probability Distribution - Decision Tree Analysis.

Unit–III : Inventory and Production Models

Inventory Decisions - Selective Approach to Management Inventory - EOQ - Different Models - Application of EOQ to Production Process.Reordering - Determination of Optimum Level - Optimal Level of Safety Stock - Joint Ordering - Reordering with Planned Stockouts -Discounts.

Unit–IV : Linear Programming

Introduction - Simplex Method - Maximization and Minimization - Duality in Linear Programming - Sensitivity Analysis - Transportation Method - Unbalanced Problem - Degeneracy – Assignment Method-Applications.

Unit–V : CPM-PERT Analysis

Introduction - Definition of PERT - Network Replanning and Adjustment – CPM - Time Estimate - Crashing - Indirect and Utility Project Costs - PERT

Cost Analysis - Project Budgeting - Control of Project Cost - Network Scheduling - Maximal Flow Problem – Limitation of PERT and CPM.

TEXT BOOKS

1. Gupta P.K, Manmohan, "Problems in Quantitative Techniques", Sultan Chand & Sons, 2nd Edition,1990.
2. Levin and Kirkpatrik "Quantitative Approaches to Management", Mcgraw Hill Int. St.Ed., 2002.

REFERENCES

1. Samir Kumar Chakravarthy, "Theory and problems on Quantitative Techniques,Management Information system and Data processing" Central Educational Enterprises, 1989 (First Edition).
2. Levin and Kirkpatrik "Quantitative Approaches to Management", McGraw Hill Int.St.Ed., 2002. Brandon-Jones, Slack: Quantitative Analysis in Operations Management: Prentice Hall.

COURSE OUTCOMES

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

CO1. Importance of understanding the concept and need of quantitative techniques.

CO2. Analysis and evaluate the feasible and optimum solution for the resource management.

CO3. Estimation of time estimation and critical path for project.

CO4. Maximize the sufficient Information about probability techniques in the decision making.

CO5. To accomplish and discuss thorough idea about resource planning and management.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3					2		3				3
CO2	3	3	3	3					2		3				3
CO3	3	3	3	2					2		3				3
CO4	3	3	3	3					2		3				3
CO5	3		1						2		3				3

ECOESCN	INTRODUCTION TO NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn and understand basic concepts of Nanoelectronics.
- To describe the principle and the operation of Nano electronics devices so that how they can be effectively used in real-time applications.

UNIT I : Introduction to Nanotechnology

Background to nanotechnology: Types of nanotechnology and Nano machines – periodic table–atomic structure–molecules and phases–energy–molecular and atomic size–surface and dimensional space–top down and bottom up; Molecular Nanotechnology: Electron microscope – scanning electron microscope – atomic force microscope – scanning tunneling microscope – Nano manipulator – Nano tweezers – atom manipulation – Nano dots – self-assembly – dip-pen nanolithography. Nanomaterials: preparation – plasma arcing – chemical vapor deposition – sol-gels – electro deposition – ball milling – applications of nanomaterials;

UNIT II : Fundamentals of Nanoelectronics

Fundamentals of logic devices: dynamic properties – threshold gates; classifications – two terminal devices – field effect devices – Design of logic gates using Nano devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems: basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain, ultimate computation

UNIT III : Silicon MOSFETS & Quantum Transport Devices

Silicon MOSFETS - Novel materials and alternate concepts:- Fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: - Electron tunneling – resonant tunneling diodes–resonant tunneling devices; Single electron devices for logic applications:- Single electron devices – applications of single electron devices to logic circuits.

UNIT IV : Carbon Nanotubes

Carbon Nano tube: Fullerenes - types of Nano tubes – formation of Nano tubes – assemblies–purification of Carbon Nano tubes–electronic properties–synthesis of Carbon Nano tubes – Carbon Nano tube interconnects – carbon nanotube FETs – Nano tube for memory applications.

UNIT V : Molecular Electronics

Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices.

TEXT BOOKS

1. Phani Kumar, “Principles of Nano Technology:-Materials, Tools and Process at Nano Scale” SCITECHPublications,2017
2. T. Pradeep, “NANO: The Essentials- Understanding Nanoscience and Nanotechnology”, TMH,2007

3. G.W. Hanson, “Fundamentals of Nano electronics”, Pearson,2009.
4. W. Ranier, “Nano electronics and Information Technology (Advanced Electronic Material and Novel Devices)”, Wiley-VCH,2003.

REFERENCES

1. K.E. Drexler, “Nano systems”, Wiley,1992.
2. J.H. Davies, “The Physics of Low-Dimensional Semiconductors”, Cambridge University Press,1998.
3. C.P. Poole, F. J. Owens, “Introduction to Nanotechnology”, Wiley,2003.

COURSE OUTCOMES

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

CO1. Discuss the types of nanotechnology, molecular technology and the preparation of Nano materials.
CO2. Explain the fundamentals of logic devices and classifications
CO3. Describe the concepts of silicon MOSFET and Quantum Transport Devices.
CO4. Summarize the types, synthesis, interconnects and applications of carbon nano tubes.
CO5. Explain the concepts, functions, fabrications and applications of molecular electronics.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2									2	2		
CO2	3		2									2	3		
CO3	3		2									2	2		
CO4	3		2									2	2		
CO5	3		3									3	3	2	

		L	T	P	C
ECOESCN	BIOMEDICAL ELECTRONICS	3	0	0	3

COURSE OBJECTIVES

- To review the Fundamentals of Biomedical Engineering
- To illustrate the communication mechanics in a biomedical system with few examples
- To understand the Bio potential recording and measurements techniques
- To explain the basic principles in imaging techniques
- To comprehend the life assisting, therapeutic devices and medical applications of computer

Unit I: Fundamentals of Biomedical Engineering

Cell and its structure–Resting and Action Potential–Nervous system and its fundamentals- Basic components of a biomedical system-Cardiovascular systems-Respiratory systems-Kidney and blood flow-Biomechanics of bone – Biomechanics of soft tissues-Physiological signals and transducers - Transducers – selection criteria– Piezoelectric, ultrasonic transducers – Temperature measurements-Fibre optic temperature sensors.

Unit II: Non Electrical Parameters Measurement and Diagnostic Procedures

Measurement of blood pressure-Cardiac output -Heart rate -Heart sound- Pulmonary function measurements –spirometer–Photo Plethysmography, Body Plethysmography–Blood Gas analysers, pH of blood–measurement of blood pCO2, pO2, finger-tipoxy meter-ESR,GSR measurements.

Unit III: Bio potential Recording & Measurements

Electrodes–Limb electrodes–floating electrodes –pregelled disposable electrodes- Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers– Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods–Typical waveforms-Electrical safety in medical environment, shock hazards–leakage current-Instruments for checking safety parameters of biomedical equipment.

Unit IV: Imaging Modalities and Analysis

Radiographic and fluoroscopic techniques–Computer tomography–MRI–Ultrasonography – Endoscopy–Thermography–Different types of biotelemetry systems-Retinal Imaging-Imaging application in Biometric systems.

Unit V: Life Assisting, Therapeutic Devices and Computer Applications in Medicine

Pacemakers–Defibrillators–Ventilators–Nerve and muscle stimulators–Diathermy–Heart – Lung machine–Audiometers–Dialysers-ICCU patient monitoring system-Telemedicine – Applications - E-Health–Introduction to :Nano Robots-Robotic surgery – Internet of Things (IoT) in Medical Field – Internet of Medical Things (IoMT).

TEXTBOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2015.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 3rd edition, 2014.
3. Joseph J Carr and John M.Brown, "Introduction to Biomedical Equipment Technology John Wiley and sons", NewYork, 4thedition, 2012

REFERENCES

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, NewYork, 2010.
2. Duane Knud son, "Fundamentals of Biomechanics", Springer, 2nd Edition, 2007.
3. Suh,Sang, Gurupur, VaradrajP., Tanik,Murat M., "Health Care Systems, Technology and Techniques", Springer,1st Edition, 2011.
4. Ed.Joseph D.Bronzino, "The Biomedical Engineering Hand Book", Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.
6. Ahmed,Mobyen Uddin, Begum, Shahina, Fasquel, Jean-Baptiste (Eds.), "Internet of Things (IoT) Technologies for Health Care, Proceedings of 4th International Conference, Healthy IoT 2017", Angers, France, October 24-25,2017.
7. Nishu Gupta & Sara Paiva, "IoT and ICT for Health care Applications", Springer International Publishing, 2020

COURSE OUTCOMES

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

CO1. Describe the Fundamentals of Biomedical Engineering
CO2. Describe the communication mechanics in a biomedical system
CO3. Summarize Bio potential recording and measurements techniques.
CO4. Describe basic principles in imaging techniques.
CO5. Explain the life assisting, therapeutic devices and medical applications of computer

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2						2		2	2	2
CO2	2	2		2		2		2			2		2	1	2
CO3							2			2					
CO4	2	2		2								2	2		
CO5			2		2						2	2	2		2

ECOESCN	INTRODUCTION TO MEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable the student to understand the basic principles of sensors and actuators, materials and fabrication aspects of MEMS and Microsystems.
- To make the student familiar with the mechanical and the electrostatic design and the associated system issues.
- To introduce the student to the different MEMS applications, the design basics, the design tools and the performance issues.

Unit I: Fundamentals

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication

Unit II: Review of Basic MEMS fabrication modules

Silicon as material, deposition techniques, lithography, doping, etching, silicon micromachining, wafer bonding, LIGA process, special materials like polymers and ceramics for Microsystems

Unit III: Micromachining

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

Unit IV: Mechanics of solids in MEMS/NEMS

Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems

Unit V: MEMS Application Case studies

Capacitive accelerometer, Peizo electric pressure sensor, Microfluidics application, Modeling of MEMS systems, CAD for MEMS

TEXT BOOKS

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, "Micro and Smart Systems", Wiley India,2012.
2. S. E.Lyshevski, "Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering" (Vol. 8). CRC press,(2005).
3. S. D. Senturia, "Microsystem Design", Kluwer Academic Publishers, 2001.

REFERENCES

1. M. Madou, "Fundamentals of Micro fabrication", CRC Press,1997.
2. G. Kovacs, "Micromachined Transducers Sourcebook", McGraw-Hill, Boston, 1998.
3. M.H. Bao, "Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes", Elsevier, New York, 2000.

COURSE OUTCOMES

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

CO1. Describe the underlying introduction to MEMS.

CO2. Demonstrate the significance and role of this course in the

present basic MEMS fabrication modules.

CO3. Estimate the different aspects of Micromachining.

CO4. Identify a suitable mechanics of solids in MEMS/NEMS.

CO5. Design the MEMS application.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3			1							3	3	
CO2	2	2		3									3	3	
CO3		2			2		1						3	3	
CO4			3	3									3	3	
CO5			3	3	2								3	3	

ECOESCN	NCC Studies (Army Wing) – I	L	T	P	C
		3	0	0	3

Course Objective

This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.

Unit I (Lecture): NCC Organisation and National Integration

NCC Organisation – History of NCC- NCC Organization - NCC Training- Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Factors affecting national integration.

Unit – II (Lecture): Personality Development and Leadership

Introduction - Factors influencing / shaping Personality - Self-Awareness – Know yourself/ Insight - Communication Skills - Leadership Traits – Types – Attitude - Time Management - Effects of Leadership - Stress Management Skills - Interview Skills - Conflict Motives - Resolution - Importance of Group / Team Work - Influencing Skills - Body Language - Sociability: Social Skills

Unit – III (Lecture): Social Awareness and Community Development

Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility

Unit – IV (Lecture): Specialized Subject (Army Wing)

Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews- Fieldcraft and Battlecraft-Basics of Map reading.

Unit – V (Practical): Basic Physical Training and Weapon Training

Basic physical Training – various exercises for fitness (with Demonstration) - Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching (WITH DEMONSTRATION)

Main Parts of a Rifle- Characteristics of .22 rifle- Characteristics of 7.62mm SLR- Characteristics of 5.56mm INSAS rifle - stripping and assembling – position and holding- safety precautions – range procedure- firing simulation.

TEXT BOOK:

1. Ramesh "National Cadet Corps- A Concise handbook of NCC Cadets", Publishing House, New Delhi, 2014.

REFERENCES:

1. "Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.

2. "NCC OTA Precise", published by DG NCC, New Delhi.

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

CO1: Display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion

CO2: acquaint and provide knowledge on personality development, self awareness, communication skills with leadership traits to work as a team and sociability values

CO3: understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils

CO4: acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.

CO5: demonstrate health exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders and basic knowledge of weapons and their use and handling.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	Pos												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	2							2	2		
CO2	3												2		
CO3	3	2	2	2									2	1	
CO4	3											2	2		
CO5	3	2										2	2		

HONOURS ELECTIVE

ECHESCN	CMOS ANALOG IC DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce MOSFET physics and various MOS models.
- To introduce various sub-circuits used in analog ICs
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation, capacitor switches and PLLs

UNIT I: Introduction

Analog IC Design Flow–MOS transistor– I-V characteristics– MOS transconductane and output resistance –MOSFET capacitance– Large-Signal and Small-Signal Models of MOS transistor –Short channel MOS model –Subthreshold MOS model.

UNIT II: CMOS Sub circuits

MOS Switch–MOS Diode/Active Resistor–Current Sinks and Sources–Current Mirrors – Current and Voltage References – Temperature-Independent References.

UNIT III: CMOS Amplifiers

Basic Concepts – Common source stage- Source follower- Common gate stage-Cascode stage– Frequency response of CS and CG stages– Noise in CS,CG, Cascode and Source follower stages–Single ended and differential operation-Basic Differential pair-Common mode response-Differential pair with MOS loads - Gilbert Cell– Noise in Differential pairs

UNIT IV: CMOS Operational Amplifiers

CMOS Operational Amplifiers: Two-Stage Op Amps: gain boosting, common mode feedback, input range limitation, slewrate, power-supply rejection ratio–Noise in Two-Stage Op Amps–Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two-Stage Opamp.

UNIT V: Switched Capacitor Circuits and PLLs

General Considerations- Sampling switches- Switched Capacitor Amplifiers-Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications

TEXT BOOKS

1. Phillip E. Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, Oxford University Press India, 2013 (3rdIndian Edition), ISBN:9780198097389.
2. Behzad Razavi,“Design of Analog CMOS Integrated Circuits”, McGraw Hill India, 2016 (3rdReprint), ISBN:9780070529038.

REFERENCES

1. R.Jacob Baker, “CMOS Circuit Design Layout and Simulation”,Wiley/IEEE Press India/U.S., 2009 (Reprint)
2. Tertulien Ndjountche, “CMOS Analog Integrated Circuits: High-Speed and Power-Efficient Design”, CRC Press (Taylor & Francis) U.K./India, 2011, ISBN: 781439854914.
3. Gray, Hurst, Lewis, Meyer, “Analysis and Design of Analog Integrated Circuits (ISV)”, Wiley U.S.,2010(5thEdition), ISBN:9788126521487

COURSE OUTCOMES

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

CO1. Describe a ASIC Design flow for any complex circuit or system and demonstrate the understanding of MOS transistor theory

CO2. Analyze various analog CMOS Sub circuits.

CO3. Examine various configurations of CMOS amplifiers.

CO4. Analyze Two stage Op-amp and explain compensation techniques used in Op-amp.

CO5. Describe the operations of switched capacitors and frequency synthesizers.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	3	2											3		
CO3	3	3											3		
CO4	3	3	2										3		
C05	2	2										2	2		

ECHESCN	SPEECH AND AUDIO PROCESSING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce basic concepts and methodologies for analysis, synthesis and coding of Speech signal.

UNIT I: Introduction

Introduction-Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

UNIT II: Linear Prediction of Speech

Basic concepts of linear prediction; Linear Prediction Analysis of non stationary signals, prediction gain, examples; Levinson-Durbin algorithm; Long term and short term linear prediction models; Moving average prediction.

UNIT III: Speech Quantization

Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers, Vector quantization–Distortion Measures, codebook design, codebook types. Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based onLSF.

UNIT IV: Linear Prediction Coding

LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction

CELP speech production model; Analysis-by- synthesis; Generic CELP

encoders and decoders; Excitation codebook search – state- save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

UNIT V: Coding Standards

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729 standards.

TEXT BOOKS

1. A.M.Kondoz, "Digital Speech", Second Edition (Wiley Students Edition), 2004.
2. W.C. Chu "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", WileyInter science, 2003.

REFERENCES

1. Dan Ellis, Nelson Morgan "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Second Edition, Ben Gold Publisher: Wiley-Interscience Release Date: August 2011 ISBN:9780470195369.
2. Dr. shaila B.Apte "Speech and Audio Processing" Wiley Edition 2012.
3. John R. JrDeller, John H. L. Hansen, John G. Proakis "Discrete-Time Processing of Speech Signals", Wiley, 2000 - Technology & Engineering.

COURSE OUTCOMES

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

CO1. Develop mathematical model for the speech signal.
CO2. Compare the quality and properties of speech signal.
CO3. Modify and enhance the speech and audio signals.
CO4. Describe the Properties of speech production and perception system.
CO5. Explain the algorithms for speech synthesis, coding and recognition.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3							2	3		
CO2	3	3	3	3	3				1	1	1		3		
CO3	3	3	3		3								3		
CO4	3	3	3									2	3		
C05	3	3	3	3	3					1			3		

ECHESCN	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To cover various adaptive signal processing algorithms (e.g., the LMS algorithm) and many applications, such as adaptive noise cancellation, interference canceling, system identification, etc.

UNIT I: Basic Concepts

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

UNIT II: LMS Algorithm

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued. The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-

adjustment. Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

UNIT III: Signal Space Concepts

Signal space concepts - Introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

UNIT IV: Vector Space

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

UNIT V: Recursive Least Squares

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

TEXT BOOKS

1. S. Haykin, "Adaptive filter theory", Prentice Hall,1986.
2. C.Widrow and S.D. Stearns, "Adaptive signal processing", Prentice Hall, 1984.

REFERENCES

1. Tülay Adali and Simon Haykin "Adaptive Signal Processing: Next Generation Solutions",Wiley publications,2010.
2. Ali H. Sayed "Adaptive Filters", Wiley, NJ,2008.

COURSE OUTCOMES

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

CO1. Discuss the concepts of adaptive filtering
CO2. Design LMS adaptive filter for signal enhancement and channel equalization
CO3. Represent signals in orthogonal space.
CO4. Describe signals in vector space
CO5. Design RLS filter.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3							2				3		
CO2	2							2					3		
CO3	2	3						2		1			3		
CO4		3		2								1	3		
C05		3	1	2	1	1	1		2		1		3		

ECHESCN	MOBILE COMMUNICATION AND NETWORKS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To study the basics of mobile communication networks and its generation.

- To understand the concepts of advanced network concepts.
- To study the basics of various receiver characteristics.

UNIT I: Cellular Concepts

Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, System capacity, wireless standards: Overview of 2G and 3G cellular standards.

UNIT II: Signal propagation

Propagation mechanism-reflection, refraction, diffraction and scattering, large scale signal propagation, fading channels-multipath and small scale fading-Doppler shift, narrowband and wideband fading models, delay spread, coherence bandwidth and coherence time, frequency selective fading, slow and fast fading, capacity of flat and frequency selective channels. Antennas-Antennas for mobile terminal, base station antennas andarrays.

UNIT III: Multiple access schemes

FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

UNIT IV: Receiver structure

Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE.

UNIT V: MIMO Technologies

Introduction to MIMO – MIMO channel capacity- SVD and Eigen values of the MIMO channel MIMO special Multiplexing – MIMO diversity -MIMO OFDM.

TEXTBOOKS

1. WCY Lee, “Mobile Cellular Telecommunications Systems”, McGraw Hill,1990.
2. Raymond Steele, “Mobile Radio Communications”, IEEE Press, New York,1992.

REFERENCES

1. AJ Viterbi, “CDMA: Principles of Spread Spectrum Communications”, Addison Wesley,1995.
2. VK Garg & JE Wilkes, “Wireless & Personal Communication Systems”, Prentice Hall,1996.

COURSE OUTCOMES

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

CO1. Explain wireless networks, architecture of wireless networks and cell acquisition.
CO2. Describe the wireless channel impairments.
CO3. Discuss various multiple access techniques.
CO4. Describe the Equalization Techniques and Receiver types.
CO5. Explain MIMO technology

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	3	3											3		
CO3	3												3		
CO4	3	3										2	3		
CO5	2											3	2		

ECHESCN	NEXT GENERATION MOBILE COMMUNICATION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce central aspects of current and next generation mobile broadband technologies and networks, focusing on the 3GPP Long Term Evolution (LTE) and beyond.

UNIT I: Legacy 3GPP Systems

Evolutionary road map: from 1G to 5G-GSM/GPRS systems: Architecture and main functionalities -UMTS/HSPA systems: Architecture and mainfunctionalities.

UNIT II: LTE System Architecture

LTE Architecture: Access Network (E-UTRAN) and Core Network (EPC) LTE service modelling (bearer services) - E-UTRAN: Functional entities, interfaces and protocols -EPC: Functional entities, interfaces and protocols - Terminals

UNIT III: Mobility and Session Management

Session Management: IP-based connectivity. PDN connections.EPS Bearer services. Session Management procedures.QoS Model - Mobility Management: Handover and mobility management procedures.

UNIT IV: LTE Radio Interface

Functional description and protocol stack - Physical layer: Physical Resource Block (PRB) concept and Frame structure - Logical, transport and physical channels Physical layer basic procedures: Synchronization and initial acquisition - Random Access and Paging procedures - Radio Bearers Serviceset-up

UNIT V: 5G, Beyond 5G

Cognitive Radio(5G): Cognitive transceiver architecture, Principles of interweaving, Spectrum sensing, Spectrum management, Spectrum sharing, Overlay, Underlay Hierarchical Access (UWB system communications), IEEE 802.15.3 – Relaying, Multi-Hop and Cooperative Communications(5G) – Pervasive Networks, Dynamic Spectrum Access (5G) – Dynamic Adhoc Wireless Networks (DAWN), MANETS(5G)– IEEE802.21Media Independent Hand off– IEEE 802.22 Wireless Regional Area Network – IEEE 802.25 Omni-Range Area Network.

TEXT BOOKS

1. Erik Dahlman Stefan Parkvall Johan Skold PerBeming,"3G Evolution: HSPA and LTE for Mobile Broadband", Academic Press (Elsevier) U.S., 2008 (2nd Edition), ISBN: 9780123745385
2. Magnus Olsson Catherine Mulligan Magnus Olsson Stefan Rommer Catherine Mulligan Shabnam Sultana Lars Frid, "SAE and The Evolved Packet core: Driving the Mobile Broadband revolution", Academic Press/Elsevier U.S., 2009(1st Edition), ISBN9780123748263

REFERENCES

1. Harri Holma, Antti Toskala (Editors), "HSDPA/HSUPA for UMTS: high speed radio access for mobile communications", Wiley International, U.S., 2006, ISBN: 9780470018842
2. MinoruEtoh (Editor),"Next Generation Mobile Systems : 3 Gand Beyond", Wiley, 2005, ISBN:9780470091517
3. Xiang, Wei, Zheng, Kan, Shen, Xuemin Sherman (Editors), "5G Mobile Communications", Springer, U.S./India, 2017, ISBN: 9783319342061, DOI: 10.1007/978-3-319-34208-5.

COURSE OUTCOMES

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

CO1. Explain the current trends in mobile/wireless communications networks

CO2. Explain the architecture fourth generation wireless communication techniques

CO3. Explain about the mobility, session management handled by the new generation of mobile communication.
CO4. Explain the physical layer interfacing with respect to emerging wireless technologies
CO5. Explain the 5G and beyond 5G mobile system.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3										2	3		
CO2	3	3							1	1	1		3		
CO3	3	3	2										3	2	
CO4	3	3										2	3		
C05	3	2	2							1			3	2	

ECHESCN	FPGA BASED SYSTEM DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To introduce the fundamentals of FPGA architecture;
- To familiarise with optimised VLSI circuits design using FPGA;
- Design digital circuits using VHDL.

UNIT I: FPGA Architecture

Digital Design and FPGA – FPGA Based System Design – FPGA Fabrics: FPGA Architectures, SRAM Based FPGAs, Permanently Programmed FPGAs – FPGA Chip I/O – Circuit Design and architecture of FPGA Fabrics.

UNIT II: VHDL and FPGA Programming

VHDLessentials:Entity,Architecture–Variabletypesandoperators–decisionsand loops –Hierarchical design – debugging models – basic data types, simulation and Test benches – libraries – synthesis – physical design flow, place and route, timing analysis – VHDL issues for FPGAdesign

UNIT III: FPGA System Design

Design using VHDL: Flip-flops, Registers, Counters, Serial to Parallel conversion, Parallel to Serial conversion – ALU function – Decoders, Multiplexers – Fixed point arithmetic – Binary multiplier

UNIT IV: FPGA Interfacing

Serial Communication: RS232 – Z- Domain functions in VHDL – Basic LPF in VHDL – Memory and VHDL – PS/2 Mouse Interface – PS/2 Keyboard Interface – VGA Interface.

UNIT V: Optimised FPGA Design

Synthesis and VHDL–RTL to Behavioural Modelling in VHDL–Techniques for logic optimisation – VHDL-AMS – Optimisation Example: DES using VHDL

TEXT BOOKS:

1. Peter Wilson, "Design Recipes for FPGAs: Using Verilog and VHDL",Elsevier (Newnes) U.S./India, 2015(2nd Edition), ISBN: 9780080971292
2. Wayne Wolf, "FPGA-Based System Design", Pearson U.S. / Prentice HallIndia, 2010(2nd Edition), ISBN:9788131724651

REFERNCES

1. Seetharaman Ramachandran, "Digital VLSI Systems Design: A DesignManual for Implementation of Projects on FPGAs and ASICs using Verilog", Springer India/Netherlands, 2007(1st Edition), ISBN:

9789401782777, DOI: 10.1007/978-1-4020-5829-5.
2. 2. Pong P. Chu – RTL Hardware Design using VHDL: Coding for efficiency, portability and scalability", Wiley-Interscience/IEEE Press, U.S. – 2006, ISBN: 9780471720928.
3. Gina R. Smith, "FPGAs 101: Everything you need to know to get started", Elsevier/Newnes India,2010(1st Edition), ISBN: 9781856177061.
4. CemUnsalanandBoraTar,"DigitalSystemDesignwithFPGA:Implementation Using Verilog and VHDL", McGraw Hill India, 2017(1st Edition), ISBN: 9789387067509.

COURSE OUTCOMES

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

CO1. Explain the architecture of FPGAs
CO2. Understand VHDL syntax and semantics and issues in VHDL for FPGA design
CO3. Interface basic devices to FPGA in designing digital systems
CO4. Write VHDL programs for optimised system design using FPGA
CO5. Use modern electronic design automation (EDA) tools and FPGA to simulate and synthesis digital circuits.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	2		3	2	2							2	2		
CO3	2	2	3										2	2	
CO4	2		3										3	2	
C05	2		3	2	3							3	3	2	

ECHESCN	ADVANCED MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To expose the students to the fundamentals of microprocessor architecture.
- To introduce the advanced features in microprocessors and microcontrollers.
- To enable the students to understand PIC microcontroller architectures.

UNIT I: High Performance CISC Architecture – Pentium

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT II: High Performance RISC Architecture – ARM

Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co- processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming - C programming – Optimizing ARM Assembly Code – Optimized Primitives.

UNIT III: ARM Application Development

Introduction to DSP on ARM –FIR filter – IIR filter – Discrete Fourier Transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Embedded Operating systems – Integrated Development Environment-STDI/OLibraries–Peripheral Interface–Application of ARM Processor -Caches – Memory protection Units – Memory Management units – Future ARM Technologies.

UNIT IV: Motorola 68HC11 Microcontrollers

Instruction set addressing modes – operating modes- Interrupt system RTC- Serial Communication Interface – A/D Converter, PWM and UART.

UNIT V: PIC Microcontroller

CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing – UART- A/D Converter –PWM and introduction to C-Compilers.'

TEXT BOOKS

1. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers,2004.
2. Steve Furber, "ARM System –On –Chip architecture", Addision Wesley,2000.

REFERENCES

1. Daniel Tabak, "Advanced Microprocessors", McGraw Hill. Inc.,1995
2. James L. Antonakos, "The Pentium Microprocessor", Pearson Education,1997.
3. GeneH.Miller,"MicroComputerEngineering",PearsonEducation,2003.
4. John B.Peatman, "Design with PIC Microcontroller", Prentice Hall,1997.
5. James L. Antonakos, "An Introduction to the Intel family of Microprocessors", Pearson Education,1999.

COURSE OUTCOMES

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

CO1. Explain the architecture and programming of High erformance CISC processor (Pentium).

CO2. Describe the architecture and programming of High performance RISC processor (ARM).

CO3. Digital Signal Processing application development in ARM processor

CO4. Acquire programming and interfacing knowledge in Motorola 68HC11 Microcontrollers.

CO5. Acquire programming and interfacing knowledge in PIC Microcontrollers

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3				3	2		3		3	
CO2	3	3			3	3			3	2		3		3	
CO3	3	3			3							3		3	
CO4	3	3	2	2	3							3		3	
C05	3	3			3		3			1		3		3	

ECHESCN	ADVANCED VLSI SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).
- To train the students on the design project involved with data path operators, data registers, serial/parallel conversion, clocking/timing details and feedback.
- To complete a significant VLSI design project having a set of objective criteria and design constraints.
- To develop tests, and the use of design for testability techniques during the VLSI system design and implementation process
- To use automated layout tools to produce geometric descriptions of complex integrated circuit designs with VLSI chip.

UNIT I: Introduction: Combinational Logic Functions – Static Complementary Gates – Switch Logic. Alternative Gate Circuits – Low Power Gates – Delay Through Resistive Interconnect – Delay Through Inductive Interconnect.

UNIT II: Subsystem Design Principles: Combinational Shifters – Adders – ALUs – Multipliers. High Density Memory – Field Programmable Gate Arrays – Programmable Logic Arrays.

UNIT III: Architecture Design: Introduction – Hardware Description Languages – Register Transfer Design – High – Level Synthesis – Architectures for Low Power – Systems – on – Chips and Embedded CPUs – Architecture Testing.

UNIT IV: Chip Design: Introduction – Design Methodologies – Kitchen Timer Chip – Microprocessor Data Path.

UNIT V: CAD Systems and Algorithms: Introduction to CAD Systems – Switch Level Simulation – Layout Synthesis – Layout Analysis – Timing Analysis and Optimization – Logic Synthesis – Test Generation – Sequential Machine Optimizations – Scheduling and Binding – Hardware/Software Co – Design.

REFERENCES

1. W. Wolf, "Modern VLSI Design: System-on-Chip Design" (Third Edition), Prentice Hall, 2002.
2. Neil H.E. Weste, Kamran Eshraghian, and Micheal John Sebastian, "Principles of CMOS VLSI Design – A Systems Perspective", Addison Wesley, 2001.
3. J.P. Uyemura, "Circuit Design for CMOS VLSI", Kluwer Academic Publishers, 1992.
4. Kerry Bernstein et al., "High Speed CMOS Design Styles", Kluwer Academic Publishers, 1998.

COURSE OUTCOMES

Upon completing the course,

CO1: Student will be able to learn and participate in the process of modern VLSI design and verification.

CO2: Student will be able to develop an understanding for the advanced design concepts in modern VLSI technologies.

CO3: Student will be able to design and layout a complex chip containing entities such as a register arrays, shifters, multipliers, an arithmetic logic unit (ALU), and other large scale devices.

CO4: Student will be able to Apply techniques used to test and debug IC designs

CO5: Be able to complete a VLSI design project having a set of objective criteria and design constraints.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			3				3	2		3		3	
CO2	3	3			2	3			3	2		3		3	
CO3	3	3			3							3		3	
CO4	2	2	2	2	2							3		2	
C05	2	3			3		3			1		3		3	

ECHESCN	SOLAR CELL DESIGN AND FABRICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of solar energy conversion systems, available solar energy and the local and national needs, photovoltaic and photothermal engineering applications, emerging technologies.
- To understand the interdisciplinary approach for designing stand-alone PV systems, predicting performance with different systems, Implementing design with cost analysis, Gain system engineering expertise related to photovoltaic energy conversion: generation, storage, and grid connection processes for residential and industrial applications,

- Be able to advance the current technology of the solar energy systems for making the process economical, environmentally safe and sustainable. Be able to serve industries or academia involved in sustainable energy engineering.

UNIT I : Concepts of Solar energy: the sun, Available solar energy from the sun, insolation vs. world energy demand, Blackbody radiation, Planck's Radiation Law, Wien's displacement Law, Stefan Boltzmann Equation, spectral distribution of extraterrestrial and terrestrial radiations, solar constant, properties of solar radiation Sun-Earth Geometry: Motion of the earth relative to the sun, Apparent motion of the sun relative to a fixed observer on the earth, Air Mass, estimation of available solar radiation on earth, absorption of solar radiation by earth's atmosphere, direct, diffused and albedo components of sunlight, solar radiation table, global radiation data. Mean annual irradiance on horizontal surface across the world, Effects of latitude, declination, slope, surface azimuth angle, hour angle, and the angle of incidence. Radiation on an inclined surface: direct, reflected, and diffused radiations, radiation on inclined surfaces, calculation of angles of incidence, direction of beam radiation, angles for tracking surfaces, ratio of beam radiation on tilted surface to that of horizontal surface

UNIT II : Photovoltaic technology: Introduction to PV, conversion of solar radiation to electrical energy, PV sizing for meeting the world's energy need, how much land area is needed, advantages and disadvantages of PV systems. Reliability and sizing of the PV/PT systems, uncertainty and risk factors in PV/PT design, Cost analysis, Terawatt challenge, Energy payback, different options of PV modules, thin film solar cells. Light absorption, Direct-bandgap and indirect bandgap semiconductors, light absorption coefficient, Reflection and reflection losses, Absorption as a function of photon energy, Carrier transport.

UNIT III : Performance parameters of PV cells: Fundamental principles of solar cell operation, Solar cell device physics, Basic structure of solar cells, Quasi Fermi energy levels, Law of junctions, Carrier generation rate, Recombination rate, Dark current, Light generated current, Current-voltage (I-V) relationship. Solar cell output parameter, Fill factor, solar cell efficiency, Short circuit current, Open circuit voltage, Maximum power point operation, Effect of finite width of the solar cell, Solar cell equivalent circuit, Effect of bandgap, maximum thermodynamic efficiency. Practical efficiency limit, Losses in short circuit current, open circuit voltage, efficiency, Temperature effects, Fill factor losses, I-V characteristic measurement, Efficiency measurement, Parasitic resistances, Effects of series and shunt resistances

UNIT IV : Solar cell module design and fabrication: Silicon solar cells to Photovoltaic Module (PV) production, Cell fabrication and interconnections, Top and Bottom connections, Manufacturing process, Cell matrix, encapsulation, vacuum lamination, Post-lamination steps, Bifacial modules, Electrical and optical performance of modules, Local shading and hot spot formation, Field performance. Introduction to concentrated Solar Power (CSP) systems, Energy generation and capacity factor, Tracking requirements, Photovoltaic and solar thermal concentrators, concentrator optics, solar collectors for CSP systems. concentrated Photovoltaic (CPV) systems: Principles and Practices, Fresnel lens, tracking systems. CPV modules, and engineering practices for CPV solar plants.

UNIT V: Performance evaluation of solar modules: Measurements and characterization of solar cells and PV modules, V – I characteristics, spectral response measurements, measurements and characterization of thin film solar cells Domestic, industrial and commercial applications, Lifetime of the PV modules, Degradation caused by UV radiation, Moisture penetration, Corrosion, Dust deposition/soiling losses, Reflection losses, Thermal effects, Delamination of the module, prevention of energy yield losses.

REFERENCES:

1]. Solar Cells: Operating Principles, Technology and System Applications, Martin Green published by the University of New South Wales, 1980 (Required) available at the BU Barnes and Noble book store

2]. A. Duffie and William A.Beckman John “Solar Engineering of Thermal Processes", Fourth Edition, John Wiley and Sons. Inc. 2005 (Chapters 1, 2, 3, and 7) Recommended
3]. Antonio Luque and Steven Hegedus “Photovoltaic Science and Engineering Handbook”, Second Edition, John Wiley and Sons, 2012 An excellent Resource
4]. Jeff Poortmans and Vladimir Arkhipov “Thin film Solar Cells”, John Wiley and Sons Ltd. 2006
5]. Stephen J. Fonash “Solar Cell Device Physics”, Second Edition, , Elsevier, Inc., 2010
6]. Thomas Markvart (Editor) “Solar Electricity”, Second Edition, , John Wiley and Sons, Ltd., 2000.
7]. Keith Lovegrove and Wes Stein “Concentrating Solar Power Technology, principles, developments and applications, Woodhead Publishing series in Energy”, Woodhead Publishing, 1518 Walnut Street, Suite 1100, Philadelphia, PA 19102-3406, USA 2012
8]. www.pveducation.org

COURSE OUTCOMES:

As an outcome of completing this course, the students will:

CO1: Gain an understanding of the available solar energy and the current solar energy conversion and utilization processes,

CO2: Have a working knowledge of semiconductor physics, optical systems, load matching, and storage and grid connections related to photovoltaic engineering,

CO3: Be able to comprehend the challenges in sustainable energy processes, perform cost analysis, design photovoltaic systems for different applications meeting residential and industrial needs, predict and test performance, and

CO4: Understand the manufacturing processes involved, environmental challenges that need to be solved, economic aspects, and future potentials of solar energy utilization

CO5: Evaluate the performance of a PV solar module using various measurement techniques

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	2		3	2	2							2	2		
CO3	2	2	3										2	2	
CO4	2		3										3	2	
C05	2		3	2	3							3	3	2	

ECHESCN	DIGITAL INTEGRATED CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of digital integrated circuits and expose them to examples of applications.
- To give the ability to analyze, design, and optimize digital circuits with respect to different quality metrics: cost, speed, power dissipation, and reliability.
- To give the basic background to go through a complete digital design cycle: analysis, design, simulation, layout and verification.
- To analyze and design of static sequential circuits and understand basic clocking issues.
- To know the basics of semiconductor memories.

UNIT I: Introduction: Design of static CMOS, nMOS and BiCMOS inverters – . Calculation of noise margins, power dissipation and gate delays – **Review of Logic UNIT I**

UNIT II: Design Fundamentals: Combinational Logic Design – Logic Simplification and Synthesis – Sequential Logic Design – Finite State Machine Design and Implementation.
UNIT III: Design of Combinational Circuits: Static CMOS Design – Dynamic CMOS Design – Power Consumption in CMOS gates – Design of Sequential Circuits: Static Sequential Circuits – Dynamic Sequential Circuits.
UNIT IV: Design of I/Os and Clock Generation: I/O Structures – PLL, clock generation and clock buffering – **Design of Memory:** Memory Core – Memory Peripheral Circuits – Memory Faults and Test Patterns.
UNIT V: Digital System Design using Hardware Description Language: Introduction to HDL, Modeling and Designing with VHDL – VHDL Description of Combinational Networks – VHDL Description of Sequential Networks – VHDL Model for Memories.
UNIT VI: Rapid Prototyping and Implementation of Digital Systems: Field Programmable Gate Arrays (FPGA), Complex Programmable Logic Devices (CPLD) – Logic Synthesis for FPGA and CPLD – Testing and Design for Testability (DFT): Boundary – Scan Test – Faults and Fault Simulation – Automatic Test – Pattern Generation – Scan Test and Built – in Self – test.

REFERENCES

1. Rabaey, J.M., "Digital Integrated Circuits – A Design Perspective", Second Edition Prentice Hall, 2002.
2. Weste, N. and Eshraghian, K., "Principles of CMOS VLSI Design – A Systems Perspective", Prentice Hall, 1993.
3. Roth Jr. C.H., "Digital Systems Design Using VHDL", PWS Publishing Com., 1998.
4. Michael J.S. Smith, "Application – Specific Integrated Circuits", Addison – Wesley, 1997.

COURSE OUTCOMES

Upon completing the course, the students will be able to

CO1: Understand the impact of technology scaling.
CO2: Understand the basic operation of MOS transistors, current equations, and parasitic and to understand the concepts of propagation delay, power consumption of CMOS ICs.
CO3: Know how to analyze and design complex logic gates in standard CMOS technology and compute their delay and power consumption.
CO4: Be able to analyze and design of static sequential circuits and understand basic clocking issues.
CO5: Know the basics of semiconductor memories.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	2		
CO2	3		3	2	2							3	2		
CO3	2	2	3										2	2	
CO4	3		3										3	2	
CO5	2		2	2	3							3	3	2	

ECHESCN	SEMICONDUCTOR DEVICES AND MODELLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basics of semiconductor materials, their electrical properties and quantitative analysis of such materials based on energy band diagrams.
- To acquaint the students with the construction, theory and operation of the P-N junction diode, its characteristics and quantitative analysis of P-N junction diodes.
- To teach the concepts of Bipolar Junction Transistors and quantitative analysis to estimate the performance factors.

- To make the students understand the effect of junction capacitance, their effect on the performance of diodes and BJTs and Breakdown characteristics of these devices
- To impart knowledge of the operation and characteristics of Photodiodes and phototransistors and qualitative analysis of these devices.

UNIT I: Quantitative analysis of Semiconductors: Atomic picture of Silicon and Germanium – Electric current, free electron density and mobility in Semiconductors – Effect of doping on minority carrier density in Semiconductors – Energy band picture of P and N type Semiconductors – Temperature dependence of conductivity – Degeneracy. Calculation of free electron density and hole density in a Semiconductor – Determination of position of Fermi level for a given Semiconductor – Carrier density expressed in terms of departure of Fermi level from intrinsic Fermi level – Fermi level in N-type and P-type samples as measured from intrinsic Fermi level – Very lightly doped samples – representation of energy band diagram in terms of potential – Equation governing potential distribution in a Semiconductor – Equation governing distribution of hole density and electron density – Continuity equation for Semiconductors – Determination of steady state excess carrier density – Concepts of Quasi Fermi level.

UNIT II: Quantitative analysis of P-N junction Diode: P-N junction under thermal equilibrium – P-N junction under Forward bias – P-N junction under Reverse bias – Behavior under large forward voltage – Temperature dependence of P-N junction characteristics – Break down under reverse bias – Thermal Break down, Zener Break down and Avalanche Break down – Transition capacitance of a P-N junction. Band diagram for a Semiconductor with an applied voltage – P-N junction in thermal equilibrium – Minority carrier densities in a P-N junction under Forward bias – Expression for total current in a P-N junction – Calculation of carrier density and current in a reverse biased junctioN-P-N junction behavior in terms of minority carrier stored charge – Calculation of electric field and voltage drop in the bulk.

UNIT III: Quantitative analysis of Bipolar Junction Transistor: Operation of a BJT – Performance parameters – Effect of collector junction voltage on current – Dependence of I_C on V_E and I_E. Uniform Base PNP transistor with Forward biased B-E junction and Reverse biased C-B junction – Calculation of performance parameters – Transit time of minority carriers through base – Effect of floating collector on transistor V-I characteristics – Effect of floating emitter junction characteristics – Collector current with base floating – Temperature effects in Transistors – Effect of device geometry on the transistor performance – Ebermoll's equation.

UNIT IV: Junction Transition capacitance and junction Break down voltages: Electric field and potential distribution in P-N junction at thermal equilibrium – transition capacitance and Break down voltages in linearly graded junction and an abrupt junction – C_T in PIN Diode – Break down voltage in transistor.

UNIT V: Quantitative analysis of Photo diodes and Photo transistors: Carrier generation by light in a uniform piece of semiconductor – P-N junction photo diode for light detection – Open circuit photo voltages – Short circuit current in photo diode – Photo diode current under combined action of light and reverse bias – Photo diode current under combined action of light and forward bias – Photo transistor – Expression for current in photo transistor – Solar cells using photo diodes.

REFERENCES

1. M.K. Achuthan and K. N. Bhat, "Fundamentals of Semiconductor devices", Tata McGraw Hill, New Delhi, 2007.
2. Ben G Streetman, "Solid State Electronics", Prentice Hall, 1999.

3. S.M.Sze, “Modern Semiconductor Devices Physics”, John Wiley and Sons, 1998.
4. Donald A. Meamen, “Semiconductor Physics and Devices – Basic Principles”, McGraw Hill, 2003.

COURSE OUTCOMES

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

CO1: Describe the equations based on energy band diagrams, acceptable approximations and for intrinsic, p and N type semiconductors
CO2: Explain the operation of p-n junction diodes quantitatively and qualitatively.
CO3: Describe the fabrication, device operation of a BJT quantitatively and model its characteristics from basic principles
CO4: Understand the effects of junction capacitance and break down voltages on the performance of P-N junction diodes and BJTs the Classify and describe the semiconductor devices for special applications
Co5: To analyze and develop models of optoelectronic devices such as Solar Cells and LEDs.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										2	3		
CO2	2		3	2	2							2	2		
CO3	2	2	3										2	2	
CO4	2		3										3	2	
C05	2		3	2	3							3	3	2	

MINOR ENGINEERING

ECMISCN	ELECTRONIC DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

Students will learn:

- To understand operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To apply concepts for the design of Regulators and Amplifiers
- To verify the theoretical concepts through laboratory and simulation experiments.
- To implement mini projects based on concept of electronics circuit concepts.

UNIT I: Introduction to Semiconductor Physics

Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.

UNIT II: P-N junction

Generation and recombination of carriers; Poisson and continuity equation P- N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.

UNIT III: Bipolar Junction Transistor

Bipolar Junction Transistor, I-V characteristics, Eber's-Moll Model, MOS capacitor, C-V characteristics.

UNIT IV: MOSFET and Optoelectronic devices

MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell

UNIT V: Integrated circuits

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

TEXTBOOKS

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices,"7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education 4th edition (1 July 2017).
3. S. M. Szeand K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, JohnWiley & Sons, 2006.

REFERENCES

1. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
2. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

COURSE OUTCOMES

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

CO1. Demonstrate the semiconductor Physics of the intrinsic and extrinsic materials.

CO2. Outline the characteristics of P-N Junction, and some special function diodes.

CO3. Explain the mathematical models of semiconductor junction's and MOS transistors for circuits and systems.

CO4. Draw dc circuits and relate acmodels of semiconductor devices with their physical Operation.

CO5. Design and analyze of electronic circuits.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			3									3		
CO2	3	2		3									3		
CO3	3		2											2	
CO4		2		3									3		
C05			2		1								3	2	

ECMISCN	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an exposure of different types of analog modulation techniques and their significances in communication systems.
- To familiarize the students about digital modulation techniques in communication systems.
- To introduce the concepts of Pulse Code Modulation techniques and multiple access techniques used in communication systems for enhancing the number of users.
- To focus on various media for digital communication and future data communication.
-

UNIT I: Linear Modulation / Demodulation

Need for modulation - Amplitude modulation - Power spectrum - Power relation Different types of modulation - Double sideband suppressed carrier. (DSB/SC), Single sideband suppressed carrier (SSB) and Vestigial sideband (VSB) generation. AM transmitters - Block diagram - Amplitude demodulation - Detection of DSB, SSB signals - Receiver characteristics - Super heterodyne reception - Automatic volume control.

UNIT II: Angle Modulation

Principle of frequency and phase modulation - Generation of FM and PM signals - Direct and indirect methods - FM transmitters - Block diagram – Pre- emphasis circuit - Frequency demodulation - Detection of FM and PM signals - Automatic frequency control - De-emphasis circuit.

UNIT III: Pulse Modulation

Analog and digital communication systems and techniques: Pulse modulation systems - Sampling theorem - Pulse amplitude modulation - Channel bandwidth - Detection of PAM signals - Cross talk in PAM signals - Pulse time modulation - Generation of PDM and PPM - Conversion of PDM to PPM - Detection of PTM signals Cross talk in PTMsignals.

UNIT IV: Pulse Code Modulation Systems

Quantization - Compounding - Pulse code modulation - Sampling and digitizing Aliasing - Sample and hold circuit - Practical implementation of sampling and digitizing - Equalization - Multiplexing - Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) - Data communications - Serial synchronous, asynchronous communication protocol - Hardware USARTS - Software USART.

UNIT V: Wireless Communication Systems

Evolution of generations(1G,2G,2.5,3G,4G and beyond 4G)-GSM and CDMA systems-cellular structure-frequency reuse-Handoff-Blue toothand UWBnetwork- Wi- Fi and Wi-Max. (Quantitative treatmentonly)

TEXT BOOKS

1. Herbert Taub, Donald L. Schiling & Gautam Saha "Principles of Communication Systems", Tata McGraw Hill Education Pvt. Ltd., Third Edition, 2008.
2. Bernard Davis & George Kennedy, "Electronic Communication Systems", Tata McGraw Hill Education Pvt. Ltd., Fifth Edition, 2011.

REFERENCES

1. K.N. HariBhat & Ganesh Rao, "Analog Communications", Pearson Publications, 2nd Edition, 2008.
2. Anokh Singh, "Principles of Communication Engineering", 6th Reprint, S. Chand & Company Ltd.,2006.
3. Sanjay Sharma, "Analog and Digital Communication", S.K. Kataria and Sons Publications, 2013.
4. Bernard Sklar & Pabitra Kumar Ray, "Digital Communications – Fundamentals and Applications", Pearson Publications, Second Edition, 2010.

COURSE OUTCOMES

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

CO1. Identify idea about modulation and demodulation techniques employed in communication systems.

CO2. Select the blocks in a design of angle modulation.

CO3.Examine various Pulse Code Modulation techniques used in communication systems.

CO4. Outline the multiple access techniques used in communication field applications.

CO5. Compare various generations in wireless system.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	2										3	
CO2	3		2	2										3	
CO3	3	3			2									3	
CO4	3	3			2								2	3	
C05		3										1	2		

ECMISCN	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Working of operational amplifiers and various applications of op-amp such as Multivibrators, Oscillators and filters.
- The theory of ADC and DAC and the concepts of waveform generation and some special Function ICs.

- Micro fabrication techniques of optical integrated circuits and optical wave guides, Opto electronic integrated circuits.

UNIT I: Introduction to Linear IC'S

Integrated circuits – monolithic integrated circuits – active and passive components of IC - fabrication of monolithic IC‟s -ideal op-amp - practical op-amp - Various stages of an operational amplifier - simplified schematic circuit of op-amp 741 – op-amp characteristics - offset current and offset voltage - frequency response of an op-amp - noise analysis - slew rate.

UNIT II: Applications of Op – Amp

DC amplifier–AC amplifier-Inverting and Non-inverting Amplifiers-Summing, scaling and Averaging amplifiers - Logarithmic Amplifiers - antilog amplifier - Instrumentation Amplifiers - Differential Amplifiers -Voltage to Current Converters - Current to Voltage Converters – Integrators –Differentiators.

UNIT III: Active Filters & Oscillators

Active filters - Butterworth filters: First order and Second Order Low-Pass filters -First order and Second Order High-Pass filters – Band-Pass filters: wide band-pass filters - narrow band-pass filters – Band-reject filters: wide band-reject filters and narrow band-reject filters - Oscillators: Oscillator Principles, Oscillator types - phase shift Oscillator - Wien Bridge Oscillator - voltage–controlled oscillator.

UNIT IV: Comparators and Converters

Basic Comparator: Comparator characteristics - Zero Crossing Detector – Schmitt Trigger – high speed and precision type comparators - window Detector – Voltage to Frequency converter - Frequency to Voltage converter - D/A converters - A/D Converters - Clippers and Clampers – positive and negative clippers – small-signal and half-wave rectifier – positive and negative clampers - Peak Detector – sample and hold circuit.

UNIT V: Waveform Generators and Other Linear IC'S

Square wave generator – triangular wave generator - saw tooth wavegenerator – Switched capacitor filter - The 555 Timer –555 Timer as an astable, bistable, monostable multi vibrators– power amplifiers - voltage regulators - Three Terminal fixedandadjustableRegulators-switchingregulators-OperationofthebasicPLL- Monolithic PLL – 565 PLL Applications.

TEXT BOOKS

1. Gayakwad R.A. "Op amp and Linear Integrated circuits", Second Edition, PHI.1988.
2. Roychoudhury and shail Jain "Linear integrated circuits" Wiley Eastern 1991.

REFERENCES

1. Jacob millman and Arvin Grabel, "Micro electronics" (2nd edition), McGraw Hill - 1987.
2. Gray and Meyer, "Analysis and design of analog IC's", Wiley International -1996.
3. Paul R. Gray, Paul J. Hurst, Robert G. Meyer, Stephen H. Lewis, "Analysis and design of analog integrated circuits", 4th education. John Wiley & Sons; (9 April 2001).

COURSE OUTCOMES

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

CO1. Outline the fabrication steps of integrated circuits

CO2. Design linear application circuits using OP-amp.
CO3. Design of filters and oscillators using Op-amp.
CO4. Describe the operation of data converters using OP- amp.
CO5. Design timer and wave form generation circuits using 555 timer IC.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3	2	
CO2															
CO3	2	2	2										2		
CO4	2	2	2										2		
C05		2	2												

ECMISCN	COMPUTER NETWORKS AND ARCHITECTURE	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

- To understand the concept of network architecture and protocols
- To understand the division of network functionalities into layers.
- To be familiar with the components required to build different types of networks.
- To be exposed to the required functionality at each layer
- To learn the flow control and congestion control algorithms

UNIT I: Introduction to computer networks and the Internet

Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

UNIT II: Switching in networks

Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.

UNIT III: Network layer

Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

UNIT IV: Transport layer

Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

UNIT V: Congestion Control and Resource Allocation

Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

TEXTBOOKS

1. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 7th Edition, 2016.
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition, 2011.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall, 1992.
4. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 2002.

REFERENCES

1. B. A. Forouzan, "Data Communications and Networking", Tata McGrawHill, 4th Edn, 2012.
2. Andrew Tanenbaum, "Computer Networks", Prentice Hall, 5th edition, 2016.
3. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall, 6th 2014.
4. William Stallings, "Data and computer communications", Prentice Hall, 10th edition, 2013.

COURSE OUTCOMES

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

CO1. Outline the functions and utilization of application layer and internet
CO2. Categorize different switching techniques to enhance the network performance
CO3. Solve various issues in routing and congestion and multiple access protocols.
CO4. Demonstrate various connection- oriented transport layer protocols to ensure end to end delivery.
CO5. Interpret the issues in Resource Allocation and analyze congestion Avoidance Mechanisms and Quality of Service improvement.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3											2	3		
CO3	3											2	3		
CO4	3	3	2									2	3		
C05	3	2										2	3		

ECMISCN	WIRELESS COMMUNICATION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE

- To acquire knowledge of Wireless channels and parameters
- To impart knowledge on mobile communication and cellular system architecture
- To understand various Modulation Techniques used in wireless communication.
- To create exposure to multipath mitigation techniques and wireless standards

UNIT I: Wireless Channels

Large Scale Path Loss – Path Loss Models- Free Space and Two-RayModels -Link Budget Design – Small Scale Fading- Parameters of Mobile Multipath Channels – Time Dispersion Parameters-Coherence Bandwidth –

Doppler Spread and Coherence Time-Fading due to Multipath Time Delay Spread-Flat Fading, Frequency Selective Fading – Fading Due to Doppler Spread - Fast Fading , SlowFading.

UNIT II: Fundamentals of Cellular Communication

Multiple access technique - FDMA, TDMA and CDMA - Operation of Cellular Systems - Frequency Reuse - Channel Assignment Strategies - Interference and System Capacity - Co-Channel Interference - Adjacent Channel Interference –Trunking and Grade of Service-Improving Coverage and Capacity in Cellular Systems - Cell Splitting - Sectoring - Repeaters for range extension - A Micro cell zone concept.

UNIT III: Modulation Techniques

Introduction to Modulation Techniques, Modulation and Demodulation - Quadrature Phase Shift Keying, Π / 4-Differential Quadrature Phase Shift Keying, Offset-Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum Shift Keying, Gaussian Minimum Shift Keying, Power Spectrum and Error Performance in Fading Channels, OFDM Principle – Cyclic Prefix, PAPR, Inter Carrier Interference.

UNIT IV: Multipath Mitigation Techniques

Equalization – Adaptive Equalization, Linear and Non - Linear equalization, Zero forcing and LMS Algorithms, Diversity–Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception.

UNIT V: Mobile Communication Systems

Overview of AMPS - DECT - CT2 - PACS - PHS - International Mobile Telecommunication 2000 - GSM Architecture - USSD - GPRS - EDGE - IS95, CDMA 2000 - WCDMA - UMTS - HSPDA - Bluetooth - WIFI - WIMAX - Introduction to LTE.

TEXT BOOKS

1. Rappaport., "Wireless and Mobile Communication", Pearson Education, 2009.
2. Yi-Bing Lin and Imrichchlantae., "Wireless and Mobile Network Architecture" John Wiley & Sons, 2008

REFERENCES

1. ITI Saha Misra., "Wireless Communications and Networks : 3G and Beyond", Tata McGraw – Hill Edition, 2013.
2. K. Fazel and S. Kaiser, "Multicarrier and Spread Spectrum Systems", Wiley, 2003.
3. D. Tse and P. Vishwanath, -"Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Lee W.C.Y., "Mobile Cellular Telecommunication Systems" McGraw Hill International Edition, 1990.
5. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2010.
6. Ramjee Prasad," OFDM for Wireless Communications Systems", Artech House, 2004.

COURSE OUTCOMES

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

CO1. Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.

CO2. Apply cellular concepts and evaluate signal reception performance in cellular Systems.

CO3. Design and Implement various Modulation schemes for fading channels

CO4. Analyze transmitter and receiver diversity techniques

CO5. Compare 2G,3G and 4G mobile systems

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2			3								3	3	
CO2		2	3										3	3	
CO3			3	2	3								3	3	
CO4				2								2	3	3	
C05			3		3	1						2	3	3	

ECMISCN	TELECOMMUNICATION SWITCHING AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concepts of Frequency and Time division multiplexing.
- To introduce digital multiplexing and digital hierarchy namely SONET /SDH
- To introduce the concepts of space switching, time switching and combination switching, example of a switch namely No.4 ESS Toll switch.
- To introduce the need for network synchronization and study synchronization issues. To outline network control and management issues.

UNIT I: Multiplexing

Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing: Pulse Transmission, Line Coding, Binary N-Zero Substitution, Digital Biphase, Differential Encoding, Time Division Multiplexing, Time Division Multiplex Loops and Rings, SONET/SDH: SONET Multiplexing Overview, SONET Frame Formats, SONET Operations, Administration and Maintenance, Payload Framing and Frequency Justification, Virtual Tributaries, DS3 Payload Mapping, E4 Payload Mapping, SONET Optical Standards, SONET Networks. SONET Rings: Unidirectional Path-Switched Ring, Bidirectional Line-Switched Ring.

UNIT II: Digital Switching

Switching Functions, Space Division Switching, Time Division Switching, two dimensional switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment. Elements of SS7 signaling.

UNIT III: Network Synchronization Control and Management Timing

Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

UNIT IV: Digital Subscriber Access ISDN

ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems,

Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.

UNIT V: Traffic Analysis

Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.

TEXT BOOKS

1. J. Bellamy, "Digital Telephony", John Wiley, Third Edition 2007.
2. JE Flood, "Telecommunications Switching, Traffic and Networks", IET,1997.

REFERENCES

1. R.A.Thomson, "Telephone switching Systems", ArtechHouse Publishers,2000.
2. W. Stalling, "Data and Computer Communications", Prentice Hall, Tenth Edition,2014.
3. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience,1994.
4. W.D. Reeve, "Subscriber Loop Signaling and Transmission Hand book",IEEE Press (Telecomm Handbook Series), 1995.
5. Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., 2015.

COURSE OUTCOMES

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

CO1. Outline the main concepts of telecommunication network design.

CO2. Solve traditional interconnection switching system design problem.

CO3. Examine the timing recovery concepts and its error performance.

CO4. Compare telephone network, data network and integrated service digital network.

CO5. Evaluate fundamental telecommunication traffic models

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			3								3		
CO2			2				1				1		3		
CO3		2	2		3								3		
CO4													3		
C05	2				3							1	3		

ONE CREDIT COURSE

	PCB DESIGNING LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To introduce the concepts of PCB Design.
- To study Schematic Creation and simulation of an electronic circuit.
- To study the Device Model and simulation.
- To test the Electronic circuits on PCB.

List of experiments:

1. Study on types of PCB layers, through Hole and SMD Components.
2. Schematic Creation and simulation of an electronic circuit
3. Mapping Components of an electronic circuit
4. Set Parameters for PCB Design.
5. Laying Tracks on PCB.
6. Create PCB Layout of an Electronic Circuit.
7. Create Device Model and simulation.
8. Create PCB layout of an amplifier design.
9. Create PCB layout of an Astable Multivibrator using IC's.
10. Create PCB layout of a Voltage Regulator using IC's.
11. Create PCB layout of a Galvanic isolation circuit.
12. Printing on PCB.
13. Etching and Drilling of PCB.
14. Soldering PCB.
15. Testing of an electronic Circuit-1 on PCB.
16. Testing of an electronic Circuit-2 on PCB.

COURSE OUTCOMES: At the end of the Course the student will be able to

CO1: Determine appropriate components to make circuits.(L3)
CO2: Interpret test results and measurements on electric circuits.(L2)
CO3: Analyze the fabrication processes of printed circuit boards.(L4)
CO4: Apply the software and hardware for PCB Design.(L3)
CO5: Evaluate an electronic printed circuit board for a specific application using industry standard software.(L5)

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2			3								3		
CO2			2				1				1		3		
CO3		2	2		3								3		
CO4													3		
C05	2				3							1	3		

	MATLAB Programming	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To learn features of MATLAB as a programming tool.
- To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
- To understand MATLAB graphic feature and its applications.
- To use MATLAB as a simulation tool.

Unit 1. Introduction to MATLAB

- The MATLAB Environment
- MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output.
- Vectors, Arrays – Matrices

Unit 2. MATLAB Functions

- Built-in Functions
- User defined Functions

Unit 3. Graphics with MATLAB

- Files and File Management – Import/Export
- Basic 2D, 3D plots
- Graphic handling

Unit 4. Programming with MATLAB

- Conditional Statements, Loops
- MATLAB Programs – Programming and Debugging.
- Applications of MATLAB Programming.

COURSE OUTCOMES:

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

CO1: Understand the features of MATLAB as a programming tool.
CO2: Develop the new teaching model that will help to improve the programming skills
CO3: Understand the MATLAB graphic feature and its applications.
CO4: Use the MATLAB as a simulation tool.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3											2	3		
CO3	3											2	3		
CO4	3	3	2									2	3		

	ANTENNA DESIGN USING HFSS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To learn the Fundamentals of Antenna design.
- To study about the antenna arrays.
- To learn about the usage of HFSS simulation software in antenna design.
- To design of Microstrip Antennas using HFSS software.
- To study the fabrication and testing methods of antenna.

Unit I: Fundamentals of Antenna

Fundamental Theory of antenna: Reciprocity theorem, antenna equivalent circuit, Classification of antennas, Special types of antennas for differentfrequency bands.

Antenna Parameters: Radiation Impedance, Radiation Pattern, Antenna Impedance, Bandwidth, Directivity, Gain, Antenna efficiency, Radiation Efficiency, Antenna Polarization, Antenna Apertures, Antenna temperature, near-field and far-field concepts, and radiation mechanism.

Unit II: Antenna Arrays

Two-Element Array N-Element Linear Array: Uniform Amplitude and Spacing N Element Linear Array: Directivity Design Procedure, N Element Linear Array: Three-Dimensional Characteristics, Rectangular-to-Polar Graphical Solution, N-Element Linear Array: Uniform Spacing, Non uniform, Binomial Array Amplitude, Planar and Circular Arrays.

Unit III: Introduction to HFSS

The mathematical method used by HFSS, The adaptive solution process and its importance to HFSS, The Six general steps in HFSS simulation, The three solution types in HFSS, available boundaries with in HFSS, Excitation in HFSS,HFSS Solution setup, HFSS Post Processing.

Unit IV: Design of Microstrip Antennas using HFSS

Feeding methods, Method of analysis, Rectangular and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarization, Arrays and Feed Networks, Multi Band, Recent advances in fractal antenna and patch array.

Unit V: Fabrication and Testing

Method of Fabrication-Chemical Etching, Photo Lithography and Computer controlled coordinatograph. Testing of Antenna-Network Analyzer: Scalar Network Analyzer (SNA), Vector Network Analyzer (VNA) and Large Signal Network Analyzer (LSNA).

REFERENCES:

1. Balanis C.A, "Antenna Theory", 2nd Edition, Wiley, 2003
2. Kyohei Fujimoto, Koichi Ito, "Antennas for Small Mobile Terminals", Artech House, 2018.
   https://www.ansys.com/products/electronics/ansys-hfss

COURSE OUTCOMES:

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

CO1: Understand the Fundamentals of Antenna design.
CO2: Understand about the antenna arrays.
CO3: Learn about the usage of HFSS simulation software in antenna design.
CO4: Designing of Microstrip Antennas by using HFSS software.
CO5: Understand the fabrication and testing methods of antenna.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3											2	3		
CO3	3											2	3		
CO4	3	3	2									2	3		
CO5	3	2										2	3		

	MEMS AND SENSOR DESIGN	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To impart knowledge about the need and applications of microsystem in engineering.
- To introduce the fundamental concepts relevant to fabrication and machining process of MEMS sensors and actuators.
- To enable the students to understand the various sensing and actuation mechanisms.
- To enable the students to design, analysis, fabrication, characterization of MEMS technology based devices

UNIT I: Introduction

Introduction to MEMS and Microsystems, MEMS Classification, MEMS versus Microelectronics, Applications of MEMS in Various Industries, Some Examples of Microsensors, Microactuators, and Microsystems, Materials for MEMS, Laws of Scaling in miniaturization

UNIT II: MEMS Fabrication

Structure of Silicon, Single Crystal Growth Techniques, Photolithography, Oxidation, Diffusion, Ion Implantation, Physical Vapor Deposition, Chemical Vapor Deposition, Bulk Micromachining: Overview of Etching, Isotropic and Anisotropic Etching, Wet Etchants, Etch Stop Techniques, Dry Etching, Surface Micromachining, LIGA, SLIGA, Wafer Bonding, Electroplating

UNIT III: Microsensors and Microactuators

Basic Modeling Elements in Mechanical, Electrical and Thermal Systems, Types of Beams: Fixed-Free (Cantilevers), Fixed-Fixed (Bridges), Fixed-Guided beams, Electrostatic sensing and Actuation: Parallel plate capacitor, Applications of parallel plate capacitors: Inertial sensor, Pressure sensor, Flow sensor, Parallel plate Actuators, Piezoresistive Sensors: Origin and Expressions of Piezoresistivity, Piezoresistive Sensor Materials, Applications of Piezoresistive Sensors, Piezoelectric Sensing and Actuation, Thermal Sensing and Actuation: Sensors and Actuators based on Thermal Expansion, Thermocouples, Thermoresistors, Shape Memory Alloy, Applications: Inertial sensors, Flow sensors, Infrared sensors

UNIT IV:

Layout, Simulation Tools, Packaging and Characterization techniques: Introduction of layout, Simulation Tools, Packaging and Various Characterization Techniques for MEMS Devices

UNIT V: RF-MEMS

MEMS devices for RF Applications: High-Q Capacitors and Inductors and Their Applications in RF Circuits, Mechanical, Electromechanical and Electromagnetic modeling of SPST, SPDT devices and their applications

BOOKS AND REFERENCES

1. Tai-Ran Hsu “MEMS and Microsystems design and manufacture”, McGraw Hill Education; 1st edition (1 July 2017).
2. N. P. Mahalik “MEMS”, Tata McGraw Hill 2013.
3. Chang Liu “Foundations of MEMS”, Pearson; 2nd edition (19 May 2011).
4. M. J. Usher, McMillian Hampshire “Sensors and Transducers” 1996.
5. Minhang Bao “Analysis and Design Principles of MEMS Devices”, Elsevier Science Ltd; 1st edition (12 April 2005).
6. M. Madou “Fundamentals of Microfabrication”, CRC Press. 2nd edition (13 March 2002).
7. R.S. Muller, Howe, Senturia and Smith “Microsensors”, IEEE (January 1, 1991).
8. S. M. Sze “Semiconductor Sensors”, Willy Inderscience Publications 2021.

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to

CO1: Identify structural and sacrificial materials for MEMS.

CO2: Describe the fabrication steps in designing of various MEMS devices.
CO3: Apply principles for the design of Sensor and actuators.
CO4: Apply MEMS for different applications in various fields of engineering.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	2										3	
CO2	3		2	2										3	
CO3	3	3			2									3	
CO4	3	3			2								2	3	

	REAL TIME OPERATING SYSTEMS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and user computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS.
- To discuss the application development using RTOS.

Unit–I : Review of Operating Systems

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling-Fault &recovery.

Unit–II : Overview of RTOS

RTOS Task and Task state –Multithreaded Premptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

Unit–III : Real Time Models and Languages

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

Unit–IV : Real Time Kernel

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

Unit–V : RTOs Application Domains

Case studies-RTOs for Image Processing – Embedded RTOs for Network communication – RTOs for fault-Tolerant Applications – RTOs for Control Systems.

TEXT BOOKS

1. Silberschatz,Galvin,Gagne, Operating System Concepts,6th ed,John Wiley,2003.
2. Raj Kamal, Embedded Systems- Architecture, Programming and Design, Tata McGraw Hill, 2006.

REFERENCES

1. Herma K., Real Time Systems – Design for distributed Embedded Applications, Kluwer Academic, 1997.
2. Charles Crowley, Operating Systems-A Design Oriented approach, McGraw Hill 1997.
3. C.M. Krishna, Kang, G.Shin, Real Time Systems, McGraw Hill, 1997.
4. Raymond J.A.Bhur, Donald L.Bailey, An Introduction to Real Time Systems, PHI 1999.
5. Mukesh Sighal and N G Shi, Advanced Concepts in Operating System, McGraw Hill

2000.
6. D.M.Dhamdhere, Operating Systems, A Concept-Based Approch,TMH,2008.

COURSE OUTCOMES

CO1: Will get to know the fundamentals of interaction of OS with a computer and User computation. (Unit–I :& II)

CO2: Will get to know the programming logic of modeling Process based on range of OS features. (Unit–III :& IV)

CO3: To help the students to come with design and development of solutions using RTOS. Unit V)

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3	2		3	2			1			3		
CO2	3		3			3	2		2				3		
CO3		1				3					1	2	3		

	COMMUNICATION NETWORK USING NS/2	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To expose the students to the basics of NS2 simulation software.
- To study about the Wired and Wireless networks.
- To train the students on Analyzing traces.
- To train the students to write NS2 Codings.

Unit I: Basics of NS2

About NS2 and NAM, Purpose and Installation, Background and architecture, OTcl and C++ interfaces, Trace files and formats, Protocol support for NS2 Simulation object, Basic Syntax, Node creation, Finish procedure, Running NS2 and NAM, Invoking external commands within NS2

Unit II: Wired and Wireless networks

Nodes & Agents, Working of NS2 commands, Wired and Wireless scenarios, Routing protocols in wireless scenarios Wired networks- Creating links, Sending traffic through NS2 links, Setting link parameters, Routing protocol support, Scenarios Wireless networks - Additional parameters, Setting node positions, GOD object and Topography, Protocol support, Scenarios

Unit III: Analyzing traces

Back to traces, AWK and Xgraph, Analyzing parameters in each trace entry, Xgraph parameters Invoking AWK scripts, Print values to console and files using AWK, Setting values for Xgraph, Invoking Xgraph, Additional Xgraph parameters

Unit IV: Advanced topics

Introduction to NS2 source code, Building NS2 from source, Patches in NS2, Energy models in wireless scenarios

COURSE OUTCOMES:

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

CO1: Understand the basics of NS2 simulation software.

CO2: Understand about the Wired and Wireless networks.

CO3: Obtain the training on Analyzing traces.

CO4: Developing Coding in NS2 simulation software.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											2	3		
CO2	3											2	3		
CO3	3											2	3		
CO4	3	3	2									2	3		

	Computer Hardware Trouble Shooting	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To study about the computer motherboards.
- To study about the various peripheral devices in personal computer.
- To understand the trouble shooting in hardware.
- To understand the operations of basic trouble shooting in hardware in practical.

UNIT 1: Hardware Basics- Basic terms, concepts, and functions of system modules (System board, firmware, storage devices, monitor, boot process, ports). CMOS and BIOS, Overview of system components, Motherboard: definition, Components/connections in motherboard, Knowing mother board of PC, Identifying types of motherboard, SMPS: Circuit diagrams and pin assignments, working of SMPS Input and load requirements.

UNIT 2: Memory Module and Hard disk 6 Features of different types memory modules, Reading memory error messages, adding RAM, Tips on installing memory chips, Static and handling precautions. Disk structure: Cylinders, heads, platters, tracks and sectors, structure of a disk, hard disk controllers. Types of interface controller and drives. Hard disk software installation: Physical formatting, partitioning, high level formatting, Hard disk installation

UNIT 3: Input / Output Devices 8 Keyboard : Keyboard and Mouse operation, Key switches, Common faults and diagnostics, Scanner: Working Principle, Types and Fault finding, CDROM drive:-CD drives mechanism installation of CD drive, Monitors: Display basics, Display adapter cards, VGA and super VGA, Failure, Troubleshooting and Elimination, Printer: Types, Interfaces, Parts, Working Principle and Connection to Computers.

UNIT 4: Troubleshooting and Preventive Maintenance 8 Troubleshooting basics, Troubleshooting by visual Inspection, Preventative Maintenance, Using Preventative Maintenance Tools, POST : Functions, Test Sequence, Error messages, Troubleshooting Procedures and Preventative Maintenance: Identifying Troubleshooting Tools, Hardware tools, Diagnostic software, Materials and equipment, Software utilities, Maintaining Environmental Controls, Ventilation and airflow, Humidity and liquids, Dirt and dust, Power, UPS, and suppressors, Completing Maintenance Tasks, Case and components, Power supplies

REFERENCE:

1. B.Govindarajalu "IBM PC & Clones: Hardware Trouble Shooting and Maintenance", Tata McGraw Hill 2019.
2. Marcia Press, Barry Press "PC Upgrade & Repair Bible", John Wiley & Sons; Desktop ed edition (11 May 2004).
3. R. P. Beales "PC Systems, Installation and Maintenance", Newnes; 2nd ed. edition (31 October 1998).
4. Ron Gilster "PC Upgrade & Repair Black Book", Dreamtech Press (28 July 2001).
5. D Balasubramanian "Computer Installation and Servicing", McGraw Hill Education; 2nd edition (15 July 2005).

COURSE OUTCOMES

CO1: Understand about the various parts in computer motherboards.
CO2: Understand about the various peripheral devices in personal computer.
CO3: Trouble shooting the printers, drives and network hardware.
CO4: Trouble shooting the monitors and motherboards in practical.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3		3		2		3	3	3		
CO2	3	3			3	2	3			2	3	3	3		
CO3	3	3	3		3								3		
CO4	3			3	3							3	3		

	Signal & Image Processing Using MATLAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To study the key features of MATLAB.
- To understand the basics the MATLAB Software.
- To train the students to develop MATLAB coding.
- To study the simulink model in MATLAB.
- To expose the image processing toolbox in MATLAB.

UNIT I: INTRODUCTION TO MATLAB

Brief Introduction-Installation of MATLAB – History-Use of MATLAB- Key features-MATLAB window-Command window – Workspace-Basic commands-Assigning variables - Operations with variables

UNIT II: MATLAB SOFTWARE

Data files and Data types - Character and string-Arrays and vectors-Arithmetic operations-Logical operators-Solving arithmetic equations-Matrix operations-M files Working with script tools - Writing Script file - Executing script files - The MATLAB Editor - Saving m files – Plots, Plot labeling, curve labeling and editing - Figure Windows - Displaying Multiple Plots in One Figure – Subplots - Introduction Of Graphical User Interface

UNIT III: MATLAB PROGRAMMING

Automating commands with scripts - Writing programs with logic and flow control - Writing functions - Control statement Programming- Conditional Statement Programming, Examples-Control Flow Conditional Control if, else, switch- Loop Control for, while, continue, break- Program Termination return - Functions - Writing user defined functions- Built in Function-Function calling - Return Value - Types of Functions- Global Variables

UNIT IV: MATLAB SIMULINK

Introduction of Simulink - Simulink Environment & Interface - Study of Library - Circuit Oriented Design - Equation Oriented Design – Model - Subsystem Design - Connect Call back to subsystem - Application

UNIT V: IMAGE PROCESSING WITH MATLAB

Introduction - Working with Images in MATLAB–MATLAB Commands for Image Enhancement Techniques - Filtering Images - Image Restoration Techniques - Feature Extraction Using Segmentation and Edge Detection - Image Registration and Image Reconstruction

REFERENCES:

1. Gonzalez, R.E. Woods, and S.L. Eddins. Digital Image Processing usingMatlab, Prentice Hall, 2004.
2. Holly Moore, " MATLAB for Engineers" Third Edition – Pearson; 3rd edition (8 September 2011).
3. Stephen J. Chapman, "MATLAB Programming for Engineers" Fourth Edition. Cengage; (1 November 2012)

COURSE OUTCOMES

CO1: understand the key features of MATLAB.
CO2: Expose the basic functionalities of the MATLAB Software.
CO3: Able to develop MATLAB coding.
CO4: Expose to simulink model in MATLAB.
CO5: Understand and utilizing the image processing toolbox in MATLAB.

Mapping of Course Outcomes with Programme Outcomes (POs) and Program Specific Outcomes (PSOs)															
Course Outcomes	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2			3						2			2		
CO2		2	3	3				2					2		
CO3	2	2										2		3	
CO4			3	3				2		2				3	
CO5			3		1							2		3	

VALUE ADDED COURSES

	Basic Electronic Engineering	L	T	P
		2	0	2

Unit I: Introduction to semiconductor diode

Intrinsic and extrinsic semiconductors, P and N type semiconductors, P-N junction, barrier potential, Forward and reverse bias, I-V characteristics, effect of temperature in a reverse biased P-N junction, Avalanche breakdown voltage, Zener diode, I-V characteristics of Zener diode.

Unit II: Introduction to Transistor and Amplifiers

Working principle of Transistor, NPN and PNP transistor, input and output characteristics of Transistors, transistor amplifiers using CE, CB and CC configurations. Comparison of their performance

Unit III: Introduction to DC Power Supplies

Unregulated and regulated DC power supply specifications: Half wave, full wave rectifiers and bridge rectifiers, filters for rectifiers, Voltage regulator using Zener diode, Application of different types of power supply, Short circuit protection, Overload protection, Fixed and variable voltage regulators, SMPS.

Unit IV: Basic Amplifier and feedback

Gain, I/O resistance, Classes of amplifier, Decibel, Amplifier bandwidth. Types of feedback, Voltage and current feedback, series and shunt feedback. Barkhausen criterion, types of oscillators.

Unit V: Linear IC's and Operation Amplifiers

Differential Amplifier, OP-Amp characteristics, Differential and Common mode gain, CMRR, Inverting and non-inverting amplifiers, Summer, differentiator and integrators using Op-amps.

References:

1. Thomas. L. Floyd, "Electronics devices", Global Edition Paperback – Pearson; 10th edition (18 January 2018.
2. Dennis L. Eggleston, "Basic Electronics for Scientists and Engineers", Cambridge University Press; Illustrated edition (28 April 2011).
3. Thomas C. Hayes, Paul Horowitz, "The Art of electronics", Cambridge University Press; 1st edition (2 March 2016).
4. J. Millman and C. C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", Mc Graw Hill International Student Ed. (1972).

	Basic Communication Systems	L	T	P
		2	0	2

UNIT – I: Amplitude Modulation: Introduction to Modulation, Need for Modulation, Ordinary Amplitude Modulation – Modulation index, Side bands, AM Power, Double

Side Band Suppressed Carrier Modulation, Single Side Band Modulation, Vestigial Side Band Modulation, AM demodulation, Applications of AM.

UNIT – II: Angle Modulation: Angle Modulation fundamentals, Frequency Modulation – Modulation index and sidebands, Narrowband FM, Wideband FM, Principles of Phase Modulation, Frequency Modulation verses Amplitude Modulation, FM demodulation, Frequency Division Multiplexing, Applications of FM.

UNIT – III: Signal Sampling and Analog Pulse Communication: Ideal Sampling, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation.

UNIT- IV: Digital Communication Techniques: Quantization, Digital Transmission of Data, Parallel and Serial Transmission, Data Conversion, Time Division Multiplexing, Pulse Code Modulation, Delta Modulation.

UNIT – IV: Transmission of Binary Data in Communication Systems: Digital Codes, Principles of Digital Transmission, Transmission Efficiency, Modem Concepts and Methods – FSK, BPSK, Error Detection and Correction.

LEARNING RESOURCES:

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3rd Edition. Tata Mcgraw Hill 2002.
2. Wayne Tomasi, Electronic Communications Systems, 5th Edition, Pearson Education (1 January 2008).

	Embedded System Design	**L**	**T**	**P**
		2	**0**	**2**

UNIT I : INTRODUCTION Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers),Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency. Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

UNIT II : Embedded Hardware and Design : Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R (CortexR4) and comparison in between them.

UNIT III: Embedded Serial Communication Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network.

UNIT IV: Embedded Software, Firmware Concepts and Design Embedded C-programming concepts (from embedded system point of view):Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming.(Laboratory work on J2ME Java mobile application). Basic embedded C programs/applications for ARM-v7, using ARM-GCCtool-chain, Emulation of ARM-v7 (e.g. using QEMU), and Linux porting onARM-v7 (emulation) board

UNIT V : ARDUINO Introduction and Familiarization - Hardware Overview - Download and Install the Arduino IDE - Arduino IDE and Sketch Overview - Understanding Arduino data types, Variables and constants, Arrays, Operators, Control Statements, Simple Projects: Automated Plant Watering System

REFERENCES

1. K.V. Shibu, "Introduction to Embedded Systems", McGraw Hill Education India Private Limited; Second edition (1 July 2017).
2. Tony Givargis Frank Vahid, "Embedded System Design – A unified hardware and software introduction", John Wiley; Student edition (1 January 2006).
3. Rajkamal (TMH) "Embedded Systems - Architecture, Programming and Design", McGraw Hill Education; Third edition (1 July 2017)
4. Lyla B Das, "Embedded Systems: An Integrated Approach", Pearson Education India; 1st edition (1 January 2012).
5. Steve Heath, "Embedded System design", Newnes; 2nd edition (30 October 2002).
6. James Arthur, "Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks, and programming", Ingram Publishing (31 March 2020).

	Solar cell design and fabrication	**L**	**T**	**P**
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UNIT I : Concepts of Solar energy: the sun, Available solar energy from the sun, insolation vs. world energy demand, Blackbody radiation, Planck's Radiation Law, Wien's displacement Law, Stefan Boltzmann Equation, spectral distribution of extraterrestrial and terrestrial radiations, solar constant, properties of solar radiation Sun-Earth Geometry: Motion of the earth relative to the sun, Apparent motion of the sun relative to a fixed observer on the earth, Air Mass, estimation of available solar radiation on earth, absorption of solar radiation by earth's atmosphere, direct, diffused and albedo components of sunlight, solar radiation table, global radiation data. Mean annual irradiance on horizontal surface across the world, Effects of latitude, declination, slope, surface azimuth angle, hour angle, and the angle of incidence. Radiation on an inclined surface: direct, reflected, and diffused radiations, radiation on inclined surfaces, calculation of angles of incidence, direction of beam radiation, angles for tracking surfaces, ratio of beam radiation on tilted surface to that of horizontal surface

UNIT II: Photovoltaic technology: Introduction to PV, conversion of solar radiation to electrical energy, PV sizing for meeting the world's energy need, how much land area is needed, advantages and disadvantages of PV systems. Reliability and sizing of the PV/PT systems, uncertainty and risk factors in PV/PT design, Cost analysis, Terawatt challenge, Energy payback, different options of PV modules, thin film solar cells. Light absorption, Direct-bandgap and indirect bandgap semiconductors, light absorption coefficient, Reflection and reflection losses, Absorption as a function of photon energy, Carrier transport.

UNIT III : Performance parameters of PV cells: Fundamental principles of solar cell operation, Solar cell device physics, Basic structure of solar cells, Quasi Fermi energy levels, Law of junctions, Carrier generation rate, Recombination rate, Dark current, Light generated current, Current-voltage (I-V) relationship. Solar cell output parameter, Fill factor, solar cell efficiency, Short circuit current, Open circuit voltage, Maximum power point operation, Effect of finite width of the solar cell, Solar cell equivalent circuit, Effect of bandgap, maximum thermodynamic efficiency. Practical efficiency limit, Losses in short circuit current, open circuit voltage, efficiency, Temperature effects, Fill factor losses, I-V characteristic measurement, Efficiency measurement, Parasitic resistances, Effects of series and shunt resistances

UNIT IV: Solar cell module design and fabrication: Silicon solar cells to Photovoltaic Module (PV) production, Cell fabrication and interconnections, Top and Bottom connections, Manufacturing process, Cell matrix, encapsulation, vacuum lamination, Post-lamination steps, Bifacial modules, Electrical and optical performance of modules, Local shading and hot spot formation, Field performance. Introduction to concentrated Solar Power (CSP) systems, Energy generation and capacity factor, Tracking requirements, Photovoltaic and solar thermal concentrators, concentrator optics, solar collectors for CSP systems. concentrated Photovoltaic (CPV) systems: Principles and

Practices, Fresnel lens, tracking systems. CPV modules, and engineering practices for CPV solar plants.

UNIT V: Performance evaluation of solar modules: Measurements and characterization of solar cells and PV modules, V – I characteristics, spectral response measurements, measurements and characterization of thin film solar cells Domestic, industrial and commercial applications, Lifetime of the PV modules, Degradation caused by UV radiation, Moisture penetration, Corrosion, Dust deposition/soiling losses, Reflection losses, Thermal effects, Delamination of the module, prevention of energy yield losses.

REFERENCES:

1]. BU Barnes and Noble book store "Solar Cells: Operating Principles, Technology and System Applications", Martin Green published by the University of New South Wales, 1980 (Required)

2]. John A. Duffie and William A.Beckman "Solar Engineering of Thermal Processes", Fourth Edition, John Wiley and Sons. Inc. 2005 (Chapters 1, 2, 3, and 7) Recommended

3]. Antonio Luque and Steven Hegedus "Photovoltaic Science and Engineering Handbook", Second Edition, John Wiley and Sons, 2012 An excellent Resource

4]. Jeff Poortmans and Vladimir Arkhipov "Thin film Solar Cells", (Ed) John Wiley and Sons Ltd. 2006

5]. Stephen J. Fonash "Solar Cell Device Physics", Second Edition, Elsevier, Inc., 2010

6]. Thomas Markvart (Editor) "Solar Electricity", Second Edition,John Wiley and Sons, Ltd., 2000.

7]. Keith Lovegrove and Wes Stein, Woodhead "Concentrating Solar Power Technology, principles, developments and applications", Publishing series in Energy, Woodhead Publishing, 1518 Walnut Street, Suite 1100, Philadelphia, PA 19102-3406, USA 2012

8]. www.pveducation.org