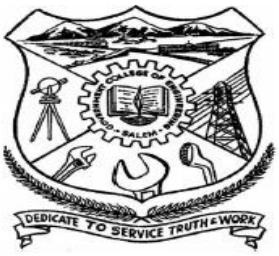


GOVERNMENT COLLEGE OF ENGINEERING

SALEM 636011

(An Autonomous Institution Affiliated to Anna University, Chennai)
(NBA Accredited)

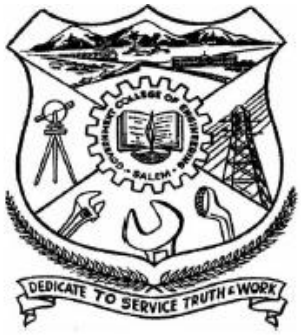
B. E

ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION, CURRICULUM AND SYALLABUS

(2018-19 ONWARDS)

2018 REGULATIONS FOR B.E DEGREE PROGRAMME



GOVERNMENT COLLEGE OF ENGINEERING
AUTONOMOUS INSTITUTION

Accredited by NBA

Affiliated to Anna University, Chennai

Salem – 636011

GOVERNMENT COLLEGE OF ENGINEERING

SALEM – 636 011

(An Autonomous Institution affiliated to Anna University- Chennai)

Regulations 2018 - Autonomous Courses

(For Students Admitted from 2018 – 2019)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(Accredited by NBA)

REGULATIONS- CURRICULUM & SYLLABUS

(Choice Based Credit System)

B.E.ELECTRONICS AND COMMUNICATION ENGINEERING (F.T)
(Accredited by NBA)

GOVERNMENT COLLEGE OF ENGINEERING, SALEM – 636 011

(An Autonomous Institution affiliated to Anna University- Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

- Strive continuously to develop Excellence in Technical Education and Research by producing technically competent Electronics and Communication Engineers to meet the growing demands of technology and socioeconomic needs.

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MISSION

- To foster and achieve unmatched excellence in Electronics and Communication Engineering Domain.
- To pursue continuous improvement in infrastructure and state-of-the art laboratories.
- To establish and set best teaching and learning standards among top grade Engineering Departments across the nation.
- To encourage learning, research, creativity, innovation and professional activity by offering ambience and support.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

PEO1: The graduates will utilize their expertise in Engineering to solve industry's technological problems.

PEO2: Analyze real life problems, design appropriate system to provide solutions that are technically sound, economically feasible and socially acceptable.

PEO3: Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PROGRAM OUTCOMES (PO's)

PO1: An ability to apply knowledge of Mathematics, Science, and Engineering in the Electronics and Communication Engineering.

PO2: An ability to design and conduct experiments, as well as to analyze and interpret data.

PO3: An ability to design a System, or Process to meet desired needs within realistic constraints such as Economic, Environmental, Social, Ethical, Health care and Safety, Manufacturability, and Sustainability.

PO4: An ability to identify, formulate and solve complex problems in the area of Electronics and

Communication Engineering.

PO5: An ability to use the techniques, skills, and modern Engineering tools necessary for engineering practice.

PO6: Knowledge of contemporary issues relevant to professional Engineering practice.

PO7: The broad education necessary to understand the impact of engineering solutions in Global, Economic, Environmental and Social context.

PO8: An understanding of Professional and Ethical responsibility.

PO9: An ability to function on multidisciplinary teams.

PO10: An ability to communicate effectively.

PO11: Recognition of the need for, and an ability to engage in research and to involve in life-long learning.

PO12: An ability to work as a leader in a team, to manage projects in Multidisciplinary environment.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To analyse, design and develop solutions for the real time problems and to apply the technical Knowledge for developing quality products for Electronics and Communication based Industry.

PSO2: To adapt to emerging Information and Communication technologies and to develop innovative ideas and solutions in RF & Communication, Networking, Embedded Systems, and VLSI.

PSO3: An ability to make use of acquired technical knowledge to get employed in the field of Electronics and Communication and also to become successful Entrepreneur.

GOVERNMENT COLLEGE OF ENGINEERING: SALEM 636011
(An Autonomous Institution Affiliated to Anna University, Chennai)
(NAAC ACCREDITED)
REGULATIONS 2018

CHOICE BASED CREDIT SYSTEM
Common to all B.E. (FULL TIME) DEGREE PROGRAMME
(For the students admitted to B.E Programme during the Academic year 2018-2019 and onwards)

1. DEFINITIONS AND NOMENCLATURE

In this regulation, unless the contest otherwise specifies

(i) **"Programme"** means Degree Programme (i.e) B.E. Degree Programme.

(ii) **"Course"** means a Theory or Practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, etc.,

2. ELIGIBILITY FOR ADMISSION

For admission to the Bachelor Degree Programme candidates will be required to satisfy the conditions of admission thereto prescribed by the Government of Tamilnadu and Anna University, Chennai. Provision is made for lateral entry candidates with Diploma in Engineering / Technology in the third semester of the programme of one of the branches of study and they will be required to satisfy the conditions of admissions thereto prescribed by the Government of Tamilnadu and Anna University, Chennai.

3. BRANCHES OF STUDY

Branches will be offered at the time of admission to the programme. The following are the branches offered in this college.

B.E. Civil Engineering

B.E. Computer Science and Engineering

B.E. Electronics and Communication Engineering

B.E. Electrical and Electronics Engineering

B.E. Mechanical Engineering

B.E. Metallurgical Engineering

4. DURATION AND STRUCTURE OF THE PROGARMME

4.1 The Minimum and Maximum period of the U.G. Full time programme are given below:

The total duration for completion of the programme shall not exceed the maximum duration irrespective of the period of break of study (vide clause 25) or prevention (vide clause 11.6) in order that the student may be eligible for the award of the degree (vide clause 23)

Programme	Minimum	Maximum
B.E. (Regular Stream)	4 Years (8 Semesters)	7 Years (14 Semesters)
B.E. (Lateral Entry)	3Years (6 Semesters)	6 Years (12 Semesters)

4.2 The duration of B.E. programme shall be 4 Years for Regular Stream and 3 Years for Lateral Entry. Each academic year will be divided into two semesters. The number of working days shall be 80 days or 540 periods (which includes the days for conducting periodical tests) each of 50 minutes duration. The number of working days shall exclude study holidays, Government holidays and end semester examination days.

4.3 Categorization of Courses

Every B.E. programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i. **Humanities and Social Sciences (HS)** courses include Technical English, Ethics and Human Values, Communication skills.

ii. **Basic Sciences (BS)** courses include Mathematics, Physics, Chemistry, Biology, Physics laboratory, Chemistry laboratory, etc.

iii. **Engineering Sciences (ES)** courses include Engineering practices, Computer Practice, Engineering Graphics, Engineering Mechanics, Basics of Electrical / Electronics / Mechanical / Civil/ Computer Engineering etc.

iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/ branch.

v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

vi. **Open Elective (OE)** courses include the courses relevant to the chosen specialization / branch which a student can choose from the curriculum of other B.E. programmes and courses offered by the Departments under the Faculty of Science and Humanities.

vii. **Project** includes Project Work, Mini Project, Seminar, Internship and Industrial/Practical Training.

viii. **Mandatory** Course includes Environmental Science, Constitution of India, Induction Programme/**NCC / NSS / SPORTS / YRC/Yoga** activities.

4.4 The courses of study shall be both theory and practical and shall be in accordance with the prescribed syllabi.

4.5 Each semester curriculum shall normally have a blend of lecture and practical courses not exceeding 9 courses. However Employability and Enhancement course(s) may be included as additional course.

4.6 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks.

4.7 The medium of instruction, examination and project report shall be English, except for courses on language other than English.

4.8 Internship

The Industrial / Practical Training / Internship / Summer Project shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of Industrial / Practical training / Internship / Summer Project, the student shall submit a detailed report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and Viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the HOD. Certificates (issued by the Organization) submitted by the student shall be attached to the mark

list and sent to COE by the HOD with due recommendations. The training will appear in the list of Value Added Courses in the Grade Sheet with the credits (additional/extra credits) obtained.

4.9 Credit Assignment

Each course is assigned certain number of credits based on the following

Contact period per week	**CREDITS**
1 Lecture Period	1
1 Tutorial Periods	1
2 Practical Periods (Laboratory / Seminar / Project Work / Mini Project/ Internship etc.)	1

4.10 One Credit Courses

One credit courses shall be offered by a Department with the prior approval from the Board of Studies. The details of the syllabus must be approved by the Board of Studies. The credits earned through the one credit courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. They shall be allowed to take one credit courses offered in other Departments also with the permission of Head of the Department offering the course.

4.11 Online Courses / Self Study Courses

4.11.1 Students may be permitted to enroll for one Online Course or Self Study Course with the approval of respective Board of Studies.

4.11.2 The students can opt for Self Study Course from the list of Professional Electives provided, the students does not have any standing arrears and the CGPA should be 7.5 and above. The purpose of the course is to permit the student to study a course of the student's choice. The students shall study on their own under the guidance of a faculty member. No formal lectures need to be delivered. One Faculty member assigned by the HOD shall be responsible for the periodic monitoring and assessment of the student in that course.

4.11.3 The Self Study Course or online Course of 3 credits can be considered instead of one Professional Elective Course.

5 COURSE ENROLLMENT AND REGISTRATION

5.1 Each student, on admission shall be assigned to a Faculty Advisor (vide clause 6) who shall advise and counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

5.2 Every student shall enroll for the course of the succeeding semester in the current semester. However, the students shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the concerned semester.

5.3 No course shall be offered by a Department unless a minimum of 10 students register for that course.

5.4 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

5.5 Each student on admission shall register for **all the courses prescribed in the curriculum in** the student's **first Semester of study.**

5.6 The enrollment for the courses of the Semesters II to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor. If the student wishes, the student may drop or add courses (vide clause 5.7) within **five** working days after the commencement of the concerned semester and complete the registration process duly authorized by the Faculty Advisor.

5.7 Flexibility to Add or Drop courses

5.7.1 A student has to earn the total number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if the student wishes, then the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme.

5.7.2 From the III to VIII semesters, the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such courses cannot exceed 6.

5.7.3 The student shall register for the project work in the respective semester only.

5.8 Fast Track System

5.8.1 Fast Track System is for meritorious B.E Full time students.

5.8.2 With the eligibility criteria he/she will be permitted to take up and complete an eight semester professional core/professional elective in the fifth semester, a professional elective in the sixth semester and a professional elective in the seventh semester under Fast track system.

5.8.3 Eligibility Criteria for opting Fast Track System: Students should have earned minimum CGPA of 7.5 up to previous semesters. There should not be any standing arrears up to IV semester for enrollment of a Professional Core/Professional elective in the V semester of study, up to V semester for enrollment of a Professional Elective in the VI semester of study and up to VI semester for enrollment of a Professional Elective in the VII semester of study.

5.8.4 If the eligibility is not satisfied at any point of time the candidate will not be permitted to continue in FAST TRACK SYSTEM and further he/she has to complete the course as per the regular system.

5.8.5 FAST TRACK SYSTEM is optional.

6 FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a teacher of the Department who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering of courses, authorize the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

The responsibilities for the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.

- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

7 SYSTEM OF EXAMINATION

Performance in each courses of study shall be evaluated based on (i) continuous internal assessment throughout the semester and (ii) an end – semester examination.

7.1 THEORY

End-semester Examination will be conducted in all theory courses at the end of each semester for all the programmes. The maximum marks of each course shall be 100, out of which the continuous internal assessment will carry 40 marks, while the end semester Examination will carry 60 marks.

7.2 PRACTICAL / MINI PROJECT

The practical classes for all the Practical/Laboratory component courses will be assessed continuously. The maximum marks for the Practical/Laboratory component courses shall be 100, out of which continuous internal assessment will carry 40 marks and the end semester practical examination will carry 60 marks. If any practical course contains Part A and B components, the maximum for each Part of the laboratory will be 50, out of which the continuous internal assessment will carry 20 marks, and the end semester practical examination will carry 30 marks. The end semester practical examination for award of marks shall be conducted by both Internal and External examiners.

7.3 PROJECT WORK AND VIVA – VOCE

For the project work and viva – voce examination, the maximum marks shall be 200, comprising 80 marks for internal assessment and 120 marks for the end semester examination. The end semester marks of 120 shall be awarded by both the Internal and External examiners, the project report shall carry a maximum of 40 marks (same mark must be awarded to every student of the project group) The viva-voce examination shall carry 80 marks (awarded to each student of the project group based on the individual performance in the viva-voce examination conducted by External examiner, and the Internal Examiner)

8 CLASS COMMITTEE

8.1 A Class Committee consists of teachers of the class concerned, student representatives and a chairperson selected from among the faculty who do not teach that class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Solving problems experienced by the students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly clauses 10, 11, 12 and 13 which should be displayed in the college Web site.
- Informing the student representatives the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / Project work / seminar

etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.

- Analyzing the performance of the students of the class after each test and finding the ways and means of improving the slow learners.
- Identifying slow learner students, if any, and requesting the teachers concerned to provide additional help or guidance or coaching to such students.

8.2 The class committee for a class under a particular branch is normally constituted by the head of the department. However, if students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Principal.

8.3 The class committee shall be constituted within the first week of each semester.

8.4 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

8.5 The chairperson of the class committee may invite the Faculty adviser(s) and the Head of the department to the meeting of the class committee.

8.6 The Principal may participate in any class committee of the institution.

8.7 The chairperson is required to prepare the minutes of every meeting, submit the same to Principal within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Head of the Institution the same shall be brought to the notice of Head of the institution by the head of the Department/Chief Faculty advisor.

8.8 The first meeting of the class committee shall be held within fifteen days from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments with the framework of the regulations. Two or three subsequent meeting may be held in a semester at suitable intervals. **The Class Committee Chairman shall put on the Notice Board the cumulative attendance particulars of each course of each student at the end of every such meeting to enable the students to know their attendance details to satisfy the clause 11 of this Regulation.** During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9 COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a ***"Course Committee"*** comprising the entire faculty teaching the common course, with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Principal depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests.

10 PROCEDURE FOR AWARD OF MARKS FOR INTERNAL ASSESSMENT

10.1 Theory Courses

10.1.1 Unit Tests [75% weightage]: Three tests, each carrying FIFTY (50) marks, shall be conducted by the Department / Institution. The total marks of three tests shall be reduced

to 75 marks. However, a re-test, at the discretion of the Head of Department and approved by the Head of Institution, may be conducted for candidates with genuine reasons.

10.1.2 Assignment [12.5% weightage]: The total marks of Three assignments carrying 10 Marks each shall be reduced to 12.5 marks.

10.1.3 Tutorial / Objective Test [12.5% weightage]: The total marks of Three Tutorial / Objective Test carrying 10 Marks each shall be reduced to 12.5 marks.

The total of 100 marks shall be reduced to 40 marks (rounded off to the nearest integer).

10.2 Practical Courses with Laboratory Component

Every Practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained.

There shall be atleast one test. The criteria for arriving at the internal assessment marks are:

Experiment / Record / Practical classes Performance : 60% Weightage

Practical Test : 40% Weightage

The total of 100 marks shall be reduced to 40 marks (rounded off to the nearest integer).

10.3 Project Work

There shall be three assessments during the semester by a review committee. The students shall make a presentation on the progress of the project before the committee. The Head of the Department shall constitute the review committee consisting of HOD, Guide and a senior member of faculty. The criteria for arriving at the internal assessment marks for the Project Work evaluated for 80 marks are:

Work assessed by the Project Guide : 50% Weightage

Work assessed by the Committee : 50% Weightage

The total of 100 marks shall be reduced to 80 marks (rounded off to the nearest integer).

10.4 Faculty incharge of the subject

Every teacher is required to maintain an **'ATTENDANCE AND ASSESSMENT RECORD'** for every semester which consists of attendance marked in each theory / Laboratory / EEC class, the assessment marks and the record of class work (topics covered), for each course handled by the teacher. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The Head of the Department will affix his/her signature and date after due verification. At the end of the semester, the record should be verified by the Head of the Department who shall keep this document in safe custody (for seven years). The records of attendance and assessment of both current and previous semesters should be available for inspection.

10.5 Assessment for Industrial / Practical Training / Internship / Summer Project

The Industrial / Practical Training / Internship / Summer Project shall carry 100 marks and shall be evaluated through Continuous Assessment only. At the end of Assessment for Industrial / Practical Training / Internship / Summer Project, the student shall submit a detailed report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-voce Examination, conducted internally by a three member Departmental Committee constituted by the HOD. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to COE by the HOD with due recommendations.

The training will appear in the list of value Added Courses in the grade sheet with the credits (additional / extra credits) obtained.

10.6 Assessment for Value Added one Credit Course

The Value Added One Credit Course shall carry 100 marks and shall be evaluated through **Continuous Assessment only.** Two assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. The HOD may identify a faculty member as Coordinator for the course. A committee consisting of the HOD, staff handling the course (if available), Programme Coordinator and a Senior Faculty nominated by the HOD shall monitor the evaluation process.

10.7 Assessment for Online Course

Students may be permitted to earn Online Courses (which are provided with certificate) with the approval of Board of Studies and HOD subject to a minimum of three credits. This Online Course of 3 credits can be considered instead of one Elective Course. Respective Boards of Studies will take a decision on the evaluation methodology for the online course. The BOS can decide whether to evaluate through End Semester Examination only and the same way be conveyed to the COE, at the beginning of the semester whenever the course is offered. The students need to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by the Institution. The HOD may identify a Faculty member Coordinator for the course, who is responsible for the evaluation of Continuous Assessment.

10.8 Assessment for Self Study Course

The faculty members approved by the HOD shall be responsible for periodic monitoring and evaluation of the self study course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

10.9 Assessment for MOOC Courses

Students may be permitted to earn credits through MOOC Courses with the approval of Board of Studies and HOD subject to a maximum of six credits per semester. The credits earned from the MOOC courses can be transferrable subject to the approval of the respective Performance Analysis Committee and no additional assessment is required.

11 REQUIREMENTS FOR COMPLETION OF A SEMESTER

A candidate who fulfils the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

11.1 He/She secures not less than 75% of attendance for each course with the total number of working hours specified in the respective curriculum.

11.2 Candidates representing University in State / National / International / Inter University Sports events, paper or project presentation in National / International Conference with prior permission from the Head of the Institution are given exemption upto 10% of the required attendance and such candidates shall be permitted to appear for the current semester examination on condonation (attendance 65% to 74%)

11.3 Candidates who could not attend classes continuously due to Trauma/Infectious diseases / Surgeries requiring continuous medical attention, on submission of a valid medical certificate in time, obtained from a Government doctor not below the rank of Assistant Surgeon, are given exemption upto 10% of the required attendance and shall be permitted to appear for the current semester examination on condonation (attendance 65% to 74%)

11.4 Permission mentioned in 11.2 and 11.3 can be allowed only twice during his/her entire course of study.

11.4.1 Fees for 1st time condonation Rs.1000/- for one course and Rs. 300/- for every additional course

11.4.2 Fees for 2nd time condonation Rs.5000/- for one course and Rs. 1000/- for every additional course

11.5 His/her conduct should be certified to be satisfactory by the Head of the Department concerned and Head of the Institution.

11.6 Candidate who does not secure 75% attendance in any one or more courses, will not be permitted to write the end semester examinations for that/those courses. However he will be permitted to move to the next semester and re-register for those courses in the next semester after earning attendance and internal marks from the course coordinator through contact hours.

11.7 Candidates who do not complete all the courses in that semester (as per clause 11.1, 11.2 and 11.3), will not be permitted to write the end-semester examination and are not permitted to move to next semester. However, they will be permitted to write the arrear examination, if any. They are required to repeat the incomplete semester in the next academic year getting the necessary permission from the authorities.

12 REQUIREMENTS FOR APPEARING FOR END SEMSTER EXAMINATION

A candidate shall normally be permitted to appear for the end semester examination of the current semester, if he/she has satisfied the semester completion requirements (subject to Clause 11.1 with 11.2 and 11.3) and has registered for examination in all courses of that semester. Registration is mandatory for arrear subjects along with current semester examinations, failing which the candidate will not be permitted to move to the higher semester.

12.1 Reappearance Registration

12.1.1 If a student fail in a theory course, the reappearance registration for that course in the subsequent semester is mandatory.

12.1.2 The student may attend the classes for the reappearance registration courses, if the student wishes. However, the attendance requirement (vide clause 11) is not compulsory for such courses.

13 END – SEMESTER EXAMINATION

13.1 There shall be one end – semester examination of 3 hour duration in each lecture – based course.

13.2 The Project report of B.E. programme will be evaluated based on the report and a viva-voce examination by an External Examiner and an Internal Examiner.

13.3 The following will be the weightage for different courses.

13.3.1 Theory courses : Internal Assessment – 40%

: End-Semester Examination – 60%

13.3.2 Laboratory based Courses : Internal Assessment – 40%
: End-Semester Examination – 60%

13.3.3 Project work [Maximum Marks: 200] : Internal Assessment – 40%
: End-Semester Examination – 60%

Internal Assessment – 80 marks : [Supervisor: 40 marks, committee: 40 marks]

End-Semester Examination – 120 Marks : [evaluation for project report (by External Examiners): 40 Marks and Viva-Voce: 80 marks (Internal and External Examiners]

14 PASSING REQUIREMENTS

14.1 The minimum number of total credits to be earned through successful completion of the courses of study of the respective branch by a candidate to qualify for the award of degree in the various branches of study is provided below.

Branch of study	Minimum number of credits to be earned through successful completion of the courses of study of the respective branch, for the award of degree	
	For regular entry (entry at first Semester)	For lateral entry (entry at third semester)
Civil Engineering	160	121
Computer Science & Engineering	159	120
Electronics & Communication Engineering	160	121
Electrical & Electronics Engineering	157	118
Mechanical Engineering	160	121
Metallurgical Engineering	161	122

14.2 For each theory and laboratory courses, examination will be conducted for 100 marks. A candidate who secures 50% marks and above in the end semester examination, and 50% in continuous assessment and end semester examination both put together, shall be declared to have passed the examination in that course.

14.3 A candidate who successfully completes the course requirements and passes all the prescribed examinations in all the eight semesters within a maximum period of 7 years (14 semesters), reckoned from the commencement of the first semester to which the candidate was admitted in regular stream and [six semesters within a maximum period of 6 years (12 semesters), reckoned from the commencement of the third semester to which the candidate was admitted for lateral entry], is eligible to get the degree.

15 REVALUATION

15.1 Copies of answer script for theory course(s) can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

15.2 A candidate can apply for revaluation or photo copy cum revaluation of his/her semester examination answer paper in a theory course, within a week from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations, as per norms given by the chairman, Academic Council. Revaluation is not permitted for Practical Courses and for Project work.

16 CHALLENGING THE REVALUATION

Challenging the revaluation is permitted for those students who have applied for photocopy of answer script. The copy of the answer script is to be valued by a competent authority and the valued script should be submitted to COE's office along with prescribed fee for challenging the revaluation within 2 days after declaration of the revaluation results.

17 MALPRACTICE

If a student indulges in malpractice in any of the end-semester examinations, he/she shall be liable to face punitive action as prescribed by the Controller of Examination, Government College of Engineering, Salem.

18 PROCEDURE FOR USING SCRIBE

If a candidate is physically challenged / meets with accident or suffers from ill health at the time of examination, then he/she may be permitted to use a scribe to write the examination on payment of a prescribed fee through proper application to the Office of the Controller of Examinations. In such case, maximum one hour extra time will be permitted. The scribe shall be a non-engineering student/ graduate.

19 PROVISION FOR WITHDRAWAL FROM EXAMINATION

19.1 A candidate who satisfies Clause 12, may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

19.2 Such withdrawal shall be permitted only ONCE during the entire period of study of the degree programme.

19.3 Withdrawal application is valid only it is made 10 days prior to the commencement of the examination in that course or courses and is recommended by the Head of the Department and approved by the Head of the Institution.

19.4 Notwithstanding the requirement of the mandatory TEN days notice, application of withdrawal for special case under extraordinary conditions will be considered on the merit of the case.

19.5 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is also applicable to those who seek withdrawal during VIII semester.

19.6 Withdrawal from the end semester examination is NOT applicable to arrear subjects of previous semesters.

19.7 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

20 AWARD OF THE LETTER GRADES

20.1 The letter grade and the grade point are awarded based on percentage of marks secured by a candidate in individual course as detailed below:

Range of Total Marks	Letter Grade	Grade Points (GP)
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	RA	0
Incomplete	I	0
Withdrawal	W	0
Withheld	WH	0

"RA" denotes "reappearance" in the course.
"I" denotes "incomplete" as per clause 11.1 and hence prevention from writing End Semester Examination.
"W" denotes "withdrawal" from the course.
"WH" denotes "withheld" due to malpractice etc.

20.2 For the Co–curricular activities such as National Cadet Corps (NCC)/ National Service Scheme (NSS) / SPORTS / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement before the completion of final semester. **A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.**

20.3 For zero credit courses Excellent / Good / Satisfactory grading will appear in the grade sheet.

21 PROCEDURE FOR COMPLETING THE PROGRAMME

21.1 A candidate, who, for some reason has discontinued the programme can join the programme of study in any semester only at the time of its normal commencement in the Institution for regular students, upon satisfying all the following conditions:

(a) He / she should have completed the course of study of the previous semesters.
(b) He / she should be eligible to register for the examinations and satisfy rule 11.1
(c) He / she should have registered for all the examinations of the previous semesters.

21.2 A candidate will be permitted to proceed from one semester to the next higher semester only if he / she satisfies the regulation for eligibility to appear for the end-semester examination in the semester concerned, subject to the condition that the candidate should register for all the arrear courses in the lower semesters along with the current (higher) semester courses.

21.3 A candidate should have completed the B.E Degree course within a period of SEVEN consecutive academic years (14 semesters) for regular stream [SIX consecutive academic years (12 semesters) for lateral entry] from the date of admission to the course, even if the candidate discontinues and rejoins subsequently, to be eligible for the award of the degree.

22 ISSUE OF GRADE SHEETS AND GPA, CGPA CALCULATION

Individual Grade sheet for each semester will be issued through the Head of the Department concerned, after the publication of the results with following details.

- The list of courses enrolled during the semester and the grade scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

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

$$GPA = \frac{\text{Sum of [CXGP]}}{\text{Sum of C}}$$

Where C – credit of a particular subject/Course
GP – grade point obtained by the student in the respective subject/Course.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. “RA”, “I” and “W” grades will be excluded for calculating GPA and CGPA.

23 ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the B.E. Degree provided the candidate has

i) Successfully completed the course requirements and has passed all the prescribed examinations in all the 8 semesters within a maximum period of 7 years for regular stream (6 semesters within a maximum period of 6 years for lateral Entry) from the commencement of first semester (third semester) to which the candidate was admitted.
ii) No disciplinary action is pending against him/her.
iii) Successfully completed NCC/NSS/SPORTS/YRC requirements.

24 CLASSIFICATION OF THE DEGREE AWARDED

24.1 FIRST CLASS WITH DISTINCTION

A candidate who qualifies for the Degree by passing the examinations in all courses of the entire programme, in first attempt, within a period of eight semesters for regular stream (six semesters for lateral entry) from the date of admission to the programme with CGPA not less than 8.50 for the entire programme shall be declared to have passed the examination for the degree in FIRST CLASS WITH DISTINCTION. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

24.2 A candidate transferred from other Institution, who qualifies for the degree by passing the examinations in all courses of the entire programme in first attempt, within a period of eight Semesters for regular stream and six semesters for Lateral Entry stream from the date of admission to the programme with CGPA not less than 8.50 for the entire programme shall be declared to have passed the examination for the degree in FIRST CLASS WITH DISTINCTION. For this purpose the withdrawal from examination will not be construed as an appearance. Further, the authorized break of study will not be counted for the purpose of classification.

24.3 FIRST CLASS

A candidate who qualifies for the award of the Degree, having passed the examinations in all the courses of the entire programme (first to eight semesters) within a maximum period of NINE consecutive semesters for regular stream (third to eight semesters) for lateral entry stream within a maximum period of SIX semesters, from the date of admission to the programme with CGPA not less than 7.00 for the entire programme, shall be declared to have passed the examination for the degree in FIRST CLASS. For this purpose, the authorized break of study will not be counted for the purpose of classification.

24.4 SECOND CLASS

All other successful candidates shall be declared to have passed the examinations for the Degree in SECOND CLASS.

24.5 A candidate who is absent for semester examination in a course / project work after having registered for the same shall be considered to have attempted that examination for the purpose of classification.

25 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

25.1 Break of study shall be granted only ONCE for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Head of the Institution (through Head of the Department) in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Principal of the Institution stating the reasons there for and the probable date of rejoining the programme.

25.2 The candidate permitted to rejoin the programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. If the Regulation is changed, then, those candidates may have to do additional courses as prescribed by the head of the department and approved by the Academic Council.

25.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (vide clause 23). However, additional break of study granted will be counted for the purpose of classification.

25.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified irrespective of the period of break of study (vide clause 4.1) in order that he/she may be eligible for award of the degree.

25.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted ‘Break of Study’ or ‘Withdrawal’ (clause 18 and 24) and is not applicable in this case.

26 DISCIPLINE

Every student is required to observe discipline and decorous behaviour both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the college. In the event of an act indiscipline being reported, the Principal shall constitute a discipline committee consisting of three Heads of Department, of which one should be from the faculty of the student, to inquire into acts of indiscipline. The disciplinary action is subject to review by the University in case the student represents to the University. Any expulsion of the student from the college shall be with prior concurrence from Director of Technical Education / University.

27 RANK OF A STUDENT

A candidate who qualifies for the Degree by passing the examination in all courses of the entire programme in the first attempt within a period of EIGHT Semesters from the date of admission to the course can be given his/her position in the class as rank. The rank is determined from the I Semester to VIII Semester end semester examination mark percentage. Students transferred from other Institutions to Government College of Engineering, Salem and lateral entry students are not eligible for rank.

28 PERSONALITY AND CHARACTER DEVELOPMENT

All students shall enroll, on admission, in any one of the personality and character programmes (the **NCC / NSS / SPORTS / YRC)**. The programme shall include classes on hygiene and health awareness and also training in first-aid.

National Cadet Corps (NCC) programme will have about 20 parades.

National Service Scheme (NSS) will have social service activities in and around college/institution.

SPORTS Games, Drills, Physical exercises etc.

Youth Red Cross (YRC) will have activities related to social services in and around college/institution.

While the training activities will normally be during weekends, the camp will normally be during vacation period.

29 REVISION OF REGULATIONS CURRICULUM AND SYLLABI

The college may from time to time revise, amend or change the regulations, scheme of examinations and syllabus, if found necessary.

GOVERNMENT COLLEGE OF ENGINEERING

SALEM – 636 011

(An Autonomous Institution affiliated to Anna University- Chennai)

Regulations2018 - Autonomous Courses

(For Students Admitted from 2018 – 2019)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
(Accredited by NBA)

CURRICULUM & SYLLABUS

(Choice Based Credit System)

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING (FT)

B.E.ELECTRONICS AND COMMUNICATION ENGINEERING (FT)
(Accredited by NBA)

GOVERNMENT COLLEGE OF ENGINEERING
SALEM – 636 011.
Regulations 2018 - Autonomous Courses
(For Students Admitted from 2018 – 2019)

B.E.ELECTRONICS AND COMMUNICATION ENGINEERING – FULL TIME

Course code	Name of the Course	Hours/Week						Maximum Marks		
		Category	Contact periods	Lecture	Tutorial/ Demo*	Practical	Credit	CA	FE	Total
SEMESTER I										
THEORY										
18EN101	Professional English	HS	2	2	0	0	2	40	60	100
18MA101	Matrices and Calculus	BS	4	3	1	0	4	40	60	100
18CY101	Chemistry	BS	4	3	1	0	4	40	60	100
18CS101	Fundamentals of Problem Solving and C Programming	ES	3	3	0	0	3	40	60	100
18MC101	Induction Program – 21 Days	MC					0			
PRACTICAL										
18EN102	Professional English Laboratory	HS	4	0	0	4	1	40	60	100
18CS102	Computer Practice Laboratory	ES	4	0	0	4	2	40	60	100
18ME102	Workshop Manufacturing Practices	ES	4	0	0	4	3	40	60	100
TOTAL			25	11	2	12	**19**	**-**	**-**	700
SEMESTER II										
THEORY										
18MA203	Differential Equations and Laplace Transforms	BS	4	3	1	0	4	40	60	100
18PH102	Physics – Electromagnetism	BS	4	3	1	0	4	40	60	100
18EE201	Principles of Electrical Engineering	ES	4	3	1	0	4	40	60	100
18ME101	Engineering Graphics & Design	ES	5	1	0	4	3	40	60	100
18CYMC01	Environmental Science	MC	-	-			0			
PRACTICAL										
18PH103	Physics Laboratory	BS	3	0	0	3	1.5	40	60	100
18CY102	Chemistry Laboratory	BS	3	0	0	3	1.5	40	60	100
18EN103	Professional Communication Laboratory	HS	2	0	0	2	1	40	60	100
18EE202	Principles of Electrical Engineering Laboratory	ES	2	0	0	2	1	40	60	100
TOTAL			27	10	3	14	**20**	**-**	**-**	800

SEMESTER III										
THEORY										
18MA303	Linear Algebra and Numerical Methods	BS	3	3	1	0	4	40	60	100
18EC301	Semiconductor Physics and Devices	ES	3	3	0	0	3	40	60	100
18EC302	Digital System Design	PC	3	3	0	0	3	40	60	100
18EC303	Signals and Systems	PC	3	3	0	0	3	40	60	100
18EC304	Network Theory and Synthesis	PC	3	3	0	0	3	40	60	100
18EC305	Transmission Lines and Waveguides	PC	3	3	0	0	3	40	60	100
18MC301	Indian Constitution	MC	1	1	-	-	0	-	-	Grade
PRACTICAL										
18EC306	Electronic Devices and Circuits Laboratory	PC	3	0	0	3	1.5	40	60	100
18EC307	Digital System Design Laboratory	PC	3	0	0	3	1.5	40	60	100
TOTAL			22	18	1	4	22	-	-	800
SEMESTER IV										
THEORY										
18MA402	Probability and Stochastic Process	BS	4	3	1	0	4	40	60	100
18EC401	Antenna and Wave Propagation	PC	3	3	0	0	3	40	60	100
18EC402	Analog Circuits	PC	3	3	0	0	3	40	60	100
18EC403	Microprocessor and Microcontroller	PC	3	3	0	0	3	40	60	100
18EC404	Analog Communication	PC	3	3	0	0	3	40	60	100
18EC405	Control Systems	PC	3	3	0	0	3	40	60	100
PRACTICAL										
18EC406	Analog Circuits Laboratory	PC	3	0	0	3	1.5	40	60	100
18EC407	Microprocessor and Microcontroller Laboratory	PC	3	0	0	3	1.5	40	60	100
TOTAL			22	15	1	6	22	-	-	800
SEMESTER V										
THEORY										
18EC501	Digital Communication	PC	3	3	0	0	3	40	60	100
18EC502	Computer Architecture	PC	3	3	0	0	3	40	60	100
18EC503	Digital Signal Processing	PC	3	3	0	0	3	40	60	100
18EC504	Computer Networks	PC	3	3	0	0	3	40	60	100
	Open Elective-1	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EC505	Communication Systems Laboratory	PC	3	0	0	3	1.5	40	60	100
18EC506	Digital Signal Processing Laboratory	PC	3	0	0	3	1.5	40	60	100
TOTAL			22	18	0	4	18	-	-	800

SEMESTER VI										
THEORY										
18EC601	VLSI Design	PC	3	3	0	0	3	40	60	100
18EC602	Embedded Systems	PC	3	3	0	0	3	40	60	100
	Program Elective- 1	PE	3	3	0	0	3	40	60	100
	Open Elective – 2	OE	3	3	0	0	3	40	60	100
	Open Elective - 3	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EC603	VLSI Design Laboratory	PC	3	0	0	3	1.5	40	60	100
18EC604	Mini Project	EEC	5	0	0	5	2.5	40	60	100
18EN501	Communication Skills Laboratory	HS	4	0	0	4	2	40	60	100
TOTAL			24	16	0	8	21	-	-	800
SEMESTER VII										
THEORY										
18EC701	Optical and Microwave Engineering	PC	3	3	0	0	3	40	60	100
18ECM701	Principles of Management	HS	3	3	0	0	3	40	60	100
	Program Elective - 2	PE	3	3	0	0	3	40	60	100
	Program Elective- 3	PE	3	3	0	0	3	40	60	100
	Open Elective - 4	OE	3	3	0	0	3	40	60	100
PRACTICAL										
18EC702	Optical and Microwave Engineering Laboratory	PC	3	0	0	3	1.5	40	60	100
18EC703	Embedded system Laboratory	PC	3	0	0	3	1.5			
TOTAL			28	18	0	10	18	-	-	900
SEMESTER VIII										
THEORY										
	Program Elective-4	PE	3	3	0	0	3	40	60	100
	Program Elective - 5	PE	3	3	0	0	3	40	60	100
	Program Elective-6	PE	3	3	0	0	3	40	60	100
PRACTICAL										
18EC801	Project Work	EEC	18	0	0	20	10	80	120	200
TOTAL			27	9	0	18	19	-	-	500

Total number of credits = 159

Electronics and Communication Engineering Scheme of Credits:

Course work	Credits recommended by AICTE	Credit % for AICTE recommendation	Credits	Credit %
Humanities and Social Sciences	**12**	7.5	**10**	6.29
Basic Sciences	**25**	15.63	**27**	16.98
Engineering Science	**24**	15	**18**	11.32
Program Core	**48**	30	**61.5**	38.68
Program Electives	**18**	11.25	**18**	11.32
Open Electives	**18**	11.25	**12**	7.55
Employment Enhancement Courses	**15**	9.38	**12.5**	7.86
Mandatory Courses(Zero Credit)	**---**	--	--	--
Total	**160**	**100.00**	**159**	**100.00**

HS	Humanities and Social Sciences
BS	Basic Sciences
ES	Engineering Sciences
PC	Program Core
PE	Program Elective
OE	Open Electives
EEC	Project Work

PROGRAM ELECTIVES (PE)

S. No.	Course Code	Course Title	Hrs/Wk& Credits				Preferred Semester
			L	T	P	C	
PROGRAM ELECTIVE-I							
1.	18ECPE601	Electronic Measurements	3	0	0	3	VI
2.	18ECPE602	Physics of Optoelectronics	3	0	0	3	
3.	18ECPE603	Digital Image Processing	3	0	0	3	
4.	18ECPE604	Wireless Communication	3	0	0	3	
PROGRAM ELECTIVE-II							
5.	18ECPE701	FPGA based System Design	3	0	0	3	VII
6.	18ECPE702	Radar Communication	3	0	0	3	
7.	18ECPE703	Internet of Things	3	0	0	3	
8.	18ECPE704	Nano Electronics	3	0	0	3	
PROGRAM ELECTIVE-III							
9.	18ECPE705	VLSI Testing	3	0	0	3	VII
10.	18ECPE706	Advanced Radiating System	3	0	0	3	
11.	18ECPE707	High Speed Networks	3	0	0	3	
12.	18ECPE708	Virtual Instrumentation	3	0	0	3	
PROGRAM ELECTIVE-IV							
13.	18ECPE801	Low Power VLSI Design	3	0	0	3	VIII
14.	18ECPE802	Multimedia Compression Techniques	3	0	0	3	
15.	18ECPE803	Software Defined Radio	3	0	0	3	
16.	18ECPE804	Pattern Recognition	3	0	0	3	
PROGRAM ELECTIVE-V							
17.	18ECPE805	System on Chip Design	3	0	0	3	VIII
18.	18ECPE806	Wireless Sensor Networks	3	0	0	3	
19.	18ECPE807	Microwave ICs	3	0	0	3	
20.	18ECPE808	Physics of Sensors	3	0	0	3	
PROGRAM ELECTIVE-VI							
21.	18ECPE809	Network Security	3	0	0	3	VIII
22.	18ECPE810	Satellite Communication	3	0	0	3	
23.	18ECPE811	Bio Medical Electronics	3	0	0	3	
24.	18ECPE812	Artificial Intelligence and Machine Learning	3	0	0	3	

OPEN ELECTIVES (OE) [For other Departments]

S. No.	Course Code	Course Title	Hrs/Wk& Credits			
			L	T	P	C
1.	18ECOE01	Fundamentals of Electron Devices	3	0	0	3
2.	18ECOE02	Principles of Modern Communication Systems	3	0	0	3
3.	18ECOE03	Microcontroller and its Applications	3	0	0	3
4.	18ECOE04	Basic VLSI Design	3	0	0	3
5.	18ECOE05	Basics of Embedded Systems	3	0	0	3
6.	18ECOE06	Basics of Internet of Things	3	0	0	3

SEMESTER I

18EN101	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives:

1.	Master basic reading skills such as phonics, word recognition and meaningful division of sentences.
2.	Read fast, decode accurately and remove oral reading errors that affect text meaning
3.	Acquire and develop writing skills for academic, social and professional purposes
4.	Gain skills in academic and functional writing tasks.

WRITING

1. Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices
2. Email – Training Programme and related details, paper submission for seminars and conferences, Fixing an appointment, Arranging and Cancelling a meeting with team members, conference details, hotel accommodation, Reminder mails, Raising queries with team members, Congratulatory mails at work, arranging for a meeting with a foreign client, personal emails.
3. Letter Writing – Business and need based communication – Formats of official, personal and business letters, official leave and request applications (Bonafide certificate, course completion, conduct certificate, permission to arrange industrial visits) complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations, placing orders, cover letter for a job application with resume.
4. Technical Report Writing – status reports – Work Done in the Project, Feasibility Reports on Office Accommodation, Introduction of New Products, Sales Promotion, Customers Feedback, Starting a New Company, Event Reports- Seminars, Conferences, Meeting, Recommendations and Checklists.
5. Charts- interpreting pie charts, graphs etc.,

READING

1. Understanding notices, messages, timetables, adverts, graphs, etc.- understanding meaning and purpose of short texts.
2. Gapped sentences – Meanings, collocations and meanings of individual words.
3. Reading passage with multiple choice questions – reading for gist and reading for specific information – skimming for general idea of and meaning and contents of the whole text.
4. Short reading passage; gap-filling – Grammar, especially prepositions, articles, auxiliary verbs, modal verbs, pronouns, relative pronouns and adverbs.
5. Short reading passages; sentence matching – Scanning – ability to pick out specific information in a short text.

METHODOLOGY

Objective Type:

1. Vocabulary of business communication.
2. Collocations related to technical and business.
3. Coherence in paragraphs – use of sequence clues.
4. Conversations and appropriate responses.
5. Tenses with time makers.
6. Verbal phrases
7. Description of objects in a sentence or two
8. Products and likely slogans
9. Tone, vocabulary, expressions in formal and informal letters.
10. Email writing- tone, vocabulary, expressions, mail ID., creation, CC, BCC.

Descriptive Writing:

1. Skimming and scanning to look for specific information.
2. Spotting Errors.
3. Email writing in different work place/ profession based contexts with hints.
4. Letter writing in different business based contexts with hints.
5. Report writing: feasibility report, progress in project reports, accident reports and

event reports.
6. Checklists in business, office and profession based context.
7. Recommendations in business, office and profession based context.
8. Resume and Cover letter.
9. Mind mapping visuals on social and environmental issues – essay writing based on the given mind map visual.

Total (L)= 30 Periods

Course Outcomes:

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

CO1	:	Read and summarize the main ideas, key details and inferred meanings from a passage
CO2	:	Internalize the grammar items such as prepositions, articles, tenses, verbs, pronouns, and adverbs adjectives through contexts and apply them to spot errors.
CO3	:	Develop the ability to classify, check information and prepare reports.
CO4	:	Apply the academic and functional writing skills in new contexts
CO5	:	Interpret pictorial representation of data and statistic

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, Cambridge University Press, 2014

Recommended Readings and Reference sources:

1.	M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
2.	Farhathullah, T.M. Communication Skills for Technical Students
3.	Meenakshi Raman and Sangeetha Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2004
4.	David F. Beer and David McMurray, Guide to Writing as an Engineer, John Willey. New York, 2004
5.	Collins Cobuild- Student's Grammar: Self-Study Edition with Answers (Collins Cobuild Grammar) paperback- 6 May 1991
6.	Essential English Grammar paperback Raymond Murphy CUP 2007
7.	Android App for Grammar: https://play.google.com/store/apps/details?id=com.zayaninfotech.english.grammar http://www.onestopenglish.com/grammar/
8.	Speak Better Write Better English paperback – Nov 2012, Norman Lewis, Goyal Publishers and Distributors
9.	Essential English Grammar Paperback Raymond Murphy CUP 2007
10	English Reading Comprehension 2014 RPH Editorial Board
11	Proficiency in Reading Comprehension Simplifying the 'Passage' for you, 2008 Ajay Singh.

18MA101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE	
1	To know the use of matrix algebra needed by engineers for practical applications.
2	To understand effectively the geometrical application of differential calculus and Beta, Gamma functions.
3	To familiarize with partial differentiation concepts and its applications
4	To obtain the knowledge of multiple integration and their related applications.
5	To acquire the knowledge of vector differentiation and integration and its applications.

Unit I	MATRICES	9	+	3

Symmetric, Skew Symmetric and Orthogonal Matrices – Characteristic equation of a Matrix – Eigen values and Eigen vectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices - Reduction of quadratic form to canonical form by orthogonal transformation

Unit II	CALCULUS	9	+	3

Curvature , Radius of Curvature (Cartesian coordinates) – Centre and Circle of curvature - Evolutes and Involutes- Definite integrals and their properties – Beta and Gamma functions and their properties.

Unit III	MULTIVARIABLE CALCULUS (DIFFERENTIATION)	9	+	3

Partial derivatives – Euler's theorem for homogenous functions – Total Derivatives –Jacobians – Maxima, Minima and Saddle point- – Method of Lagrangian multipliers- Taylor's series

Unit IV	MULTIVARIABLE CALCULUS (INTEGRATION)	9	+	3

Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables (Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes.

Unit V	VECTOR CALCULUS	9	+	3

Vector differentiation- Gradient- Directional derivative - Divergence - Curl , Vector integration- Line integration- work done – Surface and Volume integrals - Green's theorem , Gauss divergence and Stokes theorem (without proof) – Simple applications involving cubes and rectangular parallelopipeds.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	Learn the fundamental knowledge of Matrix theory.
CO2	:	Familiar with the concept of the differentiation and integration and its applications.
CO3	:	Acquire skills in applications of Integral and Vector Calculus.

Text Books:

1.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, (2015).
2.	Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.

Reference Books:

1.	James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013
2.	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B.Tech)", Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3.	Srimanta pal and Subath.C.Bhumia, "Engineering Mathematics", Oxford university publications, New Delhi, 2015
4.	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006
5.	Sivaramakrishnadas.P, Ruknmangadachari.E. "Engineering Mathematics", Pearson, Chennai & Delhi, 2nd edition, 2013

18CY101	CHEMISTRY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE

Technology is being increasingly based on the electronic, atomic and molecular level modifications. The course will enable the students to:

1	Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2	Rationalize periodic properties of elements and the knowledge of acids and bases.
3	Analyze the stereo chemical aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules
4	Rationalize bulk properties and processes in thermodynamic aspects and its extension in electrochemical processes
5	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

Unit I MOLECULAR STRUCTURE 9 + 3

Formation of molecular orbitals of diatomic molecules - energy level diagrams of – H_2, He_2, N_2, O_2, CO and NO - pi-molecular orbitals of butadiene and benzene;
Aromaticity- Huckel rule - concept of aromaticity - aromatic, non-aromatic and anti-aromatic molecules;
Crystal field theory - energy level diagrams for transition metal ions – octahedral and tetrahedral geometries - magnetic properties;
Band theory - band structure of solids- Fermi level - role of doping on band structures.

Unit II PERIODIC PROPERTIES AND ACID-BASE CONCEPTS 9 + 3

Effective nuclear charge – shielding effect, penetration of orbitals - variations of s, p, d and f orbital energies of atoms –Aufbau principle - electronic configuration of elements – periodic properties - atomic and ionic size, ionization energy, electron affinity and electro negativity - anomalous properties of second period elements - diagonal relationship;
Acids and bases - Bronsted-Lowry concept - Lewis concept - pH and pKa – problems – HSAB - buffer solutions – types- mechanism of buffer action- Henderson–Hasselbalch equation- derivation and problems.

Unit III STEREOCHEMISTRY AND ORGANIC REACTIONS 9 + 3

Stereoisomerism – geometrical isomerism – cis-trans and E-Z nomenclature – optical isomerism – symmetry, chirality, optical activity, enantiomer and diastereomers – absolute configuration - R-S notation - conformational analysis – Ethane, butane, cyclohexane;
Addition reaction – hydrogenation, halogenations - Markovnikov rule – Kharasch effect - hydration,hydrohalogenation, hydroboration;
Aliphatic nucleophilic substitution reaction –SN_1, SN_2 and SN_imechanism – electrophilic substitution reaction in benzene– mechanism - nitration, halogenations, sulfonation, alkylation and acylation;
Elimination reaction –E_1, E_2 and E_1CB- mechanism- Saytzeff rule **–** examples.

Unit IV USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA 9 + 3

Thermodynamic functions- internal energy, enthalpy, entropy and free energy- first and second law of thermodynamics - partial molar properties - Gibbs Duhem equation – variation of chemical potential with temperature and pressure – Third and Zeroth law of thermodynamics – definition only;
Free energy and EMF relation - single electrode potential - electrochemical series and its significance.- cell potential and its measurement (Poggendorff method only) - Nernst equation-derivation and problems-Standard cell potential and equilibrium constant relation- problems.

Unit V SPECTROSCOPY TECHNIQUES AND APPLICATIONS 9 + 3

Vibrational spectroscopy – principle - selection rule - harmonic and unharmonic oscillators - number of vibrational modes of poly-atomic molecules – overtones - Fermi resonance - instrumentation (block diagram only);
Rotational spectroscopy- rotational spectra of rigid and non rigid diatomic rotators, simple polyatomic molecules like CO_2, NH_3,CH_4 and H_2O;
NMR - origin of NMR signal - chemical shift - factors affecting chemical shift and spin-spin coupling – application to ethanol, acetone and ethyl methyl ether.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	Understand in-depth knowledge of atomic and molecular orbitals based chemical aspects

CO2	:	Realize the nature of periodic properties of elements and the knowledge of acids and bases.
CO3	:	Grasp the knowledge of 3D structural aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules.
CO4	:	Substantiate the various processes involved in thermodynamic considerations and its involvement in electrochemical aspects.
CO5	:	Aware of spectroscopic techniques in the field of molecular identification of materials.

Text Books:	
1.	P.R. Puri, L.R.Sharma and Madan S. Pathania,"Principle of physical chemistry" 47th Vishal Publishing Co, Jalandhar-8
2.	C. N. Banwell and E. M. Mccash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2009.
3.	Raj. K. Bansal – "A Text Book of Organic Chemistry" Revised 4th Ed.,(2005), New Age International Publishers Ltd., New Delhi.
4.	P.S. Kalsi – "Stereochemistry conformation and Mechanism", 6th Ed., (2005), New Age International Publishers Ltd., New Delhi.
5.	J.D. Lee – "A New Concise Inorganic Chemistry", 5th Edn., Oxford University Press, 2011.
6.	Wahid Malik, G.D.Tuli and R.D.Madan, "Selected Topic in Inorganic Chemistry",S.Chand& Co., Ltd (2011).
Reference Books:	
1.	David.W.Ball, Physical Chemistry, Cengage Learning India Pvt. Ltd., New Delhi, 2009.
2.	G.Aruldhas, Molecular structure and spectroscopy, second edition, PHI learning Pvt. Ltd., New Delhi, 2008.
3.	Cotton and Wilkinson – "Advanced Inorganic Chemistry", 6th Ed., John Wiley & Sons, New York- 2004.
4.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter – "Inorganic Chemistry-Principles of Structure and Reactivity", 4 thEdn., Pearson Education, 11th Impression, 2011.
5.	F.A. Carey and R.J. Sund berg – "Advanced organic chemistry" Vol. I and II– 3rd Ed.,(1984), Plenum Publications.
6.	Ernest. Eliel and Samuel H. Wilen – "Stereochemistry of Organic Compounds" – Wiley Student Ed., (2006). John Wiley and Sons Pvt. Ltd., Singapore.

18CS101	FUNDAMENTALS OF PROBLEM SOLVING AND C PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To express problem solving through programming.
2.	To practice the basic concepts of C programming language.
3.	To provide the basics knowledge about array and strings to solve simple applications.
4.	To use pointers and functions in the simple applications.
5.	To review the elementary knowledge of structures and unions.

Unit I	Introduction to Computer and Problem Solving	9	+	0

Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart- Need for computer languages, Generation and Classification of Computers- Basic Organization of a Computer.

Unit II	C Programming Basics and Control Statements	9	+	0

C Character set- Identifies and Keywords- Data Type- Declarations-Expressions-Statements and Symbolic constants-Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators- Managing Input and Output operations- Decision Making-Branching and Looping statements.

Unit III	Arrays and Strings	9	+	0

Pre-processor directives-Storage classes-Arrays – Initialization – Declaration – one dimensional and two dimensional arrays. Strings - String operations – String handling functions-Simple programs-sorting-searching.

Unit IV	Functions and Pointers	9	+	0

Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays.

Unit V	Structures, Unions and File	9	+	0

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures-Union-basic file operation.

Total (L)= 45 Periods

Course Outcomes:

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

CO1	*:*	*Formulate and apply logic to solve basic problems.*
CO2	*:*	*Write, compile and debug programs in C language.*
CO3	*:*	*Apply the concepts such as arrays, decision making and looping statements to solve real time applications.*
CO4	*:*	*Solve simple scientific and statistical problems using functions and pointers.*
CO5	*:*	*Write programs related to structures and unions for simple applications.*

Text Books:

1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011. (Unit-I).
2.	E.Balagurusamy, "Programming in ANSI C" fourth Edition, Tata McGraw-Hill, 2008. (Unit II-V).

Reference Books:

1.	Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2.	Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
3.	Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

18EN102	PROFESSIONAL ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To acquire and develop listening skills for academic, social and professional purposes.
2.	To understand short conversations or monologues
3.	To master basic reading skills such as phonics, word recognition, and fluency
4.	Acquire and develop pre-intermediate level fluency in oral skills such as discourse management, grammar and vocabulary, pronunciation and interactive communication for academic, social and professional purposes
5.	Address an audience and present a topic.
6.	Express an opinion and justify it

Methodology - Listening

List of Audio files:

1. Job Responsibilities
2. Conversation between two employees on company culture
3. Emails
4. Description of gadgets
5. Interview with a leading industrialist
6. Office procedures – applying for permission, placing an order for office equipment,
7. Enquiries about orders and deliveries
8. Conversation between two people on general topics
9. Telephone Messages
10. Fixing and Cancelling appointments
11. Asking for directions
12. Rescheduling a travel plan
13. Tones : Rude and Polite
14. Conversation : Statements, Discussions, Debating, Accepting, Negotiating
15. Conferences ; Announcements about changes in schedules and sessions
16. Motivational Speech
17. TED Talk on Team Work
18. Describing charts and data
19. Presentation at an office
20. Short self-descriptions.

METHODOLOGY: - Speaking

1. Self-Introduction – Personal information –Name, Home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations if any, likes and dislikes in food, clothes, Special features of home town, Personal role models in life, goals and dreams, favorite inspirational quote.
2. Situational Role Play between Examiner and Candidate – Customer and Sales Manager, Hotel Manager and Organiser, Team Leader and Team member, Bank Manager and Candidate, Interviewer and Applicant, Car Driver and Client, Industrialist and Candidate, Receptionist and Appointment Seeker, New Employee and Manager, Employee and Employee, P.A. and Manager Schedule for training, Asking for directions, Seeking help with office equipment, Clarifying an error in the bill, Quality of Products, Buying a Product, Selling a Product, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities, faculty advisors and student, student and student, college Office personnel and student.

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Infer, interpret and correlate routine, classroom-related conversation
CO2	:	Use a range of common vocabulary and context based idioms.
CO3	:	Comprehend native speakers when they speak quickly to one another, although the student might still have trouble.
CO4	:	Identify the most important words in a story/article.
CO5	:	Summarize the main ideas, key details, and inferred meanings from listening passages of up to five

CO6	:	Vocalize words without the aid of pictures
CO7	:	Make effective self-introductions
CO8	:	Study options, compare and contrasts the options
CO9	:	Exercise a choice, justify it by giving examples and illustrations.
C010	:	Construct a situation and to participate in conversations.

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, Cambridge University Press, 2014.

Recommended Reading and Reference Sources:

1.	Spoken English: A Self-Learning Guide. V. Sasikumar and P V Dhamija.
2.	English Conversation Practice: Grant Taylor Paperback 1976ely. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur. CUP, 1981
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback - November 2012 Norman Lewis, Goyal Publishers and Distributors.

18CS102	COMPUTER PRACTICE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To provide basic knowledge of creating Word documents and also producing mail merge.
2.	To make use of basic functions, formulas and charts in Spread sheet.
3.	To implement problem solving techniques.
4.	To promote the programming ability to develop applications for real world problems.

LIST OF EXERCISES

A. Word Processing

1. Document creation, Text manipulation with Scientific notations, Table creation, Table formatting and Conversion
2. Letter preparation using Mail merge and Draw flow Charts using tools

B. Spread Sheet

3. Chart - Line, XY, Bar and Pie.
4. Formula - formula editor, Sorting and Import and Export features.
5. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.

C. Simple C Programming

6. Program using Control statements.
7. Program using Looping.
8. Program using Array.
9. Program using String.
10. Program using Function.
11. Program using Structures.
12. Program using Pointers.
13. Program using Files.

*** For programming exercises Flow chart and pseudo code are essential**

Course Outcomes:

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

CO1	:	Demonstrate the basic mechanics of Word documents and working knowledge of mail merge.
CO2	:	Demonstrate the use of basic functions and formulas in Spread sheet.
CO3	:	Apply good programming methods for program development.
CO4	:	Implement C programs for simple applications.

18ME102	WORKSHOP MANUFACTURING PRACTICES	L	T	P	C
		1	0	4	3

Course Objectives:

1.	To provide an exposure of basic engineering practices to the student.
2.	To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

LIST OF EXERCISES

1. Introduction to Safety measures and First aid.
2. Study of Lathe -Welding methods and equipment's- Casting process and tools- Sheet metal and fitting tools- Carpentry tools and joints.
3. Fitting: V-fitting, Square fitting, Curve fitting.
4. Lathe: Facing, turning, taper turning and knurling.
5. Welding: BUTT, LAP and T- joints.
6. Foundry: Green sand preparation- mould making practice.
7. Sheet metal: Cone, tray, cylinder.
8. Carpentry: CROSS, T and DOVETAIL joints.
9. Drilling: simple exercises.

Course Outcomes:

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

CO1	*:*	*Prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.*
CO2	*:*	*Prepare simple lap, butt and tee joints using arc welding equipment.*
CO3	*:*	*Prepare green sand moulding.*
CO4	*:*	*Prepare sheet metal components.*
CO5	*:*	*Prepare simple components using lathe and drilling machine.*

Reference Books:

1.	Bawa, H.S, "Work shop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
2.	Jeyachandran, K, Natarajan, K and Balasubramanian, S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3.	Jeyapoovan, T, SaravanaPandian, M and Pranitha, S, "Engineering Practices Lab Manual", VikasPuplishing House Pvt. Ltd, 2006.

18MA203	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE

1	To obtain the knowledge to solve second order differential equations with constant and variable coefficients.
2	To familiarize with formation and solutions of first order partial differential equation.
3	To familiarize with the solutions of higher order partial differential equations.
4	To find the solutions of second order differential equation with constant coefficients by Laplace transform methods.
5	To obtain the knowledge of finding the numerical solutions to system of linear equations.

Unit I	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER**	**9**	**+**	**3**

Second order linear differential equations with constant and variable coefficients –Cauchy-Euler equation and Cauchy-Legendre's linear equation - Method of variation of parameters –Simultaneous first order linear equations with constant coefficients.

Unit II	**PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER**	**9**	**+**	**3**

Formation of partial differential equations by elimination of arbitrary constants and functions – Solutions to first order partial differential equations – Standard types of first order linear and non-linear PDE- Lagrange's linear PDE.

Unit III	**PARTIAL DIFFERENTIAL EQUATIONS**	**9**	**+**	**3**

Solution to homogeneous and non-homogeneous linear partial differential equations of second and higher order by complementary function and particular integral method - Separation of variables method: simple problems in Cartesian coordinates, Laplace equation in Cartesian and polar coordinates, one dimensional diffusion equation, one dimensional wave equation.

Unit IV	**LAPLACE TRANSFORM**	**9**	**+**	**3**

Laplace Transform- Properties of Laplace transform – Laplace Transform of periodic Functions – Finding inverse Laplace Transform by different methods, convolution theorem – Evaluation of integrals by Laplace transform- solving second order differential equations with constant coefficients by Laplace transform method.

Unit V	**SOLUTION OF EQUATIONS**	**9**	**+**	**3**

Solutions of nonlinear equations by iteration method and Newton Raphson method-Solutions of linear system of equations by Gauss Elimination, Gauss Jordan, Gauss Jacobi and Gauss Seidal methods-Inverse of a matrix by Gauss Jordan Methods.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	Learn the techniques of solving ordinary and partial differential equations of second and higher order that arise in engineering problems.
CO2	:	Familiar with the Laplace transforms method to solve second order differential equations.
CO3	:	Acquire the knowledge of finding solutions to non-linear and system of linear equations and numerically.

Text Books:

1.	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publications, Delhi, 2015.
2.	Veerarajan T., "Engineering mathematics for first year", Tata McGraw Hill Education Pvt.Ltd., New Delhi, 2009.
3.	Kandasamy. P, Thilagavathy. K, Gunavathy. K, "Numerical Methods", S.Chand & Co., New Delhi, 2005.

Reference Books:

1.	James Stewart, "Essential Calculus", Cengage Learning, New Delhi, 2nd edition, 2013.
2.	P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Engineering Mathematics (For I year B.E., B.Tech)", Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3.	Ewinkreyzig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons, 2006.
4.	Veerarajan. T and Ramachandran, "Numerical methods with Programs in C and C++ ", Tata McGraw Hill, New Delhi,2006**.**
5.	M.K.Venkataraman, "Numerical Methods", National Publishing Company, 2000.

18PH102	PHYSICS – ELECTROMAGNETISM	L	T	P	C
		3	1	0	4

Pre requisite:

Basics of vector calculus

COURSE OBJECTIVE

1	The concept of electrostatics, electric potential and their application.
2	The concept of dielectrics and boundary conditions for electrostatic field.
3	The concept of magnetostatics, magnetic fields in matter and their application.
4	The concept of Faraday's law, Ampere's Law, Maxwell's Equation and their application.
5	The concept of Electromagnetic waves, and Poynting vector.

Unit I	ELECTROSTATICS IN VACUUM	9	+	3

Electric field and electric flux density - Gauss's Law - applications of Gauss's law - electric field due to infinite line charge- infinite sheet of charge- uniformly charged sphere; Electric potential - potential due to a point charge- electric potential energy of a system of point charges - relationship between electric field and electric potential; Energy density in electrostatic fields.

Unit II	ELECTROSTATICS IN A LINEAR DIELECTRIC MEDIUM	9	+	3

Classification of materials based on conductivity ; Electric dipole - electrostatic field and potential of a dipole; Dielectrics - induced dipoles - polarization in dielectrics - dielectric constant and strength; Linear, isotropic, and homogeneous dielectrics; Capacitance - parallel plate capacitor - coaxial capacitor - spherical capacitor; Electric displacement; Laplace's and Poisson's equations for electrostatic potential.

Unit III	MAGNETOSTATICS AND MAGNETIC FIELDS IN MATTER	9	+	3

Biot-Savart's Law - magnetic induction at point *P* due to a straight filamentary conductor; Ampere's circuit law - applications of ampere's law: infinite line current - infinite sheet of current; Magnetization and associated bound currents - auxiliary Field H - Ampere's law in magnetized materials; Magnetic susceptibility and permeability; Classification of magnetic materials - diamagnetic, paramagnetic and ferromagnetic materials - hysteresis loop.

Unit IV	FARADAY'S LAW AND MAXWELL'S EQUATION	9	+	3

Faraday's law in terms of emf produced by changing magnetic flux; Lenz's law; Transformer emf; Motional emf ; Electromagnetic breaking and its applications; Self Inductance - self-inductance of a solenoid; Mutual Inductance - mutual Inductance of two tightly wound solenoids; Energy density in magnetic Fields; Displacement current - modified ampere's law; Maxwell's equation in vacuum and non-conducting medium.

Unit V	ELECTROMAGNETIC WAVES	9	+	3

The wave equation- plane electromagnetic waves in vacuum, their transverse nature and polarization; Polarization by reflection- Brewster's law; Relation between electric and magnetic fields of an electromagnetic wave; Energy carried by electromagnetic waves; Flow of energy and Poynting vector; Variation of intensity of electromagnetic wave with distance; Radiation pressure.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	Understand the concepts of electrostatics, electrical potential, and their applications.
CO2	:	Interpret the concepts of dielectrics and boundary conditions for electrostatic field.
CO3	:	Apply the concepts of magneto statics, magnetic fields in matter and their application.
CO4	:	Apply the concepts of Faraday's law, Ampere's Law, Maxwell's Equation.
CO5	:	Interpret the concepts of electromagnetic waves and Poynting vector.

Text Books:

1.	Mathew N. O.Sadiku, 'Elements of Electromagnetics', Oxford University Press, Third Edition, 2001.
2.	Halliday, Resnick, Walker, 'Fundamentals of Physics-Electricity and Magnetism', Wiley India Pvt.Ltd., 2011.
3.	Gangadhar K.A, Ramanthan P.M, 'Field Theory', Khanna Publications, 2002.

Reference Books:

1.	David J. Griffiths, 'Introduction to Electrodynamics', Prentice-Hall, Inc., 1999.
2.	Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth edition, 2010.

18EE201	PRINCIPLES OF ELECTRICAL ENGINEERING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE

1	To understand the basic concepts of electric circuits, measurements techniques and instruments.
2	To study the working principles of DC and AC machines.
3	To understand the components of Electrical installations.

Unit I	**D.C. CIRCUITS**	**9**	**+**	**3**

Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin, Norton and Maximum power transfer theorems Time-domain analysis of first-order RL and RC circuits.

Unit II	**A.C. CIRCUITS**	**9**	**+**	**3**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, realpower, reactive power, apparent power, power factor,Analysis of single-phase ac circuits consisting of RL, RC, RLC combinations (seriesand parallel), resonance.Three-phase balanced circuits, voltage and current relations in star and delta connections.

Unit III	**TRANSFORMERS**	**9**	**+**	**3**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit,losses in transformers, regulation and efficiency. Auto-transformer.

Unit IV	**ELECTRICAL MACHINES**	**9**	**+**	**3**

Construction, working and speed control of DC shunt motor. Generation of rotating fields, construction and working of a three phase induction motor. Starting and speed control of three phase induction motor. Working of single phase induction motor and its applications. Construction and working of synchronous generators.

Unit V	**ELECTRICAL INSTALLATIONS**	**9**	**+**	**3**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types ofWires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.Elementary calculations for energy consumption, power factor improvement and battery backup.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	To analyze DC and AC circuits.
CO2	:	To apply Electrical Circuit theorems to any electrical circuits.
CO3	:	To calculate the efficiency of any transformer.
CO4	:	To understand and analyze basic Electric and Magnetic circuits.
CO5	:	To study the working principles of Electrical Machines.
CO6	:	To introduce components of Low Voltage Electrical Installations.

Text Books:

1.	Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.
2.	Basic Electrical Engineering - D.C. Kulshreshtha, 2009, Tata McGraw Hill.
3.	Fundamentals of Electrical Engineering, L.S. Bobrow, Oxford University Press, 2011.

Reference Books:

1.	Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010.
2.	Electrical Engineering Fundamentals, Vincent Deltoro, Second Edition, Prentice Hall India, 1989.

18ME101	ENGINEERING GRAPHICS & DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE

1	To impart knowledge on concepts, ideas and design of engineering products and to provide an exposure to CAD Modelling.
2	Standards of Engineering Drawing: Size, layout and folding of drawing sheets, lettering - Use of drafting instruments.

Unit I	PROJECTION OF POINTS, LINES AND PLANE SURFACES	9	+	3

General principles of orthographic projection- Projection of points, located in all quadrants – Projection of straight lines located in first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

Unit II	PROJECTION OF SOLIDS	9	+	3

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to one reference plane and also inclined to one reference plane by change of position method.

Unit III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	9	+	3

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to other – solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

Unit IV	ISOMETRIC PROJECTION	9	+	3

Principles of isometric projection –isometric scale - isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Unit V	PERSPECTIVE PROJECTION	9	+	3

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Total (L+T)= 60 Periods

Note: Study of drafting software – Auto CAD – Coordinate System (Absolute, relative and polar) Creation of simple figures like polygon, Drawing a plan of residential building, Creation of 3-D Models of simple objects and obtaining 2-D multi view drawing from 3-D model**. (Internal Assessment only)**

Course Outcomes:

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

CO1	:	Understand the conventions and the methods of engineering drawing.
CO2	:	Understand the fundamental concepts of theory of projection.
CO3	:	Understand the development of different surfaces.
CO4	:	Develop the relationships between 2D and 3D environments.
CO5	:	Demonstrate computer aided drafting.

Text Books:

1.	Bhatt N.D, “Engineering Drawing”, Charotar publishing House, 2003.
2.	Natarajan, K.V, “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, 2006.

Reference Books:

1.	Gopalakrishnana K.R, “Engineering Drawing", Vol. I and II, Subhas Publications, 1999.
2.	Dhananjay A. Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.
3.	Venugopal, K and Prabhu Raja, V., “Engineering Graphics”, New Age International (P) Ltd, 2008.
4.	Gill, P.S, “Engineering Drawing-Geometrical Drawing”, S.K Kataria and Sons, 2008.
5.	CAD Software Theory and User Manuals

18CYMC01	ENVIRONMENTAL SCIENCE	L	T	P	C
AIM		**0**	**0**	**1**	**0**

To impart awareness to the student that they are separate from the environment and should not control the environment.

OBJECTIVES

1.	They are part of the environment
2.	To have an ancient wisdom drawn from Vedas
3.	Activities based knowledge to preserve environment
4.	Conservation of water and its optimization.

Environmental Awareness

1. Group activity on water management
2. Group discussion on recycle of waste (4R's)
3. Slogan making contest.
4. Poster making event.
5. Expert lecture on environmental awareness.
6. Imparting knowledge on reduction of electricity usage

6 hours

Environmental activities

1. Identification and segregation of biodegradable and non biodegradable waste
2. Campus cleaning activity
3. Plantation of trees in the college campus and local waste lands.
4. Identification of varieties of plants and their usage
5. Shutting down the fans and ACs of the campus for an hour
6. Field work on growing of kitchen garden for mess.

8 hours

TOTAL 14 HOURS

18PH103	PHYSICS LABORATORY	L	T	P	C
		0	**0**	**3**	**1.5**

Course Objectives:

1.	To handle different measuring instruments.
2.	To understand the basic concepts of interference, diffraction, heat conduction and to measure the important parameters.

LIST OF EXERCISES

1. Newton's rings – Determination of radius of curvature of a Plano convex lens.
2. Carey Foster's bridge – Determination of specific resistance of the material of the wire.
3. Poiseuille's flow – Determination of Coefficient of viscosity of a liquid.
4. Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5. Lee's disc – Determination of thermal conductivity of a Bad conductor.
6. Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid.
7. Non-uniform bending – Determination of young's modulus of the material of the Bar.
8. Determination of Band gap of a given semi conductor.
9. Determination of Wavelength of laser using grating and determination of particle size using Laser.
10. Determination of Acceptance angle and Numerical Aperture of fiber.

Course Outcomes:

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

CO1	*:*	*Handle different measuring instruments and to measure different parameters.*
CO2	*:*	*Calculate the important parameters and to arrive at the final result based on the experimental measurements.*

18CY102	CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To gain practical knowledge by applying theoretical principles and performing the following experiments**.**

LIST OF EXERCISES

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Estimation of Alkalinity in water
4. Estimation of Chloride in water sample (Iodimetry)
5. Conductometric titration of Strong Acid and Strong Base
6. Conductometric titration of Mixture of acids and Strong base
7. Determination of strength of Iron by Potentiometric method
8. Estimation of Iron by Spectrophotometry
9. Determination of molecular weight and degree of Polymerisation by Viscometry.

NOTE:

- All the nine experiments shall be offered.

Course Outcomes:

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

CO1	*:*	*To know the applicability of the practical skill gained in various fields.*
CO2	*:*	*To know the composition of brass quantitatively and the molecular weight of polymers.*
CO3	*:*	*To understand the principle and applications of conductometric titrations, spectrometer and potentiometric titrations.*

18EN103	PROFESSIONAL COMMUNICATION LABORATORY	L	T	P	C
	(Common to All Branches)	0	0	2	1

Course Objectives:	
1.	Improve their reading skills.
2.	Address an audience and present a topic.
3.	Acquire speaking competency in English.
4.	Strengthen their fluency in speaking
EXPERIMENTS	
	Methodology – Reading 1) Reading a story aloud with exact pronunciation, with intonation, and with expressing sense. 2) Reading poems for improving verbal skills, memory, and critical thinking. 3) Reading newspaper articles for strengthening the vocabulary and writing skills. 4) Reading homophones with exact pronunciation for expressing different meanings
	Methodology – Speaking 1) Power point presentation – on general topics - for organising and structuring presentation. 2) Oral presentation -on basic technical ideas related to engineering. 3) Speaking on a given topic – current affairs, expressing opinion on social issues. 4) Describing a process – booking Ticket online, survey for starting a new office, sending an e-mail, etc. 5) Organising official events –compering,presenting welcome address, proposing vote of thanks

		Total (P)= 30 Periods
Course Outcomes:		
After the successful completion of the practical session, the students will be able to		
CO1	:	read short passages fluently, avoiding mispronunciation, substitution, omission and transposition of word-pairs
CO2	:	vocalize words without the aid of pictures.
CO3	:	develop a well-paced, expressive style of reading.
CO4	:	make effective oral presentations on technical and general contexts
CO5	:	describe a process with coherence and cohesion.

Text Books:	
1.	Norman Whitby. Business Benchmark – Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014
Recommended Reading and Reference Sources:	
1.	Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2.	English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur.CUP, 1981.
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback – November 2012 Norman Lewis, Goyal Publishers and Distributors

18EE202	PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXERCISES

1. Study of basic safety precautions, measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope and Electrical components.
2. Study of transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage.
3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
4. Resonance in R-L-C circuits.
5. (Demonstration) Transformers: Observation of the no-load current waveform on an oscilloscope (no sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
6. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
7. Measurement of three-phase power in three-phase circuits.
8. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.

Course Outcomes:

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

CO1	:	Get an exposure to common electrical components and their ratings.
CO2	:	Make electrical connections by wires of appropriate ratings.
CO3	:	Understand the usage of common electrical measuring instruments.
CO4	:	Understand the basic characteristics of transformers and electrical machines.

SEMESTER III					
18MA303	**LINEAR ALGEBRA AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objectives:

1.	To obtain the knowledge about the vector spaces, inverse of a linear transformation and composition of linear maps.
2.	To familiar with numerical interpolation and to obtain the knowledge about the fitting of curves by the method of least squares.
3.	To obtain the knowledge about numerical differentiation and integration.
4.	To acquire the knowledge about numerical solution to initial value problems using single step and multi step methods.
5.	To gain the knowledge of numerical solution to partial differential equations by using explicit and implicit methods

Unit I	**VECTOR SPACES**	**9**	**+**	**3**

Vector space - linear dependence of vectors, basis and dimension- Linear transformations (maps) - range and kernel of linear transformation- rank and nullity- Inverse of linear transformation- rank-nullity theorem – Composition of linear maps- Matrix associated with linear map.

Unit II	**INTERPOLATION AND CURVE FITTING**	**9**	**+**	**3**

Interpolation using Newton's Forward and Backward formulae-Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae - Curve fitting by the Method of Least Squares –Fitting of straight lines, second degree parabolas and curves reducible to linear forms.

Unit III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**	**+**	**3**

Numerical Differentiation .Numerical Integration-Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule, Two point and Three point Gaussian quadrature formulae.

Unit IV	**NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS**	**9**	**+**	**3**

Numerical methods for initial value problems- Taylor's series method- Euler's and modified Euler's method- Runge-Kutta method of fourth order, Multi-step method: Milne's predictor - corrector method- Solution of second order boundary value problems by finite difference method.

Unit V	**NUMERICAL SOLUTION FOR PARTIAL DIFFERENTIAL EQUATION**	**9**	**+**	**3**

Partial differential equations: Finite difference solution of two dimensional Laplace and Poisson equations- Implicit and Explicit methods for one dimensional heat equation (Bender Schmidt and Crank-Nicholson methods) - Finite difference explicit method for wave equation.

Total (L+T)= 60 Periods

Course Outcomes:

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

CO1	:	Learn about the vector spaces, linear transformation and composition of linear maps.
CO2	:	Obtain the knowledge about interpolation and fitting the curves by Least Square Method.
CO3	:	Differentiate and integrate numerically.
CO4	:	Solve the initial value problems by using single-step and multi-step methods
CO5	:	Find the numerical solution of partial differential equation by using Finite difference methods.

Text Books:

1.	Gilbert Strang, "Linear Algebra and its applications", Cengage Learning, New Delhi, 4th edition, 2006.
2.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, "Numerical Methods" S.Chand& Co., New Delhi, 2005.

Reference Books:

1.	D.Poole, "Linear Algebra, A Modern introduction", 2nd edition, Brooks, 2005.
2.	V.Krishnamurthy, V.P.Mainra and J.L.Arora, "An introduction to Linear Algebra", East-West press, Reprint 2005
3.	M.K.Venkataraman, "Numerical Methods", National Publishing Company,2000
4.	Jain M.K.Iyengar, K & Jain R.K., "Numerical Methods for Scientific and Engineering Computation ", New Age International (P) Ltd, Publishers 2003
5.	Manish Goyal, "Numerical Methods and Statistical techniques Using "C" ", 1st Edition, Laxmi Publications (P) Ltd, 2009.

18EC301	SEMICONDUCTOR PHYSICS AND DEVICES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals of electron devices and apply the knowledge of these devices in electronic circuits.
2.	To design and analyse single stage and multistage amplifier circuits.
3.	To understand and classify different kinds of power and feedback amplifiers.

Unit I	SEMICONDUCTOR DIODES	9	+	0

PN junction diode - Current equations - Energy Band diagram - Diffusion and Drift current densities - Forward and Reverse bias characteristics - Transition and Diffusion Capacitances - Switching Characteristics - Breakdown in PN Junction Diodes - Diode Applications - Clipper and Clamper circuits - Voltage doubler - Rectifier circuits with and without Capacitor filter.

Unit II	SPECIAL SEMICONDUCTOR DEVICES	9	+	0

Metal Semiconductor Junction- MESFET – FINFET- PINFET- CNTFET- DUAL GATE MOSFET- Schottky barrier diode - Zener diode - Varactor diode –Tunnel diode- Gallium Arsenide device - LASER diode - LDR.

Unit III	TRANSISTOR AMPLIFIERS	9	+	0

Bipolar Junction Transistor-Device structure and physical operation - Current-Voltage characteristics - Ebers-Moll Model - MOSFET-device structure and physical operation - Current-Voltage characteristics - Biasing schemes for BJT and FET amplifiers - Bias stability - Various configurations (such as CE/CS, CB/CG, CC/CD) and their features.

Unit IV	FREQUENCY RESPONSE OF AMPLIFIERS	9	+	0

Small signal models of BJT and MOSFET - Frequency response of amplifiers - Low Frequency response of Common Emitter and Common Source Amplifiers - Internal Capacitive Effects – High Frequency Model of the BJT and MOSFET- High Frequency Response of the CS and CE Amplifiers - General expression for frequency response of multistage amplifiers - Calculation of overall upper and lower cut off frequencies of multistage amplifiers - Cascode amplifier.

Unit V	POWER AND FEEDBACK AMPLIFIERS	9	+	0

Power amplifiers – Operation of Class A, Class B, Class AB, and Class C – Power conversion efficiency and power dissipation calculations - Cross-over distortion - Feedback topologies: Voltage series - current series - voltage shunt - Current shunt - Effect of feedback on gain, bandwidth – Concept of stability - Gain margin and phase margin.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the characteristics of diodes and special semiconductor devices.
CO2	:	Acquire knowledge on working principles, characteristics and applications of BJT and FET.
CO3	:	Analyse the frequency response characteristics of amplifiers.
CO4	:	Design and analyse power and feedback amplifiers.

Text Books:

1.	A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, 7th edition, Oxford University Press, 2015.
2.	S. Salivahanan and N. Suresh kumar, “Electronic Devices and Circuits”, 4th edition, McGraw Hill Education, 2017.

Reference Books:

1.	Donald A. Neamen. “Semiconductor Physics and Devices”, 4th Edition, McGraw Hill Education 2012.
2.	Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory” ,11th edition, PHI, 2013.
3.	Ben G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices” ,7th edition, Pearson, 2014.
4.	Jacob Millman, Christos C. Halkias and Satyabrata Jit, “Electronic Devices and Circuits,” 4th Edition, McGraw Hill Education, 2015

E-References:

1.	http://www.radio-electronics.com/info/data/semicond/semiconductor/semiconductor-materials-types-ist.php
2.	http://911electronic.com/
3.	http://www.electronics-tutorials.ws/

18EC302	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1	Understand the fundamentals of Boolean algebra.
2	Understand and design combinational and sequential circuits.
3	Understand the concept of Memories and Programmable Logic Devices and apply the knowledge of these devices in design Digital electronic circuits.

Unit I	NUMBER SYSTEMS AND LOGIC GATES	9	+	0

Binary – Decimal – Octal - Hexa decimal - Binary codes: BCD – Gray code - Boolean Algebra and Minimization Techniques - Canonical forms – Conversion between canonical forms – Simplifications of Boolean expressions using Karnaugh map – Logic Gates: Implementations of Logic Functions using gates – Logic Families: TTL NAND gate – Specifications - Noise margin -Propagation delay - fan-in - fan-out Tristate TTL- ECL.

Unit II	COMBINATIONAL CIRCUITS	9	+	0

Design procedure – Adders/Subtractor – Serial adder/ Subtractor - Parallel adder/ Subtractor- Carry look ahead adder- BCD adder- Magnitude Comparator- Multiplexer/ Demultiplexer- Encoder / Decoder – Parity checker – Code converters - Implementation of combinational logic using MUX and Decoder.

Unit III	SEQUENTIAL CIRCUITS	9	+	0

Design Procedure - Flip flops: SR, JK, T, D and JK Master Slave – Triggering of Flip-flop - Realization of flip flops –Moore and Mealy circuits – Counters: Asynchronous / Ripple counters – Synchronous counters – Modulo n counter – Design of Synchronous counters – Register **-** Shift registers -: Universal shift register – Shift Register counters.

Unit IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS	9	+	0

Design of fundamental mode circuits – Primitive state / flow table – Minimization of primitive state table – state assignment – Excitation table – Excitation map - Problems in Asynchronous Circuits: Cycles– Races – Hazards - Design of Hazard Free Switching Circuits: Static – Dynamic - Essential Hazards and Hazard elimination.

Unit V	MEMORY DEVICES	9	+	0

Classification of memories –RAM organization – ROM organization – Flash Memory - Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Implementation of combinational logic using ROM, PAL and PLA.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Minimize Boolean expressions and implement using logic gates
CO2	:	Design and analyse combinational logic circuits.
CO3	:	Design and analyse synchronous and asynchronous sequential logic circuits
CO4	:	Understand the concepts of memories and PLDs and implementation of circuits using memory and PLDs.

Text Books:

1.	M. Morris Mano, "Digital Design", 4th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2008.
2.	R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th Edition, 2009

Reference Books:

1.	W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, ,2006.
2.	D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
3.	S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 2nd edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2004.
4.	Charles H.Roth. "Fundamentals of Logic Design", Thomson Publication Company, 2003.

E-References:

1.	http://nptel.ac.in/noc/individual_course.php?id=noc15-ec01
2.	https://nptel.ac.in/courses/117105080/6
3.	https://nptel.ac.in/courses/117105080/8

18EC303	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisite

- Basic Calculus and Differential Equations

Course Objectives:

1.	To introduce basics of signals and system
2.	To understand and perform Fourier analysis on continuous and discrete time signal.
3.	To introduce Laplace and Z transform in analysing signals and system

Unit I	**INTRODUCTION TO SIGNALS AND SYSTEM**	**9**		**0**

Classification of Signals: Even and Odd Signal **-** Energy and power signals - Continuous time (CT) and Discrete time (DT) signals - Continuous and Discrete amplitude signal -. System properties and representation: linearity - Tme-invariance – Causality – Stability - Realizability. - Linear Tme-Invariant (LTI) systems: Iimpulse response and step response – Convolution – Correlation - System representation through differential equations and difference equations.

Unit II	**FOURIER ANALYSIS OF CONTINUOUS TIME SIGNAL AND SYSTEMS**	**9**		**0**

Continuous Time Fourier Series (CTFS) - Properties of CTFS - Continuous Time Fourier Transform (CTFT) – CTFT of CT periodic signals - Properties of CTFT - Frequency response of systems characterized by differential equations.

Unit III	**LAPLACE TRANSFORM AND CONTINUOUS-TIME LTI SYSTEMS**	**9**		**0**

Laplace Transform - Laplace Transforms of some Common Signals - Region of Convergence -Properties of Laplace Transform- Inverse Laplace Transform - System Function - The Unilateral Laplace Transform -Solving differential equation of CT system.

Unit IV	**SAMPLING THEOREM AND Z-TRANSFORMS**	**9**		**0**

Representation of continuous time signals by its sample - Sampling theorem – Nyquist rate of sampling – Effects of under sampling (aliasing) – Sampling techniques - Data Reconstruction - Sampling of band pass signals - Z-transform - Relationship between z-transform and Fourier transform - Z-transform for discrete time signals - Region of Convergence – Properties of ROC – Properties of Z-transform - Poles and Zeros - Inverse Z-transform.

Unit V	**FOURIER ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS**	**9**		**0**

Discrete Time Fourier Series (DTFS) - Properties of CTFS – Discrete Time Fourier Transform (DTFT) – Properties of CTFT - Frequency Response of Discrete Time LTI Systems - Discrete Fourier Transform (DFT) - Realization structures – Direct form I - Direct form – II - Cascade and parallel forms.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Analyse different types of signals.
CO2	:	Represent continuous and discrete systems in time and frequency domain using different transforms.
CO3	:	Analyse and Investigate system using Laplace transform and Z transform.
CO4	:	Sampling and reconstruction of a signal.

Text Books:

1.	A.Anand Kumar, " Signals and Systems" , 3rd Edition, PHI, 2013.
2.	B.P. Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2009.

Reference Books:

1.	Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, "Signals and Systems", 2nd edition, PHI Learning Private Limited, New Delhi, 2010.
2.	Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, 1998.
3.	Hsu.H.P, Rakesh Ranjan "Signals and Systems",2nd Edition Schaum's Outlines, Tata McGraw Hill, 2010.
4.	Krishnaveni.V, Rajeswari.A, "Signals and Systems", 1st Edition, Wiley India Pvt.. Ltd, 2012.

E-References:

1.	https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-2
2.	http://nptel.ac.in/courses/117104074/
3.	https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

18EC304	NETWORK THEORY AND SYNTHESIS	L	T	P	C
		3	0	0	3

Course objectives:

1. To impart knowledge on solving circuits using network theorems.
2. To educate on obtaining the transient response of circuits and resonance in coupled circuits.
3. To impart knowledge on two port networks and network synthesis.

Unit I	NETWORK ANALYSIS TECHNIQUES AND THEOREMS	9	+	0

Mesh and Nodal Analysis - Comparison of Node and Mesh Analysis - Delta – Wye Transformation - Source Transformation and Duality - Network theorems: Superposition – Reciprocity - Thevenin's - Norton's - Maximum Power Transfer – Compensation - Substitution - Tellegen's theorem (for both DC and AC circuits).

Unit II	TRANSIENT ANALYSIS AND CIRCUIT ANALYSIS IN s – DOMAIN	9	+	0

Transient study in RL , RC, and RLC networks : Response to Step, Impulse and Sinusoidal inputs - Concept of Complex frequency: Driving points and Transfer Functions - Poles and zeros of Immittance function – Properties - Sinusoidal response from pole-zero locations - Convolution theorem.

Unit III	MAGNETIC RESONANCE CIRCUITS	9	+	0

Series and parallel resonance - Variation of impedance with frequency- Bandwidth of RLC circuit – Q factor - Impedance of RLC circuit near resonance - Selectivity – Magnification - Self-inductance – Mutual inductance - Coefficient of coupling - Dot convention - Analysis of multi-winding coupled circuits – Series and parallel connection - Ideal transformer- Tuned circuits.

Unit IV	TWO PORT NETWORKS	9	+	0

One port and Two port networks – Z parameters – Y parameters – h parameters – ABCD parameters – Symmetrical and Asymmetrical networks – Characteristic impedance.

Unit V	PASSIVE NETWORK SYNTHESIS	9	+	0

Elements of Realizability Theory: Stability-Hurwitz Polynomials - Positive Real Functions : Definition - Necessary and sufficient conditions for a function to be positive real - Elements of circuit synthesis - Foster and Cauer forms of LC Networks - Synthesis of RC and RL networks.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Analyse the electric circuit using best suited network theorem
CO2	:	Apply the knowledge of Fourier Series, Fourier Transform and Laplace Transform to analyse the circuit
CO3	:	Understand and analyse the resonance behaviour of circuit, and apply the knowledge to design bandlimited circuits according to the application.
CO4	:	Analyse the linear network parameters, and its interaction with other network and to learn elementary network synthesis process.

Text Books:

1. S.K.Bhattacharya and Manpteet Singh, "Network analysis and Synthesis", 1st edition, Pearson Publication,2015.
2. Abhijit Chakrabarthy, "Circuit Theory Analysis and Synthesis", DhanpathRai & Sons, New Delhi, 2011.

Reference Books:

1. Alexander C. and Sadiku M. N. O., — "Fundamentals of Electric Circuits ", Tata McGraw Hill, New Delhi, 2013.
2. Sudhakar A. and Shyammohan S. Pillai, — "Circuits and Networks Analysis and Synthesis", McGraw Hill, New Delhi, 2015.
3. John. D. Ryder, "Networks Lines and Fields"- PHI 2nd edition, 2003.
4. Van Valkenburg, — "Introduction to Modern Network Synthesis", New Age International Publisher, New Delhi, 2001.

E-References:

1. https://nptel.ac.in/courses/108102042/
2. https://nptel.ac.in/courses/106105154/2
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-2/

18EC305	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the various types of transmission lines and to discuss the losses.
2. To compute various parameters for loaded transmission lines using Smith chart and acquire knowledge of stub matching in Transmission Lines.
3. To impart knowledge on guided waves, rectangular and circular waveguides and waveguide resonators

Unit I TRANSMISSION LINE THEORY 9 + 0

Introduction to Different types of transmission lines – Characteristic impedance and Propagation Constant – The line of cascaded T-Sections - General Solution of the transmission line – Input and Transfer impedance-Open and Short circuited lines - Wavelength and Velocity of Propagation - Waveform distortion – Distortion less transmission line - Telephone cable – Inductance loading of telephone cables - Reflection on a line not terminated by Zo – Reflection coefficient –Reflection factor and reflection loss – T and π Section equivalent to lines.

Unit II THE LINE AT RADIO FREQUENCIES 9 + 0

Voltage and current on the dissipation less lines – Input impedance of the dissipation less line –Parameters of open wire line and co-axial line at high frequencies - Input impedance of open and short circuited line – Reflection losses - Standing waves and standing wave ratio on a line – λ/8 line – λ/4 line and impedance matching – λ/2 line- Relation between VSWR and reflection co-efficient – The Smith Chart – Applications of the Smith Chart - Solutions of problems using Smith chart – single stub matching and double stub matching.

Unit III GUIDED WAVES 9 + 0

Waves between parallel planes of perfect conductors – Transverse electric waves - transverse magnetic waves – characteristics of TE and TM Waves – Transverse Electromagnetic waves, properties of TEM wave – Velocities of propagation – Attenuation of TE and TM waves in parallel plane guides – Wave impedances.

Unit IV RECTANGULAR WAVEGUIDES 9 + 0

Transverse Magnetic waves in Rectangular wave guides – Transverse Electric Waves in Rectangular Waveguides – Characteristic of TE and TM Waves – Cutoff wavelength and phase velocity – Impossibility of TEM waves in waveguides – Dominant mode in rectangular waveguide – Attenuation of TE and TM modes in rectangular waveguides – Wave impedances – characteristic impedance – Excitation of modes.

Unit V CIRCULAR WAVE GUIDES AND RESONATORS 9 + 0

Bessel functions – Solution of field equations in cylindrical co-ordinates – TM and TE waves in circular guides – wave impedances and characteristic impedance – Dominant mode in circular waveguide – excitation of modes – Microwave cavities - Rectangular cavity resonators - circular cavity resonator.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Anlyze the propagation of signals through transmission lines.
CO2	:	Calculate reflection and transmission coefficients, standing wave ratio and power for transmission lines using HF applications.
CO3	:	Compute various parameters for loaded transmission lines using Smith chart and acquire knowledge of stub matching in Transmission Lines.
CO4	:	Determine parameters such as frequency, phase constant, velocity, attenuation and associated characteristic impedance for different types of waveguides.

Text Books:

1. J.D.Ryder “Networks, Lines and Fields”, PHI, New Delhi, 2006.
2. E.C. Jordan and K.G.Balmain “Electro Magnetic Waves and Radiating System, PHI, New Delhi, 2010.

Reference Books:

1. Umesh Sinha, “Tranmission Lines & Networks” SathyaPrakashan publication, 2002.
2. Annapurna Das and SisirK.Das, “ Microwave Engineering”, TMH, 2000.
3. David M.Pozar: ”Microwave Engineering”, 2nd Edition ,John Wiley, 2000.
4. David K.Cheng, ”Field and Waves in Electromagnetism”, Pearson Education, 1989.

E-References:

1. https://www.youtube.com/watch?v=0OwmYAljz4A&list=PL0925FD10648D664E
2. https://www.scribd.com/document/18789654/Transmission-Lines-and-Wave-Guides-Ec-1305
3. https://link.springer.com/chapter/10.1007/978-1-4615-6459-1_28

18MC301	INDIAN CONSTITUTION	L	T	P	C
(Common to all branches)		2	0	0	0

Course Objectives:

1.	learn the salient features of the Indian Constitution
2.	list the Fundamental Rights and Fundamental Duties
3.	present a systematic analysis of all dimensions of Indian Political System
4.	understand the power and functions of the Parliament, the Legislature and the Judiciary

UNIT I		**6**	**+**	**0**

Union and its Territory – Citizenship–Fundamental Rights–Directive Principles of State Policy–Fundamental Duties

UNIT II		**6**	**+**	**0**

The Union–The States–The Union Territories–The Panchayats–The Municipalities

UNIT III		**6**	**+**	**0**

The Co-operative Societies–The scheduled and Tribal Areas–Relations between the Union and the States–Finance, Property, Contracts and Suits–Trade and Commerce within the territory of India

UNIT IV		**6**	**+**	**0**

Services under the Union, the States – Tribunals – Elections– Special Provisions –Relating to certain Classes

UNIT V		**6**	**+**	**0**

Languages–Emergency Provisions – Miscellaneous–Amendment of the Constitution

Total (L+T)= 30 Periods

Course Outcomes:

On completion of the course, students will:

CO1	:	understand the emergence and evolution of the Indian Constitution
CO2	:	explain the key concepts of Indian Political System
CO3	:	describe the role of constitution in a democratic society.
CO4	:	present the structure and functions of the Central and State Governments, the Legislature and the Judiciary

Text Books:

1.	SubhashC.Kashyap, *Our Constitution*, National Book Trust, 2017
2.	Durga Das Basu, *Introduction to the Constitution of India,* Lexis Nexis, 2015.
3.	M.V.Pylee, *Constitutional History of India,* S.Chand publishing, 2010
4.	Granville Austin, *The Indian Constitution: Cornerstone of a Nation,* Oxford University Press, 1999

18EC306	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To provide an insight into the characteristics of electron devices.
2.	To design and analyse various amplifier circuits.
3.	To study the operation of rectifiers and filters.

EXPERIMENTS

1.	Characteristics of PN Junction Diode and Zener Diode.
2.	Characteristics of special diodes.
3.	Clippers and Clampers.
4.	Rectifiers with and without capacitor filter.
5.	Characteristics of CE/CB/CC configurations of Bipolar transistors.
6.	Characteristics of MOSFET.
7.	Frequency response of BJT Amplifier.
8.	Frequency response of Multi stage amplifiers.
9.	Class A power amplifier.
10.	Class B Complementary symmetry power amplifier.
11.	Design and Analysis of Series feedback amplifiers.
12.	Design and Analysis of Shunt feedback amplifiers.

Total (P)= 30 Periods

Course Outcomes:

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

CO1	:	Analyze the characteristics of diodes and transistors.
CO2	:	Design electronic circuits such as rectifiers and analyse their performance.
CO3	:	Analyze the frequency response of small signal, power and feedback amplifiers using discrete components.
CO4	:	Test electronic circuits and their performance.

References:

1.	A.S. Sedra and K.C. Smith, “Microelectronic Circuits”, 7th edition, Oxford University Press, 2015.
2.	S. Salivahanan and N. Suresh kumar, “Electronic Devices and Circuits”, 4th Edition, McGraw Hill Education, 2017.

E-References:

1.	http://nptel.ac.in/courses/117105080/40
2.	http://nptel.ac.in/courses/117108038/1
3.	http://www.electronics-tutorials.ws/

18EC307	DIGITAL SYSTEM DESIGN LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	The course intends to provide an insight into the design
2.	Implementation of combinational and sequential logic circuits.

EXPERIMENTS:

1.	Study of Logic Gates.
2.	Implementation of logic circuits using NAND gate and NOR gate.
3.	Design and construct Adders and subtractors.
4.	Design and implementation of Multiplexer and Demultiplexer using logic gates and IC74159 and IC74154.
5.	Design and construct encoder and decoder using logic gates and study of IC7445 and IC74147.
6.	Study of Flip-Flops.
7.	Construction and verification of 4 bit ripple counter and Mod- N Ripple counters.
8.	Design and implementation of 3-bit synchronous up/down counter.
9.	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
10.	Design and implementation of Hazard free circuits.
11.	Implementation of combinational logic circuits using Multiplexer and Decoder.
12.	Implementation of combinational logic functions using ROM, PLA and PAL.

Total (P)= 30 Periods

Course Outcomes:

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

CO1	:	Design and Construct combinational logic circuits.
CO2	:	Design and Construct counters and shift registers.
CO3	:	Understand the concept of Hazard and construct Hazard free Circuit.
CO4	:	Understand the concept ROM, PLA and PAL.

References:

1.	R.P. Jain, “Modern digital Electronics”, 4th Edition, Tata McGraw Hill, 2009.
2.	M. Morris Mano, “Digital Design”, 4th Edition, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2008.

E-References:

1.	https://nptel.ac.in/courses/117105080/24
2.	https://nptel.ac.in/courses/117106086/
3.	https://www.youtube.com/watch?v=CeD2L6KbtVM

SEMESTER IV					
18MA402	**PROBABILITY AND STOCHASTIC PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	To learn the axioms of Probability and use of Baye's theorem and its applications
2.	To learn the standard Probability Distribution and its Applications and two dimensional Random Variables.
3	To understand the convergence of Random sequences and the concepts of strong and weak laws of large numbers and central limits.
4.	To understand effectively about the stochastic processes and the applications of correlation, spectral densities of the Random process.

Unit I	**PROBABILTY AND ONE DIMENSIONAL RANDOM VARIBLE**	**9**	**+**	**0**

Axioms of Probability – Conditional Probability – Total Probability- Baye's theorem- Random variable- Probability mass function- Probability density function- Probability distribution function- Moments- Moment generating functions and their properties- Characteristic functions.

Unit II	**STANDARD DISTRIBUTION**	**9**	**+**	**0**

Binomial, Poisson, Geometric, Uniform, Normal Distributions and their properties- Functions of a random variable.

Unit III	**TWO DIMENSIONAL RANDOM VARIABLES**	**9**	**+**	**0**

Joint Distribution- Marginal and Conditional distributions- Markov, Chebyshev, Chernoff bounds.

Unit IV	**RANDOM PROCESSES**	**9**	**+**	**0**

Random sequences and modes of convergence (everywhere, almost everywhere, probability distribution and mean square)- Strong and Weak laws of large numbers – Central limit theorem

Unit V	**CORRELATION AND SPECTRAL DENSITIES**	**9**	**+**	**0**

Classification – Stationary process – Mean and Covariance functions- Ergodicity – Transmission of Random process through LTI- Auto correlation- Cross correlation- Properties- Power spectral density.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Learn the fundamental knowledge of the probability concepts
CO2	:	Understand and characterize phenomenon which evolve with respect to time in a probabilistic manner
CO3	:	Acquire the knowledge of Random Processes and Spectral Densities

Text Books:

1.	Veerarajan.T, "Probability, Statistics and Random process", Tata McGraw- Hill publications, second edition, New Delhi, 2002.
2.	Ross.s, "A First course in Probability", 5th Edition, Pearson Education, Delhi, 2002.

Reference Books:

1.	H.Stark and John W.Woods "Probability and Random processes with Applications to Signal processing", Pearson Education, Third Edition, Delhi 2002
2.	Peebles Jr.P.Z. "Probability Random Variables and Random Signal Principles", Tata McGraw- Hill Publishers, 4th Edition, New Delhi 2002. (Chapter 6, 7 and 8)
3.	K.L.Chung, "Introduction to Probability theory with Stochastic processes", Springer International
4.	Ochi, M. K, "Applied Probability and Stochastic process", John Wiley & sons, New York, 1990
5.	Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", Elsevier Publications, 2013

18EC401	ANTENNA AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamental principles of Antenna theory, and wave propagation with a lucid explanation of the basic concepts and equations.
2.	To understand the design and operation of various antenna types.
3.	To study the fundamental electromagnetic wave propagation in different layers of the atmosphere.

Unit I	**RADIATION FIELDS OF WIRE ANTENNAS**	**9**	**+**	**0**

Potential functions and electromagnetic field - Potential functions for sinusoidal oscillations - Fields associated with Hertzian dipole - Alternating current element - Power radiated and radiation resistance of current element - Radiation resistance of elementary dipole with linear current distribution - Current distribution on a thin wire antennas - Radiation from half-wave dipole or Effective length- Effective area.

Unit II	**ANTENNA ARRAYS**	**9**	**+**	**0**

Expression for electric field from two and three element arrays - Uniform linear array - Broadside array - Endfire array - Method of pattern multiplication - Binomial array - Use of method of images for antennas above ground - Folded dipole antenna - Yagi Uda antenna - Log periodic dipole array.

Unit III	**LOOP, HELICAL AND REFLECTOR ANTENNA**	**9**	**+**	**0**

Loop Antennas: small loop and general case - Radiation resistance of loops – Directivity of circular loop – λ/10 diameter loop – λ/π diameter loop - Helical antenna: Helical geometry – monofilar axial-mode helical antenna - Radiation from a traveling wave on a wire - Rhombic antenna: Analysis & Design of Rhombic antennas - Reflector antennas: Flat sheet reflector - Corner reflector – Paraboloidal reflector - Feed systems.

Unit IV	**APERTURE AND LENS ANTENNA**	**9**	**+**	**0**

Induction and equivalence theorems - Radiation from an elemental area of a plane wave (Huygen's Source) - Radiation from the open end of a coaxial line - Radiation from a rectangular aperture treated as an array of Huygen's sources – Slot antennas - Pattern of slot antennas in flat sheets - Babinet's principle and complementary antennas - Impedances of slot antennas - Method of feeding slot antennas - Field on the axis of an E-Plane sectoral horn - Radiation from circular aperture - Beam Width and Effective area - Dielectric lens and metal plane lens antennas - Lumeberg lens - Spherical waves and Biconical antenna.

Unit V	**WAVE PROPAGATION**	**9**	**+**	**0**

Sky wave propagation**:** Structure of the ionosphere - Effective dielectric constant of ionized region - Mechanism of refraction - Refractive index - Critical frequency - Skip distance - Effect of earth's magnetic field - Energy loss in the ionosphere due to collisions - Maximum usable frequency - Fading and Diversity reception - Space wave propagation - Reflection from ground for vertically and horizontally polarized waves - Reflection characteristics of earth - Resultant of direct and reflected ray at the receiver - Duct propagation - Ground wave propagation: Attenuation characteristics for ground wave propagation - Calculation of field strength at a distance.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the behavior of antenna and its performance parameters.
CO2	:	Design and analyze antenna arrays.
CO3	:	Design and analyze aperture and lens antennas.
CO4	:	Study radio wave propagation and its effects.

Text Books:

1.	E.C.Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", PHI, 1968, Reprint 2010.
2.	John D.Kraus and RonalatoryMarhefka, "Antennas", Tata McGraw-Hill Book Company, 2010.

Reference Books:

1.	Terman, F.E., "Radio Engineers Handbook", Tata McGraw-Hill, 1985.
2.	Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 2012.
3.	R.E.Collins, 'Antennas and Radio Propagation ", McGraw-Hill, 1987.
4.	Elliot, R.S, "Antenna theory and design", PHI, New Delhi, 1985.

E-References:

1.	https://www.youtube.com/watch?v=LF9kebBTWXo&list=PLAULbhIvfai5yvvLIm-oIb89dGNp1BtM6
2.	https://www.youtube.com/watch?v=jA8aTA1Pg4s&list=PLCcWs0lpRgKcOu8LAX7GlZLIAHgyN1oVS
3.	https://link.springer.com/chapter/10.1007/978-1-4615-6459-1_28

18EC402	ANALOG CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To give a comprehensive exposure to all types of discrete amplifiers and oscillators. To develop a strong basis for linear and digital integrated circuits.
2.	To understand the various linear and non-linear applications of op-amp.
3.	To understand the operation of the D/A & A/D converter types and its applications.

Unit I	OSCILLATORS	9	+	0

Feedback Amplifier: Block diagram - Gain with feedback - Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude - Analysis of Oscillator using Cascade connection of RC and LC filters - RC phase shift Oscillator - Wien bridge Oscillator and Twin-T Oscillators - Analysis of LC Oscillators: Colpitts – Hartley – Clapp - Miller and Pierce oscillators - Frequency range of RC Oscillators - Electrical equivalent circuit of Crystal.

Unit II	TUNED AMPLIFIERS AND MULTIVIBRATORS	9	+	0

Analysis of single tuned and synchronously tuned amplifiers - Class C tuned amplifiers and their applications - Efficiency of Class C tuned Amplifier- Collector coupled and Emitter coupled Astable Multivibrator - Monostable Multivibrator - Bistable Multivibrator - Triggering methods - Monostable and Astable Blocking Oscillators using Emitter and base timing.

Unit III	CIRCUIT FOR LINEAR IC'S	9	+	0

Current mirror: Basic topology and its variants - Differential amplifier: Basic structure and principle of operation - Calculation of differential gain - Common Mode gain, CMRR - OP-AMP design -Design of Differential amplifier - Design of gain stages and output stages – compensation - DC and AC characteristics of OP-AM - slew rate.

Unit IV	APPLICATIONS OF OPERATIONAL AMPLIFIER	9	+	0

Inverting and non-inverting amplifiers - Integrator and Differentiator - Summing amplifier - Precision rectifier - Schmitt trigger and its applications - Active filters: Low pass, high pass, band pass and band stop filters - Sine wave oscillators – Comparator - Multivibrator.

Unit V	DATA CONVERTERS AND SPECIAL FUNCTION ICs	9	+	0

Digital-to-Analog converters (DAC) : Weighted resistor - R-2R ladder - . Analog to-Digital converters (ADC): Single slope - dual slope - Successive Approximation - Flash type - IC 555 timer and its applications - IC723 Voltage regulators.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Develop feedback amplifiers.
CO2	:	Design LC and RC oscillators, tuned amplifiers, multivibrators, power amplifier.
CO3	:	Develop competence in linear and nonlinear Opamp circuit analysis.
CO4	:	Differentiate A/D and D/A converter, understand their types and analyze their applications.

Text Books:

1.	B.Visvesvara Rao, K.RajaRajeswari, P.ChalamRajuPantulu, K.Bhaskara Rama Murthy, "Electronic Circuits-II", Pearson Education,2012
2.	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2011.

Reference Books:

1.	Millman J. and Taub H., "Pulse Digital and Switching waveform", 3rd Edition, McGraw-Hill International , 2011.
2.	Sedera& Smith, "Micro Electronic Circuits", 4th Edition, Oxford University Press, Chennai.
3.	Michael Jacob, 'Applications and Design with Analog Integrated Circuits', Prentice Hall of India, 1996.
4.	K.R.Botkar, 'Integrated Circuits', 10th edition, Khanna Publishers, 2010.

E-References:

1.	http://nptel.ac.in/courses/117105080/40
2.	http://freevideolectures.com/Course/2915/Linear-Integrated-Circuits
3.	http://nptel.ac.in/courses/117108038/1

18EC403	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To develop an understanding of the operations of microprocessors and micro controllers.
2.	To understand and study the architecture, programming of microcontroller 8051.
3	Knowledge on architecture and programming concepts of 8086 Microprocessor, 8051 and PIC Microcontrollers

Unit I	**MICROPROCESSOR ARCHITECTURE**	9	+	0

8085 – Architecture - Pin outs – Functional Blocks of Processor – Memory Organization – 8086 Microprocessor Architecture – Pin Assignments – Minimum/Maximum mode configuration - Memory and I/O interfacing - Bus cycles - Timing diagram.

Unit II	**8086 PROGRAMMING AND INTERFACING**	9	+	0

8086: Instruction set - Addressing Modes – Procedure - Assembler Directives - Assembly language programming - Peripheral Interfacing using 8255 PPI - 8279 Keyboard/Display controller - 8251 USART.

Unit III	**8051 ARCHITECTURE**	9	+	0

History of microcontroller embedded version external memory devices - 8 – bit and 16 – bit microcontrollers - CISC and RISC processors: Harvard and Von–Neumann Architecture - Commercial Microcontrollers - 8051 architecture - Registers in 8051 - Pin description - 8051 parallel I/O ports - memory organization.

Unit IV	**8051 PROGRAMMING AND INTERFACING**	9	+	0

8051 Instruction Set - Programming 8051Timers - Serial Port Programming - Interrupts Programming - LCD and Keyboard Interfacing - ADC, DAC and Sensor Interfacing - External Memory Interface - RTC Interfacing - Motor Control.

Unit V	**PIC MICROCONTROLLERS**	9	+	0

PIC Microcontrollers: Overview and features - PIC 16C6X/7X – ALU, CPU registers - Pin diagram - Memory organization – Instruction Set - Addressing modes - I/O ports - Introduction to PIC F8XX Flash microcontrollers.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understands the internal architecture and organization of 8085,8086.
CO2	:	Understands the interfacing techniques to 8086 and 8051 and can develop assembly language programming to design microprocessor/ micro controller based systems.
CO3	:	Illustrate how the different peripherals (8255, 8253 etc.)are interfaced with Microprocessor.
CO4	:	Design any application specific circuit for real-time applications.

Text Books:

1.	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011.
2.	Ramesh S Gaonkar, "Microprocessor Architecture, Programming and application with 8085", 5th Edition, Penram International Publishing, New Delhi, 2011.

Reference Books:

1.	Kenneth J-Ayala, "The Microcontroller Architecture-Programming & Applications" Pearson International, 2003.
2.	Krishnakant, "Microprocessors and Microcontrollers Architecture- programming and system design 8085-8086- 8051- 8096", PHI New Delhi, 2007,
3.	Steve Furber "ARM System-on-chip-architecture ", 2nd edition, Addison Wesley 2000.
4	John Uffenbeck, "The 80x86 Family, Design, Programming and Interfacing", Third Edition, Pearson Education, 2002.

E-References:

1.	http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html
2.	http://www.vssut.ac.in/lecture_notes/lecture1423813120.pdf
3.	https://onlinecourses.nptel.ac.in/noc19_ee11/preview

18EC404	ANALOG OMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce the concepts of various analog modulation and demodulation techniques.
2.	To understand the sources of noise and its effects in Communication systems and to analyse the performance of receiver in the presence of noise
3.	To study the limits set by Information Theory.

Unit I	AMPLITUDE MODULATION	9	+	0

Generation and demodulation of AM, DSB-SC, SSB-SC - VSB signals - Filtering of sidebands - Comparison of amplitude modulation systems - Frequency translation - Frequency division multiplexing - AM Superhetrodyne receiver.

Unit II	ANGLE MODULATION	9	+	0

Angle modulation: Phase and Frequency modulation - Narrowband and Wideband FM - Transmission bandwidth of FM signals - Generation of FM signal – Direct FM – Indirect FM - Demodulation of FM signals - FM stereo multiplexing - PLL – Nonlinear model and linear model of PLL - FM Superhetrodyne receiver.

Unit III	NOISE PERFORMANCE OF DSB, SSB RECEIVERS	9	+	0

Noise : Shot Noise - Thermal Noise - White Noise - Noise Equivalent Bandwidth - Noise temperature - Noise figure - Narrowband Noise - Representation of Narrowband Noise in terms of envelope and phase components - Sine wave Plus Narrowband Noise - Receiver Mode -, Noise in DSB-SC Receiver - Noise in SSB Receiver.

Unit IV	NOISE PERFORMANCE OF AM AND FM RECEIVERS	9	+	0

Noise in AM receivers : Threshold effect - Noise in FM receivers: Capture effect - FM threshold effect - FM threshold reduction - Pre-emphasis and De-emphasis in FM - Comparison of performance of AM and FM.

Unit V	INFORMATION THEORY	9	+	0

Uncertainty - Information and entropy - Rate of information - Joint Entropy and Conditional Entropy - Mutual information - Discrete memory less channel - Channel Capacity - Shannon's Theorem - Continuous Channel - Shannon - Hartley Theorem - BW and S/N Trade-off - Huffman and Shannon - Fano codes.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will have:

CO1	:	Knowledge on designing AM and FM communication systems
CO2	:	The exposure to the sources of noise and its effects in Communication systems
CO3	:	Ability to analyze the performance of receiver in the presence of noise
CO4	:	Ability to measure the capacity of a channel

Text Books:

1.	Simon Haykin, "Communication Systems", 5th Edition , International Student Version, John Wiley & sons, NY, 2010.
2.	R.P. Singh &S.D.Spare, "Communication Systems, Analog & Digital", Tata McGraw Hill, 1995.

Reference Books:

1.	Taub and Schilling, "Principles of communication systems", TMH, New Delhi, 2008
2.	Roddy and Coolen, "Electronic communication", 4th Edition , PHI, New Delhi, 2003.
3.	Bruce Carlson.A, Paul B.Crilly, "Communication systems", 5th Edition ,McGraw-Hill Int. , 2009.
4.	Anokhsingh, "Principles of Communication Engineering", S. Chand & Company Ltd. 2006.

E-References:

1.	https://www.telecommunications-tutorials.com/
2.	http://www.nptelvideos.in/2012/11/communication-engineering.html
3.	https://www.tutorialspoint.com/analog_communication/analog_communication_introduction.htm

18EC405	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requiste:

1.	Laplace Transform, Partial Differential Equation

Course Objectives:

1.	To introduce the elements of control system and various modelling techniques.
2.	To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3.	To introduce the state variable analysis method.

Unit I	**CONTROL SYSTEM MODELING**	**9**	**+**	**0**

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

Unit II	**TIME RESPONSE ANALYSIS**	**9**	**+**	**0**

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

Unit III	**FREQUENCY RESPONSE ANALYSIS**	**9**	**+**	**0**

Frequency Response - Bode Plot - Polar Plot - Nyquist Plot - Frequency Domain specifications from the plots - Series, Parallel and series-parallel Compensators - Lead, Lag and Lead Lag Compensators, Analysis using Simulation tool.

Unit IV	**STABILITY ANALYSIS**	**9**	**+**	**0**

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

Unit V	**STATE VARIABLE ANALYSIS**	**9**	**+**	**0**

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Model the mechanical and electrical systems.
CO2	:	Perform time domain and frequency domain analysis of control systems for stability analysis.
CO3	:	Design the compensation technique to stabilize control systems.
CO4	:	Perform state variable analysis for continuous time system

Text Books:

1.	Nagrath and Gopal, “Control System Engineering”, 6th Edition, New Age International Edition, 2018.
2.	A.Anand Kumar, “Control Systems”, Prentice Hall of India, 2012

Reference Books:

1.	Benjamin.C.Kuo, Automatic Control Systems, 7th Edition, PHI, 2009.
2.	Schaum"s Outline Series, “Feed back and Control Systems”, Tata McGraw-Hill, 2007
3.	M.Gopal, “Control System – Principles and Design”, 2nd Edition Tata McGraw Hill, 2002

E-References:

1.	https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x
2.	https://onlinecourses.nptel.ac.in/noc17_ee12

18EC406	ANALOG CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To understand the analysis and design of LC and RC oscillators, amplifiers and multivibrators.
2	To Apply Operational Amplifiers in Linear And Nonlinear Applications.
3	To use simulation tools for circuit design.

EXPERIMENTS

1.	Design of RC Phase shift oscillator and Wein Bridge Oscillator .
2.	Design of Hartley and ColpittsOscillator .
3.	Design of Tuned Class C Amplifier.
4.	Design of Astable, Monostable and Bistable multivibrators using BJT.
5.	Simulation of Astable, Monostable and Bistable multivibrators.
6.	Design of basic Circuits using Op-amp 741.
7.	Active Low pass, High pass and Band pass filter.
8.	Astable, Monostable multivibrators using Op-Amp.
9.	Schmitt Trigger using op-amp.
10.	Phase shift and Wien bridge oscillator using op-amp.
11.	Astable and Monostable multivibrators using NE555 Timer.
12.	High voltage regulator using LM723.

Total (P)= 30 Periods

Course Outcomes:

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

CO1	:	Design oscillators, multivibrators and power amplifiers for the variety of engineering applications.
CO2	:	Design Filters Using Opamp and Perform Experiment on Frequency Response.
CO3	:	Design and simulate multivibrators using Simulation Tool.
CO4	:	Design analog circuits and test their performance

References:

1.	*Analog Electronic circuits Laboratory Manual*. 2. David A. Bell, "*Electronic* Devices and *Circuits*", 5thEdition, Oxford University Press,
2.	B.Sasikala, S.Poornachandra Rao, "Handbook of experiments in Electronics and Communication Engineering", Vikas Publishing, 2007.

E-References:

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2.	http://www.gopalancolleges.com/gcem/course-material/ece/manuals/sem-lll/analog-electronics-laboratory-manual-10ESL37.pdf
3	https://www.slideshare.net/vampec/ec-ii-lab-manual

18EC407	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
2.	To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
3.	To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

EXPERIMENTS

8085/8086 Programs

1.	8/16 bit Arithmetic operations
2.	Sorting and Searching
3.	String manipulation operations (Using 8086).
4.	Interfacing and Programming of Stepper Motor and DC Motor control.
5.	Interfacing and Programming 8259 and 8253.
6.	Serial Communication between two MP Kits using 8251.
7.	Parallel Communication between two MP Kits using 8255.
8.	Programs for Digital clock and Stop watch (Using 8086).

8051 Programs

9.	Programs for 8-bit Arithmetic operations (Using 8051).
10.	Programs for logical and bit manipulation operations (Using 8051).
11.	Programs for Sum of Elements in an Array operation (Using 8051).
12.	Interfacing – DAC /ADC and 8051.

Total (P)= 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
CO2	:	Gain Knowledge to Interface different I/Os with processor
CO3	:	Generate waveforms using Microprocessors
CO4	:	Develop assembly language programs for various applications using 8051 microcontroller

References:

1.	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
2.	Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 5th Edition, Penram International Publishing, New Delhi, 2011.

E-References:

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2.	https://www.bitswgl.ac.in/ece/B.Tech%20Lab%20manuals/MPID%20MANUAL_%20IV-I%20sem%20EEE.pdf
3	https://studylib.net/doc/10152660/microprocessor-and-microcontroller-lab-manual

18EC502	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

Pre-Requisite:

1. Digital Electronics

Course Objectives:

1. To understand the evolution of computer architecture and the factors influencing the design of hardware and software components.
2. To understand various computer arithmetic algorithms.
3. To gain the knowledge on various functional blocks in computers along with their peripherals.

Unit I STRUCTURE OF COMPUTERS 9 + 0

Functional units - Basic Operational Concepts - Bus Structures – Software - Performance – Multiprocessors and Multicomputer – Memory addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Basic I/O operations – stacks and queues.

Unit II COMPUTER ARITHMETIC 9 + 0

Addition and subtraction of signed numbers - Design of fast adders - multiplication of positive numbers - signed operand multiplication, Booth algorithm - Fast multiplication - Bit pair recoding of the multiplier - Carry save addition - Integer division - Floating point numbers - Arithmetic operations on floating point numbers - Guard bits and truncation.

Unit III PROCESSING UNITS 9 + 0

Fundamental concepts – Execution of a complete Instruction – Multiple bus organization – Hardwired control – Micro programmed control - Pipelining – Basic concepts – Data hazards – Instruction hazards – Influence on Instruction sets – Data path and control consideration – Superscalar operation – Performance considerations.

Unit IV MEMORY SYSTEM 9 + 0

Basic concepts – semiconductor RAMs, ROMs – Speed, size and cost – Cache memories - Performance consideration – Virtual memory- Memory Management requirements – Secondary storage - CD-ROM - DVD_ROM - DVD drive - Hard drive,

Unit V I/O SYSTEM 9 + 0

Accessing I/O devices – Interrupts – Direct Memory Access, - Bus arbitration – Buses: Synchronous bus - Asynchronous bus – Interface Circuits: Serial port - Parallel port – Standard I/O Interfaces: PCI, SCSI, and USB.

Total (L+T)= 45 periods

Course Outcomes:

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

CO1	:	Understand the design of hardware and software components in computer architecture.
CO2	:	Illustrate the fixed point and floating-point arithmetic for ALU operation.
CO3	:	Discuss about implementation schemes of control unit and pipeline performance
CO4	:	Explain the concept of various memories and Input / Output organization.

Text Books:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization” 5th Ed, McGraw Hill, 2001.
2. Andrew S.Tanenbaum, Todd Austin, “Structured Computer Organization” , 6th Edition, Pearson, 2013.

Reference Books:

1. William Stallings, “Computer Organization and Architecture – Designing for Performance”, 10th Edition, Pearson, 2016.
2. David A. Patterson and John L.Hennessy, “Computer Organization and Design, the hardware / software interface”, 5th edition, Morgan Kaufmann, Elsevier, 2014.
3. Caxton C. Foster, “Computer Architecture”, 6th Edition, Van Nostrand Reinhold Company.
4. M.Morris Mano, “Computer System Architecture”, 3rd s Edition, Pearson, 2007.

E-References:

1. http://nptel.ac.in/courses/106102062/

SEMESTER V					
18EC501	**DIGITAL COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	Understand the building blocks of digital communication system and to prepare mathematical background for communication signal analysis .
2.	Express pass-band data transmission and comparison of Digital modulation systems.
3.	Analyze the error performance of a digital communication system in the presence of noise and other interferences.Understand the concept of spread spectrum communication system.

Unit I	**DETECTION AND ESTIMATION AND PULSE MODULATION**	**9**	**+**	**0**

Model of Digital Communication System - Gram-Schmidt orthogonalization procedure – Geometric interpretation of signals - Detection: Maximum-likelihood detector - Probability of error - Correlation receiver - Matched filter receiver – Sampling process – PAM - Other forms of pulse modulation –TDM - Waveform coding techniques: PCM- Noise considerations in PCM Systems - Quantization noise and SNR – DPCM - Delta modulation – Adaptive Delta Modulation.

Unit II	**BASEBAND TRANSMISSION OF DIGITAL SIGNALS**	**9**	**+**	**0**

Discrete PAM signals - Power Spectra of Discrete PAM signals – Inter Symbol Interference - Nyquist's criterion for Distortion less Base band Binary Transmission - Correlative level coding - Duo binary and modified duo binary signalling – Eye patterns – Baseband M-ary PAM Systems – Adaptive Equalization for data transmission.

Unit III	**PASSBAND TRANSMISSION OF DIGITAL SIGNALS**	**9**	**+**	**0**

Digital Modulation Formats - Pass band Transmission model - Coherent Binary Modulation Techniques: Generation – Detection - Signal space diagram - Bit error probability - Power spectra and waveforms of BPSK, BFSK, QPSK and MSK schemes – Differential phase shift keying – Comparison of Digital modulation systems using a single carrier – Introduction to M-ary Modulation techniques - Synchronization: Carrier and symbol synchronization.

Unit IV	**ERROR CONTROL CODING**	**9**	**+**	**0**

Rationale for coding and types of codes - Discrete memory less channels – Linear block codes - Cyclic codes - Cyclic redundancy check codes - Convolutional codes – Maximum likelihood decoding of convolutional codes- Viterbi Algorithm - Trellis coded Modulation - Turbo codes - Maximum length and Gold codes.

Unit V	**SPREAD SPECTRUM MODULATION**	**9**	**+**	**0**

Pseudo-Noise sequences – A notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying – Signal space Dimensionality and processing gain –Probability of error – Frequency Hop Spread Spectrum (FHSS).

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	*:*	Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO2	*:*	Perform the time and frequency domain analysis of the signals in a digital communication system and error free communication.
CO3	*:*	Select the blocks in a design of digital communication system.
CO4	*:*	Analyze Performance of spread spectrum communication system.

Text Books:

1.	Simon Haykins, "Communication Systems" John Wiley, 5th Edition, 2016.
2.	Simon Haykins, "Digital Communication systems" John Wiley, 2014.

Reference Books:

1.	Taub& Schilling, "Principles of Digital Communication", 28th reprint , Tata McGraw-Hill, 2014.
2.	R.N.Mutagi,"Digital Communication", 2nd Edition, Oxford University Press, 2013
3.	Dennis Roddy, John Coolen,"Electronic Communications", 10th impression, Pearson Prentice Hall, 2013.
4.	John G.Proakis, "Digital Communication", 3rd Edition, Tata McGraw-Hill, 1995.

E-References:

1.	http://www.nptelvideos.in/2012/11/communication-engineering.html
2.	https://www.tutorialspoint.com/analog_communication/analog_communication_introduction.htm
3.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-973-communication-system-design-spring-2006/lecture-notes/
4.	http://nptel.ac.in/courses/106102062/37 - https://youtu.be/4TzMyXmzL8M

18EC503	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Prerequisite:

1. Signals and Systems

Course Objectives:

1. To analyse the Discrete Fourier Transform, Fast Fourier Transform algorithms.
2. To design and realize IIR, FIR filters and to understand finite word length effects on digital filters.
3. Gain knowledge of DSP architecture, Programming and concepts of Multirate signal processing.

Unit I	DISCRETE FOURIER TRANSFORM	9	+	0

Discrete systems attributes - Analysis of LTI systems - Frequency Analysis - Introduction to DFT – Properties of DFT - Crcular convolution - FFT algorithms – Radix-2 FFT algorithms – Decimation in Time and Decimation in Frequency algorithms.

Unit II	INFINITE IMPULSE RESPONSE FILTER DESIGN	9	+	0

Characteristics of Analog Butterworth filter - Chebyshev filter - Low pass filter, High pass filter, Band pass filter and Band stop filter - Transformation of analog filters in to equivalent digital filters using bilinear transformation method - Realization structure for IIR filters-Direct form - Cascade form - Parallel form.

Unit III	FINITE IMPULSE RESPONSE FILTER DESIGN	9	+	0

Linear phase response of FIR filter - FIR design using window method: Rectangular, Hamming, Hanning and Blackmann Windows - Park-McClellan's method - Realization structures for FIR filters - Linear phase structures and Direct form structure - Comparison of FIR and IIR filters.

Unit IV	FINITE WORD LENGTH EFFECTS	9	+	0

Representation of numbers - Quantization by truncation and rounding – Derivation for quantization noise power – co-efficient quantization error – Product quantization error – Round off noise power - Limit cycle oscillations due to product round off and overflow errors - scaling to prevent overflow.

Unit V	DSP APPLICATIONS AND DIGITAL SIGNAL PROCESSOR	9	+	0

Introduction to Multi Rate signal processing: Decimation, Interpolation - Introduction to DSP TMS320C54X processor: Architecture - Instruction set - Addressing modes.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Analyse the need for Discrete Fourier Transform, Fast Fourier Transform algorithms in digital signals & systems.
CO2	:	Design and realize IIR, FIR filters and characterize finite Word length effect on filters.
CO3	:	Gain the knowledge on DSP architecture and programming
CO4	:	Apply the concepts of Multirate signal processing in real time applications.

Text Books:

1. S.K. Mitra, “Digital Signal Processing, A Computer Based approach”, 4th Edition, McGraw-Hill, 2010.
2. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, 4th Edition, Pearson Education, 2009.

Reference Books:

- Emmanuel C. Ifeacher, Barry W. Jervis, “Digital Signal Processing: A Practical Approach”, 2nd Edition, Pearson Education, 2004.
- A.V.Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, 3rd Edition Prentice Hall,
- L.R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.
- 5. J.R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.

E-References:

1. https://www.coursera.org/learn/dsp
2. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3. www.nptelvideos.in/2012/12/digital-signal-processing.html

18EC504	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce the basic concept in modern data communication and computer networking.
2.	To have the knowledge about the functions of different layers and the protocols used in various layers.
3.	To familiarize the concept of congestion in networks and QOS parameters.

UNIT I	DATA COMMUNICATIONS AND NETWORK MODELS	9	+	0

Components – Networks – Components and Categories – Topologies – Protocols and Standards – The OSI model – Addressing - Transmission Media – Guided media & unguided media - Dial-up Modems - EIA 232 Interfacing sequence - Switching: Circuit switched networks - Packet switching: Datagram Networks - Virtual Circuit Networks.

UNIT II	DATA LINK LAYER	9	+	0

Error detection and correction : Block coding - Linear block coding - Cyclic codes – Checksum – Framing - Flow Control and Error control - Noiseless channel - Noisy channel– HDLC - Wired LANs: Ethernet IEEE 802.3, IEEE 802.4 and IEEE 802.5 – Wireless LANs: IEEE 802.11 – Connecting devices - SONET.

UNIT III	NETWORK LAYER `	9	+	0

IPv4 Addresses: Address space - Notations - Classful addressing - Classeless addressing - NAT- Internetworking – Ipv4: datagram – Fragmentation – Checksum - IPv6 - Unicast routing protocol: Distance Vector Routing – Link State Routing – Multicast Routing.

UNIT IV	TRANSPORT LAYER	9	+	0

Multiplexing – De multiplexing – Connectionless versus connection – Oriented service, Reliable versus Unreliable– User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control and Quality of services (QoS) – Integrated Services

UNIT V	APPLICATION LAYER	9	+	0

Domain Name Space (DNS) – Electronic mail- File Transfer Protocol - Hyper Text Transfer Protocol - World Wide Web – Security: Principles of Cryptography – Network security: Message Integrity,Message Authentication – Security in Internet: PGP, Firewalls.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Classify the available networks and the media used in the networking based on the standards.
CO2	:	Design an error free and controlled data communication.
CO3	:	Find the efficient route between source and destination
CO4	:	Analyzethe quality service of the networks and Create a secured communication.

Text Books:

1.	Behrouz A. Foruzan, “Data communication and Networking”, 4th edition, TMH, 2013.
2.	James. F. Kurouse& W. Rouse, “Computer Networking: A Top down Approach Featuring”, TMH, 2012.

Reference Books:

1.	Larry L.Peterson& Peter S. Davie, “Computer Networks”, 2nd Edition, Harcourt Asia Pvt. Ltd., 2011.
2.	Andrew S. Tanenbaum, “Computer Networks”, 4th edition, PHI, 2010.
3.	William Stallings, “Data and Computer Communication”, 8th Edition, Pearson Education, 2014.
4.	Ajit Pal, “Data Communication and Computer Networks”, PHI, 2013.

E-References:

1.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-829-computer-networks-fall-2002/lecture-notes/
2.	http://nptel.ac.in/courses/106105081/1
3.	https://nptel.ac.in/courses/106105183/

18EC505	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:	
1.	To make the students to understand the basics of analog and digital modulation techniques
2.	To deal with the different pulse modulation schemes.
3.	To simulate different modulation scheme using suitable tool.
EXPERIMENTS:	
1.	Generation and detection of AM signal
2.	Generation and detection of FM signal
3.	Pulse Amplitude Modulation
4.	Pulse Width Modulation
5.	Pulse Position Modulation
6.	Sampling and reconstruction of signals
7.	Digital Modulation Techniques: ASK,PSK,FSK,QPSK
8.	Delta and Adaptive Delta modulation
9.	Pulse Code Modulation
10.	Time Division Multiplexing and De multiplexing
11.	Measurement of frequency components of various waveforms using Spectrum Analyzer.
12	Simulation and performance analysis of analog and digital modulation techniques .
	Total (P)= 30 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to :		
CO1	:	Generate and analyse analog and digital l modulated signals.
CO2	:	Sample the given analog signal for various sampling frequency.
CO3	:	Generate various signals and analyse the frequency components using spectrum analyser.
CO4	:	Write codes for various analog and digital modulation schemes.

References :	
1.	S.Poorna Chandra, B.Sasikala, “Electronics Laboratory Primer”, S.Chand& Company Ltd, 2010.
2.	L.K. Maheshwari, M.M.S. Anand, “Laboratory Manual for Introductory Electronics Experiments”, New age International (P) Limited Publishers, 2010.
3.	Simon Haykin S., "Digital Communications Systems", 3rd Edition, John Wiley and Sons, 2013.
E-References:	
1.	https://umairbfrend.files.wordpress.com/2015/01/analogue-digital-communication-manual_august-2015.pdf
2.	Spread Spectrum Analyzer: https://youtu.be/ABnqkyrQcUs , https://youtu.be/2jeBSCa2deA
3.	www.vlab.co.in/ba-nptel-labs-electronics-and-communications

18EC506	DIGITAL SIGNAL PROCESSING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

1.	To implement FFT algorithms, Linear/Circular convolution using software tool.
2.	To design IIR and FIR filters
3.	To implement the DSP algorithms using TMS320C54X

EXPERIMENTS:

USING SOFTWARE TOOL:

1.	Generation of Signals
2.	Discrete time convolution
3.	Circular convolution of two sequences
4.	Sampling and effect of aliasing
5.	Spectrum analysis using Discrete Fourier Transform
6.	Calculation of FFT of a signal using a)Decimation in time algorithm b)Decimation in frequency algorithm
7.	Design of FIR filters using a) Windowing technique b) Frequency sampling method
8.	Design of IIR digital filter using a)Bilinear transformation b)Impulse invariant method
9.	Verification of BIBO stability of a system.

USING TMS320C54X

1.	Study of various addressing modes of DSP using simple programming examples and generation of sine waveform.
2.	Sampling of input signal and display
3	Implementation of FIR filter
4.	Calculation of FFT

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Generate andanalyze various signal processing algorithms.
CO2	:	Implement FFT algorithms, Linear/Circular convolution.
CO3	:	Design IIR and FIR filters.
CO4	:	Implement DSP algorithms using TMS320C54X processor.

References:

1.	Digital Signal Processing Using MATLAB,Vinay K. Ingle John G. Proakis,Centage learning, 3rd Edition ,2012
2.	Sanjit K. Mitra, "Digital Signal Processing", 3rd Edition, McGraw Hill Higher Education, 2007.

E-References:

1.	https://nptel.ac.in/courses/117102060/
2.	studentsfocus.com/notes/anna_university/ECE/5SEM/EC6511%20-%20DSP%20Lab/EC%206511%20DIGITAL%20SIGNAL%20PROCESSING%20LAB%20MANUAL_2013_regulation.pdf
3.	*vlab.co.in/ba_nptel_labs.php?id=1*

SEMESTER VI					
18EC601	**VLSI DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite:

1. Digital Electronics

Course Objectives:

1. To understand the concepts of MOS transistors operations and their AC, DC characteristics.
2. To understand the fabrication process of CMOS technology and its layout design rules.
3. To Design Data path systems and Subsystems using Verilog HDL and Learn FPGA architectures.

Unit I	**MOS TRANSISTOR THEORY**	**9**	**+**	**0**

NMOS, PMOS Enhancement transistor - Threshold voltage - Body effect – MOS device DC Equation: Basic DC equations - Channel length modulation - Mobility variation - MOS models - Small signal AC characteristics - Complementary CMOS inverter: DC characteristics - Noise Margin - Rise time - Fall time - Power dissipation - Transmission gate – Stick diagram – Layout diagram.

Unit II	**CMOS TECHNOLOGY**	**9**	**+**	**0**

An overview of Silicon semiconductor technology - Basic CMOS technology: n-well - P well - Twin tub and SOI Process – CMOS process enhancements: Interconnects - Circuit elements: Resistors – Capacitors - Electrically Alterable ROMs - Bipolar transistors - Latch up and its prevention techniques.

Unit III	**DATA PATH SYSTEMS AND ARRAY OF SUBSYSTEMS**	**9**	**+**	**0**

Datapath Subsystems: Addition/Subtraction - One/Zero Detectors – Comparators – Counters - Multiplication - Array Subsystems: SRAM – DRAM - Read-Only Memory.

Unit IV	**VERILOG HARDWARE DESCRIPTION LANGUAGE**	**9**	**+**	**0**

Basic Concepts: VLSI Design flow - Modules and ports - Switch level modelling - Gate level modelling - Data flow modelling – Behavioral modelling - Structural gate level description of decoder - Equality detector – Comparator - Priority encoder - D-flip flop - Half adder - Full adder - Ripple Carry Adder.

Unit V	**CMOS CHIP DESIGN**	**9**	**+**	**0**

ASIC design flow - CMOS chip design options: Full custom ASIC - Standard Cell based ASIC - Gate Array based ASIC - Channelled - Channel less and structured GA - Programmable logic structures; Programming of PALs - Programmable Interconnect - Reprogrammable GA - Need for CMOS testing.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Use analytical methods and circuit analysis models in analysis of CMOS circuits.
CO2	:	Understand the CMOS process technology and design layout diagrams.
CO3	:	Able to learn and design data path systems.
CO4	:	Model the digital system using Verilog Hardware Description Language and learn FPGA architectures.

Text Books:

1. Neil H. E. Weste & David Money Harris, "CMOS VLSI Design Circuits and System perspective ", 2nd Edition, Pearson Education, 2016
2. Samir Palnitkar: "Verilog HDL" A Guide to Digital Design and Synthesis", 2nd Edition, Pearson Education, 2012.

Reference Books:

1. Douglas.A.Puchnell, Kamran Eshraghian, "'Basics VLSI Design and Circuits", 3rd Edition, Prentice Hall India 2011.
2. M.J.S .Smith, "Application - Specific Integrated Circuits", Pearson Education, 2009.
3. V.G.Kirankumar, H.R.Nagesh, "Introduction to VLSI Design", Pearson Education,2011
4. Wayne Wolf, " Modern VLSI Design", Pearson Education, 2003.

E-References:

1. https://freevideolectures.com/Subject/VLSI-and-ASIC-Design
2. https://www.tutorialspoint.com/vlsi_design/vlsi_design_useful_resources.html
3. https://nptel.ac.in/courses/117101058/

18EC602	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite:

1.	Microcontrollers

Course Objectives:

1.	To impart knowledge on embedded system architecture and embedded development Strategies
2.	To understand the bus Communication in processors and peripheral interfacing
3.	To understand basics of Real Time Operating System

Unit I	**INTRODUCTION TO EMBEDDED SYSTEMS**	**9**	**+**	**0**

Introduction to Embedded Systems –Structural units in Embedded processor - Selection of processor and memory devices - DMA – Memory management methods - Timer and Counting devices - Watchdog Timer - Real Time Clock - In circuit emulato - Target Hardware Debugging.

Unit II	**EMBEDDED NETWORKING**	**9**	**+**	**0**

Embedded Networking: Introduction - I/O Device Ports and Buses – Serial Bus communication protocols: RS232 standard – RS422 – RS 485 - CAN Bus - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –Need for device drivers.

Unit III	**EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT**	**9**	**+**	**0**

Embedded Product Development Life Cycle – Objectives - Different phases of EDLC - Modelling of EDLC - Issues in Hardware -Software Co-design - Data Flow Graph - State Machine Model - Sequential Program Model - Concurrent Model - Object Oriented Model.

Unit IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9**	**+**	**0**

Introduction to basic concepts of RTOS: Task - Process and Threads - Interrupt routines in RTOS - Multiprocessing and Multitasking - Preemptive and non-preemptive scheduling - Task communication shared memory - Message passing - Inter process Communication – Synchronization between processes - Semaphores, Mailbox – Pipes - Priority inversion - Priority inheritance.

Unit V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**9**	**+**	**0**

RFID Systems - GPS Navigation System - Automotive Application - Smart card System Application - ATM machine – Digital camera.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Ability to understand and analyze Embedded systems
CO2	:	Ability to study about the bus Communication and Peripheral interfacing
CO3	:	Ability to acquire knowledge on Real time operating system
CO4	:	Design and Analyze the real-time applications of embedded-systems

Text Books:

1.	Peckol, “Embedded system Design”, John Wiley & Sons,2010
2.	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013

Reference Books:

1.	Shibu. K.V, “Introduction to Embedded Systems”, nd Edition, Mcgraw Hill, 2017.
2.	Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, McGraw Hill, 2013
3.	Tammy Noergaard, “Embedded Systems Architecture” , Newnes an Imprint of Elsevier, Massachusetts, 2006.
4.	Rajib Mall, “Real-Time systems Theory and Practice” , Pearson Education, 2007.

E-References:

1.	https://lecturenotes.in/subject/225/embedded-system-es
2.	https://nptel.ac.in/courses/108102045/19
3.	https://www.coursera.org/learn/introduction-embedded-systems

18EC603	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:	
1.	To learn Hardware Description Language.
2.	To explore the design aspects of various combination circuits and sequential circuits.
3.	To familiarize implementation of logical modules on FPGA.
4.	To practically train the programming concepts using Verilog HDL and implement in FPGA.
Experiments	
Design and simulation using Verilog HDL	
1.	Multiplexer and Demultiplexer.
2.	Encoder and Decoder.
3.	Ripple carry adder and Serial Binary Adder.
4.	Look Ahead Adder.
5.	4-bit binary counters and BCD counters.
6.	Code converters.
7.	Traffic light controller.
8.	Pipelined parallel adder to add 8 number of size 12 bits each in 2's complement.
9.	8 bit signed multiplication algorithm.
10.	Study of FPGA board
11.	Implementation of ALU/MAC unit in FPGA.
12.	Implementation of Flip-Flops in FPGA.
	Total (P)= 30 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	**:**	To demonstrate a clear understanding in VeriLog HDL.
CO2	**:**	Model a combinational circuit using Verilog HDL.
CO3	**:**	Model sequential circuit using Verilog HDL.
CO4	**:**	Import the logic modules into FPGA boards.

References :	
1.	Samir Palnitkar: “Verilog HDL” A Guide to Digital Design and Synthesis Second Edition , 2nd Edition, Pearson Education , 2012.
2.	J.Bhaskar, “ Verilog HDL Primer” 2nd Edition, 2004.
E-References:	
1.	https://www.tutorialspoint.com/vlsi_design/vlsi_design_verilog_introduction.htm

18EN501	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives: To enable the students to:

1.	Communicate effectively with interviewers
2.	Express opinions, illustrate with examples, elucidate and conclude in group discussions
3.	Write error free letters and prepare reports
4.	Speak fluently and avoid pitfalls in pronunciation and grammatical errors

EXPERIMENTS

WRITING SKILLS		**15 Hours**
1	Letter seeking permission to go on industrial visit	
2	Letter of invitation	
3	Resume and Cover Letter	
4	Report Writing – Progress in project work	
SPEAKING SKILLS		**15 Hours**
13.	Welcome Address and Vote of Thanks	
14.	Analysing and presenting business articles	
15.	Power Point Presentation	
16.	Group Discussion	
SOFT SKILLS		**15 Hours**
1	Psychometric profile	
2	Self-Introduction	
3	Interview skills	
4	Conducting a board meeting	
VERBAL ABILITIES		**15 Hours**
1	Error Spotting	
2	Listening Comprehension	
3	Rearranging Jumbled sentences	
4	Vocabulary	
LAB RECORD		
1	Group Discussion - Literature survey	
2	Group Discussion - Transcripts	
3	Group Discussion - Assessment forms	
4	Interview Skills – Psychometric profile	
5	Interview Skills – Self-introduction	
6	Interview Skills – Resume and Cover Letter	
7	Interview Skills – Transcription of interview	
8	Interview Skills – Assessment sheet signed by interview panel	
9	Power Point Presentation	
10	Error spotting worksheet	
11	Jumbled sentences worksheet	
12	Welcome Address	
13	Vote of Thanks	
14	Letter seeking permission to go on industrial visit	
15	Report Writing – Progress in project work	
16	Presentation of business articles - Transcription	

Total (P)= 60 Periods

Course Outcomes:

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

CO1	:	Write error free letters and prepare reports
CO2	:	Deliver welcome address and vote of thanks
CO3	:	Speak coherently with proper pronunciation and accent
CO4	:	Avoid common Indianisms and grammatical errors
CO5	:	Improve repertoire of passive vocabulary
CO6	:	Answer questions posed by interviewers confidently
CO7	:	Participate in group discussion effectively
CO8	:	Undertake online psychometric and IQ test to understand their strengths and weaknesses

Reference Books:

1. Anderson, P.V, Technical Communication, Thomason Wadsworth, Sixth Edition, New Delhi, 2007.

2.	Prakash, P, Verbal and Non-Verbal Reasoning, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3.	John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
4.	Evans, D, Decision maker, Cambridge University Press, 1997.
5.	Thorpe, E, and Thorpe, S, Objective English, Pearson Education, Second Edition, New Delhi, 2007.
6.	Turton, N.D and Heaton, J.B, Dictionary of Common Errors, AddisionWesley Longman Ltd., Indian reprint 1998.
7.	Ready,Steaady, Go. Deepak Mehra, Jaico Publishing House, Delhi,2015
8.	Business English Certificate Materials, Cambridge University Press
E- **Reference**	
1.	http://www.seemypersonality.com (Personality Test and IQ Test).
2.	http://www.humanmetrics.com/cgi-win/jtypes2.asp

SEMESTER VII					
18EC701	**OPTICAL AND MICROWAVE ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	To understand and gain knowledge about various microwave components.
2.	To study the microwave generation and amplification using microwave tubes and solid state devices and to understand the concepts of strip lines and MMIC.
3.	To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.

Unit I	**MICROWAVE COMPONENTS**	**9**	**+**	**0**

Hybrid Circuits - Waveguide Tees - Magic Tees (Hybrid Tees) - Hybrid Rings (Rat-Race Circuits) -Waveguide Corners - Bends and Twists - Directional Couplers - Two-Hole Directional Couplers - Review of low frequency parameters: Z,Y and ABCD Parameters - Introduction to S parameters - S Matrix of a Directional Coupler - Hybrid Couplers - Circulators and Isolators.

Unit II	**SOLID STATE MICROWAVE DEVICES**	**9**	**+**	**0**

Introduction- Gunn_Effect Diodes - GaAs Diode - Ridely-Watkins - Hilsun (RWH) Theory - Modes of Operation - Microwave Generation and Amplification - Avalanche transit - Time devices – Introduction - Read Diode - IMPATT Diodes - TRAPATT Diodes -BARITT Diodes - Parametric Devices.

Unit III	**MICROWAVE TUBES**	**9**	**+**	**0**

Klystrons - Two cavity Klystron Amplifiers - Reflex Klystrons - Velocity Modulation - Power Output and Efficiency - Electronic Admittance - Helix Traveling - Wave Tubes (TWTs) - Slow-Wave structures - Amplification Process - Convection Current - Axial Electric Field - Wave Modes - Gain Consideration - Magnetron Oscillators - Cylindrical Magnetron - Coaxial Magnetron.

Unit IV	**SIGNAL DEGRADATION IN OPTICAL FIBERS**	**9**	**+**	**0**

Attenuation - Absorption losses - Scattering losses - Bending Losses - Core and Cladding losses - Signal Distortion in Fibers - Intermodal delay - Intramodal dispersion - Factors contributing to dispersion - Group Delay - Material Dispersion - Wave guide Dispersion - Basics of semiconductor physics – LED – Structures - Light source materials - Quantum efficiency and LED power - LASER diodes.

Unit V	**FIBER OPTICAL RECEIVERS AND DIGITAL TRANSMISSION SYSTEM**	**9**	**+**	**0**

Physical principles of photodiodes - PIN photo diode - Avalanche photo diodes - Photodetector noise - SNR-Detector response time - Double Hetero structure photodiodes - structure for InGaAS APDs -Temperature effect on avalanche gain - Fundamental receiver operation - Digital signal transmission - Error sources - Front end amplifier - Digital receiver performance - Receiver sensitivity - Optical Amplifiers – Types - Erbium Doped fiber amplifier.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Explain the active and passive microwave components used in microwave communication.
CO2	:	Have an in-depth knowledge of microwave generation and amplification.
CO3	:	Calculate the degradation in the signal due to losses and dispersion.
CO4	:	Explain the various optical sources and optical detectors and their use in the optical communication system.

Text Books:

1.	Samuel Y.Liao, “Microwave Devices and Circuits”, 3rd Edition, Pearson education, 2008.
2.	Gerd Keiser, “Optical Fiber Communication” , 3rd& 4th Edition, McGraw –Hill International, 2012

Reference Books:

1.	R.E. Collin, “Foundations for Microwave Engineering”, 2nd Edition, IEEE Press , 2002.
2.	David M.Pozar, “Microwave Engineering”, 2nd Edition, John Wiley & Sons, 2003
3.	P.A.Rizzi, “Microwave Engineering Passive circuits”, PHI
4.	S.C.Gupta, “Textbook on Optical Fiber Communication and its applications”, 2nd Edition, PHI, 2012.

E-References:

1.	web page:www.ni.com/rf-acdemy
2.	http://nptel.ac.in/courses/113104012/
3.	http://nptel.ac.in/courses/115102026/

18ECM701	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite

1.	Professional Ethics

Course Objectives: The students will be able to

1.	Understand the managerial functions like planning, organizing, staffing, leading and controlling.
2.	Understand international aspect of management
3.	Understand the method of applying principles in various managerial situations.

Unit I	**HISTORICAL DEVELOPMENT**	**9**	**+**	**0**

Definition of Management – Science or Art – Management and Administration – Role of managers - Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Organizational and environmental factors – Managing globally – Strategies to international business - Types of Business Organization.

Unit II	**PLANNING**	**9**	**+**	**0**

Nature and Purpose – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies and Planning Premises - Barriers to planning Forecasting – Decision-making.

Unit III	**ORGANISING**	**9**	**+**	**0**

Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness – performance appraisal – Managing team conflict..

Unit IV	**DIRECTING**	**9**	**+**	**0**

Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication – Interpersonal Skills.

Unit V	**CONTROLLING**	**9**	**+**	**0**

System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management – Total quality management(TQM) principles.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Apply the principles of management for all kinds of people in all kinds of organizations.
CO2	:	Understanding of the managerial functions like planning, organizing, staffing, leading and controlling.
CO3	:	Gain Basic knowledge on international aspect of management
CO4	:	Understand Total Quality Management

Text Books:

1.	Harold Kooritz& Heinz Weihrich , “Essentials of Management”, Tata McGraw-Hill, 2015.
2.	Joseph L Massie “Essentials of Management”, 4th Edition, Prentice Hall of India, (Pearson), 2003.

Reference Books:

1.	Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw-Hill, ’99.
2.	Decenzo David, Robbin Stephen A, “Personnel and Human Reasons Management”, Prentice Hall of India, 1996
3.	JAF Stomer, Freeman R. E and Daniel R Gilbert,” Management,”, 6th Edition,Pearson Education, 2004.
4.	Fraidoon Mazda, “Engineering Management”, Addison Wesley,2000.

E-References:

1.	https://www.coursera.org/learn/fundamentals-of-management
2.	https://nptel.ac.in/courses/122108038/

18EC702	OPTICAL COMMUNICATION AND MICROWAVE ENGINEERING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:	
1.	To Understand the working principle of optical sources, detector, fibres and microwave components
2.	To Develop and understand simple optical communication link.
3.	To Learn about the characteristics and measurements in optical fibre.
4.	To Practice microwave measurement procedures.
EXPERIMENTS:	
	OPTICAL COMMUNICATION
1.	Determination of Numerical aperture for fibers and Measurement of Attenuation in Fibers.
2.	Mode Characteristics of Fibers – SM Fibers.
3.	Coupling Fibers to Semi-Conductor Sources – Connectors & Splices.
4.	Establish Fiber optic communication links.
5.	LED, LD & Photo Diode Characteristics.
	MICROWAVE ENGINEERING
6.	VSWR Measurements
7.	Determination of terminated impedance.
8.	Determination of guide wavelength and frequency.
9.	Radiation Pattern of Horn antenna.
10.	Microwave Power Measurement.
11.	Characteristics of Gunn diode Oscillator.
12.	Mode Characteristics Reflex Klystron.
13.	Study of Isolator, circulator and Hybrid Tee.
	Total (P)=30 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to :		
CO1	:	Analyze the performance of simple optical link.
CO2	:	Gain knowledge on testing microwave and optical components.
CO3	:	Analyze the mode characteristics of fiber
CO4	:	Analyze the radiation of pattern of antenna, Measure Impedance, VSWR and Frequency, Measure microwave power

Reference :	
1.	Samuel Y.Liao, —Microwave Devices and Circuitsǁ, Pearson education, 3rd Edition, 2008.
2.	Gerd Keiser, —Optical Fiber Communicationǁ McGraw –Hill International, 3rd& 4th ed., 2012
E-References:	
1.	http://nptel.ac.in/courses/113104012/
2.	http://nptel.ac.in/courses/115102026/
3.	http://nptel.ac.in/courses/113106062/21

18EC703	EMBEDDED SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

Prerequiste:	
1.	Embedded system Design
Course Objectives: The student should be made to	
1.	Learn programming of various Microcontoller
2.	Understand the Building Blocks of Embedded Systems and simulation tools
3.	Learn the concept of interfacing and interrupt performance
EXPERIMENTS:	
1.	Study of Embedded system trainer kit with software debugger tool.
2.	Embedded program for I/O interfacing.
3.	Design a stepper motor controller using LCD and keys.
4.	Generate 3-phase PWM signals and demonstrate the utility of PWM with high bright LED lights.
5.	Measure room temperature and display the same in a LCD with keyboard interaction
6.	Design a real time clock using 7-segment displays and create keyboard interaction for the operations
7.	Create a Foreground-background application system using interrupt structure of RL78
8.	Design an embedded system to measure the unknown signal frequency using timer/counter of RL78.
9.	Demonstrate the usage of watchdog timers and voltage detection facilities of RL78 in an application.
10.	Interface DAC with embedded system trainer kit.
11.	Interface ADC with embedded system trainer kit.
12.	Basic experiments using ARM cortex
	Total (P)= 30 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to :		
CO1	:	Write, debug and compile embedded processors programs for a given Application.
CO2	:	Interface and control stepper and DC motors .
CO3	:	Interface A/D and D/A convertors with embedded system .
CO4	:	Implement interrupt control for a given embedded System.

References:	
1.	Peckol, “Embedded system Design”, John Wiley & Sons,2010
2.	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
E-References:	
1.	http://nptel.ac.in/courses/108102045/
2.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/lecture-notes/
3.	https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/

PROGRAM ELECTIVES (PE)

18ECPE601	ELECTRONIC MEASUREMENTS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basics of measurement, different types of sensors and transducers.
2. To learn the concepts of signal analyzers, digital instruments, data display and recording systems.
3. To understand and gain knowledge on Different types transducers and their usage in the Data Acquisition and its instrumentation

Unit I	BASIC MEASUREMENTS	9	+	0

Performance characteristics of Instruments - Static characteristics - Accuracy – Resolution - Precision - Expected value - Types of Error: Gross Errors - Systematic Error - Random Error - Limiting errors(Quantitative analysis)-System of Units: International - Other systems - DC Ammeters - DC Voltmeters – Multi range – Ohm meter - Series Type - Shunt Type – Multi meter for Voltage - Current and resistance measurements.

Unit II	SIGNAL GENERATOR & ANALYZERS	9	+	0

Signal Generation - Sine wave generator - Frequency Synthesized Generator - Frequency divider generator- Sweep Frequency Generator - Pulse and square wave generator - Function Generators – Audio frequency signal generation - Wave Analyzers - Harmonic Distortion Analyzers - Spectrum Analyzers.

Unit III	OSCILLOSCOPE MEASUREMENTS `	9	+	0

Principle of oscilloscope – Oscilloscope block diagram-Cathode Ray Tube circuits - Multiple Trace-Horizontal Deflection system - Oscilloscope techniques - Special Oscilloscopes: Storage oscilloscope - Sampling oscilloscope - Digital storage oscilloscope(DSO) - MSO - Measurement of amplitude and frequency - Lissajous method of frequency measurement - Standard specifications of CRO - Probes for CRO - Active and Passive - Attenuator type.

Unit IV	BRIDGE MEASUREMENT	9	+	0

Introduction - Wheatstone bridge - Kelvin Bridge - Guarded Wheatstone Bridge - AC Bridges and their Applications - Maxwell's bridge-Hay Bridge - Schering Bridge-Unbalance Conditions - Wein Bridge - Errors and precautions in using bridges.

Unit V	TRANSDUCER &DATA ACQUISITION SYSTEMS	9	+	0

Transducers – Classification - Selecting a transducer - Strain gauges - Displacement Transducers: LVDT - Piezo Electric transducers -Temperature measurements - Resistance Thermometers – Thermocouples – Thermistors - Sensistors - Photosensitive Devices- Optical and Digital transducers - Data acquisition systems: Interfacing transducers to electronic control and measuring systems - Multiplexing.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Identify errors in different types of electrical measurements.
CO2	:	To categorize different instruments used for signal generation and analysis.
CO3	:	Have knowledge on digital instruments, data display and recording Systems.
CO4	:	To understand the function of Analog and Digital data acquisition systems.

Text Books:

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, PHI, 2011.
2. H.S.Kalsi , "Electronic Instrumentation", 2nd Edition, Tata McGraw Hill, 2004.

Reference Books:

1. David A. Bell, "Electronic Instrumentation And Measurements", PHI, 2nd Edition, 2003.
2. Robert A.Witte, "Electronic Test Instruments, Analog and Digital Measurements", 2nd Editon, Pearson Education, 2004.
3. K. Lal Kishore, "Electronic Measurements And Instrumentations", Pearson Education , 2005.
4. E.O. Doebelin, 'Measurement Systems – Application and Design', TMH 2003.

E-References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-071j
2. https://ocw.mit.edu/courses/biological-engineering/20-309
3. http://www.academia.edu/8140873/A_K.Sawhney-

18ECPE602	PHYSICS OF OPTOELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:To gain knowledge on,

1.	Basic concepts of semiconductors and light semiconductor interaction.
2.	Principle, working, materials and characteristics of LEDs and LCDs.
3.	Structure, materials and device characteristics of semiconductor laser, photo detectors, opto electronics modulators and solar cell.

Unit I	REVIEW OF SEMICONDUCTOR PHYSICS	9	+	0

E-k diagram - Density of states - Occupation probability - Fermi level and quasi - Fermi level (variation by carrier concentration and temperature) - P-N junction - Metal-semiconductor junction (Ohmic and Schottky) - Carrier transport – generation and recombination - Semiconductor materials of interest for optoelectronic devices – Band gap modification - Hetero structures - Light semiconductor interaction: Rates of optical transitions - Joint density of states and condition for optical amplification.

Unit II	SEMICONDUCTOR OPTICAL DIODES (LEDS AND LCDS)	9	+	0

Rate equations for carrier density - Radiative and non-radiative recombination mechanisms in semiconductors - LED: Device structure - Materials – Characteristics and figures of merit – LCD - Principle and working – Optical switches – Self Electro optic Effect Devices (SEED).

Unit III	SEMICONDUCTOR LASERS	9	+	0

Review of laser physics - Rate equations for carrier and photon density - Steady state Solutions - Laser dynamics - Relaxation oscillations - Input-output characteristics of lasers - Semiconductor laser: Structure – Materials - Device characteristics - Figures of merit – DFB - DBR - Vertical_cavity surface_Emitting lasers (VECSEL) - Tunable semiconductor lasers.

Unit IV	PHOTO DETECTORS	9	+	0

Types of semiconductor photo detectors - PN junction, PIN, Avalanche: Structure, materials, working principle, and characteristics. Noise limits on performance; Photovoltaic effect - Solar cells – construction, working and applications.

Unit V	OPTOELECTRONIC MODULATOR	9	+	0

Introduction - Analog and Digital Modulation - Electro-optic modulators - Magneto-Optic devices - Franz-Keldysh and Stark effect electro absorption modulators - Acousto optic devices - Optical, Switching and Logic Devices.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the physics bebind the semiconductors devices.
CO2	:	Gain knowledge on principle of working of optical semiconductor devices.
CO3	:	Gain knowledge on principle of working photo detectors.
CO4	:	Understand and design opto electronic modulators and other optical devices.

Text Books:

1.	Pallab Bhattacharya, “Semiconductor optoelectronic devices”, Pearson Education publications, New delhi, 2002.
2.	S.M.Sze, “emiconductor Devices:Physics and Technology”,wiley,2008.

Reference Books:

1.	David A.Bell, “Electronic Devices and Circuits”, Oxford University press publications, New Delhi, 2008.
2.	Arumugam M, “Semiconductor Physics and Optoelectronics”, Anuradha publications, kumbakonam, 2006.
3.	Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTEL
4.	Online course: “Optoelectronic Materials and Devices” by Monica Katiyar and Deepak Gupta on NPTEL.

E-References:

1.	https://ocw.mit.edu/courses
2.	https://electrical-engineering-and-computer-science
3.	https://semiconductor-optoelectronics-theory-and-design-fall-2002/

18ECPE603	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Prerequisite:

1. Digital Signal Processing

Course Objectives:

1. To study the fundamentals and mathematical transforms necessary for image processing
2. To study the image enhancement and restoration techniques
3. To study the image segmentation, representation and compression procedures.

Unit I **DIGITAL IMAGE PROCESSING** **7 + 0**

Two dimensional signals and systems - Mathematical preliminaries - Elements of Digital Image Processing System - Structure of the human eye - Image formation and contrast sensitivity - Sampling and Quantization - Neighbours of pixel – Distance measures – Image processing applications.

Unit II **IMAGE TRANSFORMS** **7 + 0**

Introduction to Fourier transform - Discrete Fourier transform - Properties of DFT – Separability – Translation – Periodicity – Rotation - Average Value – Discrete Cosine Transform – Properties - Haar Transform.

Unit III **IMAGE ENHANCEMENT AND RESTORATION** **7 + 0**

Enhancement in spatial domain - Histogram Equalization technique - Spatial Filtering – Low pass filtering – Median filtering – Sharpening Filters - Enhancement in frequency domain - Homomorphic filtering – Image Restoration - Degradation model - Noise models - Inverse Filtering - Unconstrained and constrained Restoration methods.

Unit IV **IMAGE SEGMENTATION AND REPRESENTATION** **8 + 0**

Point, Line and Edge detections - Gradient operators - Thresholding – Region-Oriented Segmentation - Representation schemes: Chain codes - Polygon approximation - Boundary descriptors: Simple descriptors - Shape numbers Fourier descriptors.

Unit V **IMAGE COMPRESSION** **16 + 0**

Coding - Inter pixel and Psychovisual redundancies - Fidelity criteria - Image Compressions models - Variable length coding - Bit plane coding – Lossless and Lossy Predictive coding - Transform coding techniques – Image compression standards.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Conceptual understanding of digital image processing and analyze various images transforms.
CO2	:	Demonstrate the understanding of image enhancement and restoration algorithms.
CO3	:	Interpret image segmentation and representation techniques.
CO4	:	Categorize various compression techniques and Interpret Image compression standards.

Text Books:

1. Rafael C Gonzalez and Richard E Woods, “Digital Image Processing” 4th Edition - Pearson, 2018.
2. Jayaraman S, Esakkirajan S and Veerakumar T,”Digital Image Processing”, Tata McGraw Hill, New Delhi, 2009.

Reference Books:

1. Kenneth R Castleman, “Digital Image Processing”, Prentice Hall, New Delhi, 2008.
2. Sid Ahmed M A, ”Image Processing Theory, Algorithm and Architecturesll”, McGraw-Hill, New Delhi, 1995
3. Rafael C Gonzalez, Richard E.woods and Steven L. Eddins, “Digital Image Processing Using MATLAB” Tata McGraw Hill, New Delhi, 2010.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Brooks/Cole, Singapore, 2008.

E-References:

1. https://www.coursera.org/learn
2. https://onlinecourses.nptel.ac.in
3. https://www.youtube.com/watch?v=uvXTZxSzdMk

18ECPE604	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

Prerequisite:

1. Signals and system, Digital signal processing

Course Objectives:

1. To introduce wireless fundamentals and statistical multipath models
2. To have the knowledge to improve the coverage and capacity and the propagation models.
3. To gain the knowledge on modulation techniques, Multiple Access techniques and Coders used in MC.

Unit I WIRELESS FUNDAMENTALS **9 + 0**

Cellular concept - Path loss and shadowing - Radio Wave Propagation - Transmit and Receive Signal Models - Free-Space Path Loss - Ray Tracing - Empirical Path Loss Models - Simplified Path Loss Model - Shadow Fading - Combined Path Loss and Shadowing.

Unit II STATISTICAL MULTIPATH MODELS **9 + 0**

Time -Varying Channel Impulse Response - Narrowband Fading Models - Wideband Fading Model - Capacity Analysis: Capacity of Flat fading Channels - Channel and system model - Channel Distribution Information(CDI) - Channel Side Information at Receiver - Channel Side Information at transmitter and receiver - Capacity of frequency selective fading Channels - Time Invariant Channels - Time varying Channels.

Unit III MULTIPLE ACCESS AND MODULATION TECHNIQUES **9 + 0**

Multiple Access Techniques: FDMA – TDMA - SS Multiple Access – SDMA -Capacity of Cellular CDMA - Capacity of CDMA with Multiple Cells - Capacity of SDMA - Constant Envelope Modulation: BFSK – MFSK – GMSK - Combined Linear and Constant Envelope Modulation Techniques - Spread Spectrum Modulation Techniques - Performance of Digital Modulation in Slow Flat Fading and Frequency Selective Mobile Channels.

Unit IV SPATIAL DIVERSITY **9 + 0**

Transmit Diversity: Channel known at transmitter - Channel unknown at transmitter - Alamouti scheme - Receive Diversity: Selection combining - Equal Gain combining - Threshold Combining - Maximal Ratio Combining - Spatial Multiplexing in MIMO - Moment Generating functions in diversity analysis - Receiver structures**:** Maximum Likelihood Receiver - Zero forcing receiver - Minimum Mean Square Error Receiver - V-BLAST Receiver.

UNIT V SPEECH CODING AND WIRELESS SYSTEMS AND STANDARDS **9 + 0**

Speech Coding: Characteristics of speech signals – Vocoders - Linear Predictive Coders - Choosing speech Codecs for mobile communication - GSM Codec - USDC Codec - Standards: AMPS – GSM - CDMA - Digital Cellular Standard(IS-95) - CT2 - DECT- PACS -PDC.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Classify the available wireless communication systems and standards.
CO2	:	Analyse various propagation mechanism models, small& large scale and multipath fading models in mobile environment.
CO3	:	Select the modulation techniques and multiple access techniques for mobile environment.
CO4	:	Analyze the speech signal parameters and identify Codecs for mobile communication.

Text Books:

1. Theodore S.Rappaport , “Wireless Communications: Principles and Practice”, 2nd Edition.”, Pearson, 2009.
2. Andrea Goldsmith, “ Wireless Communications”, Cambridge University Press, 2005

Reference Books:

1. A.Molisch,Wiley, “Wireless Communications”, 2nd Edition, 2013
2. V.K. Garg,” IS-95 CDMA and CDMA 2000”, Pearson, 2012
3. Simon Haykin S., "Digital Communication”, Student Edition, John Wiley and Sons, 2010.
4. W. Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2003.

E-References:

1. http://www.pdfsdownload.com/download-pdf-for-free/wireless+communication+rappaport
2. https://www.udemy.com/topic/wireless-networking/
3. https://nptel.ac.in/courses/117102062/

18ECPE701	FPGA BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study basic concepts of FPGA based systems.
2. To design Combinational and Sequential logics.
3. To know the concepts of architecture and large scale systems.

Unit I	FPGA BASED SYSTEMS	9	+	0

Introduction – Basic Concepts - Digital Design and FPGA's - FPGA Based System Design - VLSI Technology Behind FPGA/CPLD - Manufacturing Processes - CMOS Logic Gates – Wires - Registers and RAM -Packages and Pads.

Unit II	FPGA FABRICS	9	+	0

FPGA Fabrics - FPGA Architectures -SRAM Based FPGAs - Permanently Programmed FPGAs -Chip I/O-Circuit Design of FPGA Fabrics - Architecture of FPGA Fabrics.

Unit III	COMBINATIONAL LOGIC	9	+	0

Combinational Logic -The Logic Design Process - Hardware Description Languages - Combinational Network Delay - Power and Energy Optimization -Arithmetic Logic - Logic Implementation of FPGAs - Physical Design of FPGAs -The Logic Design Process.

Unit IV	SEQUENTIAL MACHINES	9	+	0

Sequential Machines - Sequential Machine Design Process - Sequential Design Styles - Rules For Clocking - Performance Analysis - Power Optimization.

Unit V	ARCHITECTURE AND LARGE SCALE SYSTEMS	9	+	0

Architecture - Behavioural Design - Design Methodologies - Design Example - Large Scale Systems - Busses-Platform FPGAs - Multi FPGA Systems - Novel Architectures

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the basic concepts of FPGA based systems.
CO2	:	Design Combinational logic.
CO3	:	Design Sequential logic.
CO4	:	Know the concepts of architecture and large scale systems.

Text Books:

1. Wolf, FPGA – Based System Design Wayne,1st Edition, Prentice Hall PTR, 2009.
2. Wayne Wolf, Modern VLSI Design: System-on-Chip Design 4th Edition, Prentice hall , 2008

Reference Books:

1. Stephen D. Brown, and ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog Design, 2nd Edition," McGraw Hill, June, 2007.
2. CemUnsalan and Bora Tar, "Digital System Design with FPGA: Implementation Using Verilog and VHDL", Digital System Design with FPGA: Implementation Using Verilog and VHDL", McGraw Hill, June, 2007
3. Steve Kilts, "Advanced FPGA Design: Architecture Implementation and Optimisation", Wiley interscience, 2017.
4. Justin Rajewski, "Learning FPGAs: Digital Design for Beginners with Mojo and Lucid HDL", O'Reilly Media inc.

E-References:

1. https://theeye.eu/public/Books/robot.bolink.org/Logic%20and%20Computer%20Design%20Fundamentals%203e%20-%20Part%20I%20By%20Mano%2CKime.pdf
2. file:///C:/Users/admin/Downloads/FPGA-Based_System_Design_Wayne_Wolf_SAmp.pdf
3. http://ebook.pldworld.com/_eBook/FPGA%EF%BC%8FHDL/-Eng-/Digital%20Systems%20Design%20Using%20VHDL%20(Charles%20Roth).pdf

18ECPE702	RADAR COMMUNICATION	L	T	P	C
		3	0	0	3

Prerequisite:

1. Analog and Digital Communication, Signal Processing.

Course objective:

1. To understand the technologies used in RADAR.
2. To gain knowledge on different types of RADAR and its application
3. To learn about RADAR receivers.

Unit I	INTRODUCTION TO RADAR	9	+	0

Basics of RADAR - EM Waves and properties - Applications of RADAR - RADAR frequencies - RADAR block diagram - RADAR Coordinates - RADAR equation for hard targets and the SNR-radar cross section of targets - RADAR Resolution Elements – Pulse , CW and FMCW RADAR – Configurations - Transmitter power - Pulse repetition frequency - Duty Ratio - Pulse Compression – Coding - Detection of signals in noise and Radar signals.

Unit II	RADAR TRANSMITTER	9	+	0

Introduction- Types of Transmitters - linear-beam power tubes- solid-state RF power sources- magnetron- Klystron, crossed-filed amplifier – RADAR receiver - Receiver noise figure - Super Heterodyne receiver - Digital Receivers - Duplexers and receiver protectors - RADAR displays - Human Machine Interface (HMI).

Unit III	RADAR RECEIVER	9	+	0

RADAR receiver - Receiver noise figure - Super Heterodyne receiver - Digital Receivers - Duplexers and receiver protectors - RADAR displays - Human Machine Interface (HMI).

Unit IV	RADAR ANTENNA	9	+	0

Functions of RADAR antenna - Antenna parameters - Antenna radiation pattern and aperture illumination - Reflector antennas - Electronically steered phased array antennas - Phase shifters – Frequency - Scan arrays - Architectures for phased arrays - Radiators for phased arrays - Mechanically steered planar array antennas - Radiation pattern synthesis - Effect of errors on radiation patterns - Low side lobes antennas.

Unit V	MTI AND PULSE DOPPLER RADAR	9	+	0

Introduction to Doppler and MTI RADAR - Delay – Line cancellers - Staggered pulse repetition frequencies - Doppler filter banks - Digital MTI processing - Moving target detector - Limitations to MTI performance - Pulse Doppler RADAR - MTD - Tracking RADAR - Mono pulse tracking - Conical scan and sequential lobbing - Comparison of trackers - Tracking accuracy – low_angle tracking - Atmospheric and Weather RADAR: Precipitation Radars - Doppler Weather Radar - Polarimetric RADAR - Clear Air RADARs.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Gain basic understanding on various types of RADARs
CO2	:	Analyze and design RADAR transmitter and receiver.
CO3	:	Design antenna for RADAR applications.
CO4		Utilize knowledge on RADARs for target detection and weather prediction based applications.

Text Books:

1. Merril I Skolnik,"Introduction to RADAR Systems", McGraw-Hill, 2008.
2. Richard J Doviak and Dusan S Zrnic, "Doppler RADAR and Weather Observations" , Dover Publications, 1993.

Reference Books:

1. Bringi V N and Chandrasekar V, "Polarimetric Doppler Weather RADAR", Cambridge University Press, 2001.
2. Richards M A, Scheer J A and Holm W A, "Principles of Modern RADAR", Yes Dee Publishing Pvt. Ltd., 2012.
3. Principles of morden RADAR by Mark A. Richards, James A. Scheer Scitech Publishing; 1st edition (May 10,
4. Introduction to Radar Systems by Merrill I. Skolnik, Third Edition,Published August 2000 by McGraw-Hill.

E-References:

1. http://www.radio-electronics.com/info/data/semicond/semiconductor/semiconductor-materials-types-list.php
2. http://911electronic.com/
3. http://www.electronics-tutorials.ws/

18ECPE703	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To gain an understanding of IoT market perspective.
2.	To familiarize the students about the state of the art – IoT architecture.
3.	To acquire knowledge on the constraints in real world IoT design.

Unit I	M2M TO IOT – THE VISION	9	+	0

Introduction - From M2M to IoT- M2M towards IoT - The global context - A use case example - Differing Characteristics.

Unit II	M2M TO IOT – A MARKET PERSPECTIVE	9	+	0

Introduction - Some Definitions - M2M Value Chains - IoT Value Chains - An emerging industrial structure for IoT - Iinternational driven global value chain and global information monopolies - M2M to IoT-An Architectural Overview – Building an architecture - Main design principles and needed capabilities - An IoT architecture outline - Standards considerations.

Unit III	M2M AND IOT TECHNOLOGY FUNDAMENTALS	9	+	0

Devices and gateways - Local and wide area networking - Data management - Business processes in IoT - Everything as a Service(XaaS) - M2M and IoT Analytics - Knowledge Management.

Unit IV	IOT ARCHITECTURE	9	+	0

IoT Architecture - State of the Art - Architecture Reference Model – Introduction - Reference Model and architecture - IoT reference Model - IoT Reference Architecture - Real World Design Constraints.

Unit V	IOT USE CASES	9	+	0

Industrial Automation – Service_oriented architecture_based device integration - SOCRADES: Realizing the enterprise integrated Web of Things - IMC-AESOP: From the Web of Things to the Cloud of Things - Commercial Building Automation – Introduction - Case study(Phase one): Commercial building automation today - Case study(Phase two) - Commercial building automation in the future.

Total (L+T)=45 Periods

Course Outcomes:

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

CO1	:	Understand the vision of IoT from a global context.
CO2	:	Determine the Market perspective of IoT.
CO3	:	Understand the IoT technology fundamentals and build the state of the art architecture in IoT.
CO4	:	Apply the knowledge of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

Text Books:

1.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2.	Olivier Hersent, davidBoswarthick, Omar Elloumi, 'The Internet of Things Applications to the smart grid and building automation', John Wiley & Sons, 2012.

Reference Books:

1.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3.	HakimaChaouchi, 'The Internet of Things Connecting Objects', John Wiley & Sons, 2010.
4.	FabriceTheoleyr, Ai-Chun Pang, 'Internet of Things and M2M Communications', River Publishers, 2013.

E-References:

1.	https://nptel.ac.in/courses/106105166
2.	https://nptel.ac.in/courses/108108098
3.	https://onlineitguru.com/iot-online-training.html

18ECPE704	NANO ELECTRONICS	L	T	P	C
		3	0	0	3

Prerequisites:

1. Semiconductor Devices, Microelectronics – VLSI, Quantum Physics

Course objective:

1. To present the state of the art in the areas of semiconductor device physics and materials technology.
2. To impart knowledge on Nano scale structure design.
3. To introduce the challenges in Nano scale fabrication techniques.

Unit I	NANOELECTRONICS AND SCALING	9	+	0

Introduction to Nanoelectronics – Classical and quantum systems – Current CMOS device technology- International Technology Roadmap for Semiconductor projections – Scaling principles – General scaling -,Characteristic - Scale length – Limits to scaling – Quantum mechanics - Atomistic effects - Thermodynamic Effects - Practical considerations – Power constrained scaling limits.

Unit II	PHYSICAL PROPERTIES OF NANOSCALE STRUCTURES	9	+	0

Energy sub-bands and Density of States in nanoscale structures – Electron transport in a Two Dimensional electron gas – Resistance of a ballistic semiconductor – Landauer formula – Transmission probability calculation – Resonant tunnelling effect – Coulomb blockade – Quantization of thermal conductance in ballistic nanostructures.

Unit III	SINGLE ELECTRON, SESO AND CNT DEVICES	9	+	0

Introduction – Quantum Dot transistor – structure and fabrication – Single Electron and Single Hole Quantum Dot transistor – Artificial atom – Single Electron MOS Memory – structure and fabrication - SESO Transistor – SESO Memory – CNT transistor – CNT based Field Emission devices – CNT based Microwave devices.

Unit IV	SPINTRONICS AND MOLECULAR NANODEVICES	9	+	0

Introduction – Spin filters – Spin diodes – Spin transistors – Spin based optoelectronic devices – Electrical conduction of molecules – Manipulation of single molecules – Molecular motors – Molecular nanoactuators – Molecular electronic devices – Molecular based optic devices.

Unit V	FABRICATION TECHNIQUES	9	+	0

Optical lithography – Electron beam lithography – X_Ray lithography - Focussed Ion beam lithography – Nanoimprint lithography – Pulsed laser deposition – Sputter deposition – Chemical Vapour Deposition – Wet and dry etching techniques – Chemical Mechanical Polishing.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand problem to down scaling while moving to Nano electronics.
CO2	:	Gain knowledge on how physical properties of devices is exploited to build Nano electronics.
CO3	:	Understand the fabrication technique.
CO4	:	Understand how spinning properties of electrons are exploited to build Nano devices.

Text Books:

1. Mircea Dragoman and Daniela Dragoman, “Nanoelectronics Principles and Devices”, Artech house, Boston, 2006.
2. ShunriOda and David Ferry, ”SiliconNanoelectronics”, Taylor & Francis, USA, 2006.

Reference Books:

1. W.R.Fahrner, “Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques”, Springer (India), New Delhi, 2011.
2. Rainer Waser,”Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices”, Wiley – VCH, Germany, 2005.
3. George W. Hanson,”Fundamentals of Nanoelectronics” , Pearson, New Delhi, 2012.
4. Krzysztof Iniewski, ,”Nano-Semiconductors: Devices and Technology “, CRC Press, 24-Oct-2011

E-References:

1. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-701-introduction-to-nanoelectronics-spring-2010/readings/
2. http://nptel.ac.in/courses/118102003/
3. https://www.edx.org/course/fundamentals-of-nanoelectronics-basic-concepts

18ECPE705	VLSI TESTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To gain the Basic knowledge on fault modelling, testing and test generation in logic circuit and delay test.
2.	To get exposure on testability approaches and test vector generation algorithms for logic circuits
3.	To understand the various fault diagnosis methods in logic systems

Unit I	TESTING AND TESTABLE DESIGN OF DIGITAL SYSTEMS	9	+	0

Need for testing - Fault models - Fault detection and redundancy - Combinational circuits – Sequential circuits - Fault equivalence - Fault dominance – Logic simulation - Compiler driven Simulation - Event driven Simulation - Fault simulation techniques - Serial, parallel, deductive.

Unit II	TESTING FOR SINGLE STUCK AT - FAULTS	9	+	0

Test generation algorithms for combinational circuits - Fault oriented ATG – D algorithm – Examples – PODEM – Fault independent ATG - Random test generation – ATG for SSFs in sequential circuits.

Unit III	DELAY TEST	9	+	0

Delay test problem – Path delay test – Transition faults – Delay test methodologies.

Unit IV	SELF-TEST AND TEST ALGORITHMS	9	+	0

Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures – Testable Memory Design - Test algorithms - Test generation for Embedded RAMs. FAULT DIAGNOSIS

Unit V	FAULT DIAGNOSIS	9	+	0

Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits – Self checking design - System Level Diagnosis.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Have basic knowledge on fault modelling, testing and test generation in logic circuits.
CO2	:	Understand the delay test methodologies.
CO3	:	Exposure to testability approaches and test vector generation algorithms for memory and logic Circuits
CO4	:	Understanding of the various fault diagnosis methods in logic systems.

Text Books:

1.	Abramovici M., Brever A., and Friedman D., "Digital Systems Testing and Testable Design", Jaico Publishing House, 2013.
2.	Michael L Bushnell and Vishwani D Agarwal, “Essentials of Electronic Testing for Digital, Memory and Mixed Signal Circuits”, Springer, 2002.

Reference Books:

1.	Stanley L Hurst “VLSI Testing : Digital and Mixed Analogue Digital Techniques”, Institute of Electrical Engineers,1998.
2.	Xiaoqing Wen, Cheng Wen Wu and LaungTerng Wang “VLSI Test Principles and Architectures: Design for Testability”, Morgan Kaufmann, 2011.
3	Parag K Lala, “Fault Tolerant and Fault Testable Hardware Design” BS Publications, 2002.
4.	A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Beijing China Electric Power Press, 2010.

E-References:

1.	https://nptel.ac.in/courses/106103116/handout/mod7.pdf
2.	http://www.ee.ncu.edu.tw/~jfli/soctest/lecture/ch03.pdf
3.	file:///C:/Users/admin/Downloads/chap1_lect00_testintro.pdf

18ECPE706	ADVANCED RADIATING SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals in antenna design
2.	To understand radiation from apertures, array and microstrip antennas.
3.	To understand EMC and antenna measurement techniques.

Unit I	ANTENNA FUNDAMENTALS	9	+	0

Antenna fundamental parameters Radiation integrals - Radiation from surface and line current distributions: Dipole, Monopole - Loop antenna - Mobile phone antenna - Base station - Hand set antenna - Reciprocity theorem - Broadband antennas and matching techniques - Balance to unbalance transformer - Introduction to numerical techniques .

Unit II	RADIATION FROM APERTURES	9	+	0

Field equivalence principle - Radiation from Rectangular and Circular apertures - Uniform aperture distribution on an infinite ground plane - Slot antenna - Horn antenna - Reflector antenna - Aperture blockage and design consideration.

Unit III	ARRAY ANTENNA	9	+	0

Uniform array - Phased array, beam scanning - Grating lobe - feed network, Linear array synthesis techniques – Binomial and Chebyshev distributions – Super Directivity – Planar array- Circular array - Design problems.

Unit IV	MICRO STRIP ANTENNA:	9	+	0

Radiation Mechanism and Excitation techniques : Microstrip dipole – Patch - Rectangular patch - Circular patch - and Ring antenna – Radiation analysis from cavity model - Input impedance of rectangular and circular patch antenna - Microstrip array and feed network - Applications of Microstrip array antenna.

Unit V	EMC ANTENNA AND ANTENNA MEASUREMENTS	9	+	0

Concept of EMC measuring antenna – Transmission and Receiving antenna factors - Log periodic dipole - Bi-conica - Ridge guide- Multi turn loop - Antenna measurement and Instrumentation: Gain, Impedance and antenna factor measurement - Antenna test range Design.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Solve and design basic problems antennas
CO2	:	Analyse radiation from aperture, array and microstrip antennas
CO3	:	Understand EMC for any electronic equipments
CO4	:	Use measurement techniques to study radiation pattern.

Text Books:

1.	Balanis A, “Antenna Theory Analysis and Design”ǁ, John Wiley and Sons, New York, 2009
2.	Robert S Elliot “ Antenna Theory and Design” , Wiley Publisher , 2015

Reference Books:

1.	Krauss J D, —Antennasǁ, John Wiley and sons, New York, 2009.
2.	Bahl I J and Bhartia P, —Microstrip Antennasǁ, Artech House,Inc.,1980
3.	Stutzman W L and Thiele G A, —Antenna Theory and Designǁ, John Wiley and Sons Inc., 1998.
4.	R.E.Collins, “ Antrennas and Radio Propagation”, McGraw-Hill,1987.

E-References:

1.	https://onlinecourses.nptel.ac.in/noc18_ee13/preview
2.	https://www.edx.org/course/electricity-and-magnetism-maxwells-equations
3.	https://nptel.ac.in/courses/117107035/

18ECPE707	HIGH SPEED NETWORKS	L	T	P	C
		3	0	0	3

Prerequisite:

1. Computer Networks.

Cousre objective:

1. The objective of this course is to highlight the features of different technologies involved in High Speed Networking and their performance.
2. To impart knowledge on congestion control and traffic management in various protocol architecture.
3. To introduce technologies used to improve the quality of services.

Unit I **INTRODUCTION TO HIGH SPEED NETWORKS** **9 + 0**

The need for a protocol architecture - The TCP/IP protocol architecture – Internetworking - Packet switching networks Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture - ATM logical Connection, ATM Cell – ATM Service Categories – AAL - High Speed LANs:Fast Ethernet - Gigabit Ethernet - Fiber Channel – W ireless LANs: Applications requirements – Architecture of 802.11

Unit II **CONGESTION AND TRAFFIC MANAGEMENT** **9 + 0**

Queuing Analysis - Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

Unit III **TCP AND ATM CONGESTION CONTROL** **9 + 0**

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management –Exponential RTO back off – KARN's Algorithm – Window management – Performance of TCP over ATM - Traffic and Congestion control in ATM – Requirements – Attributes –Traffic Management Frame work - Traffic Control – ABR traffic Management – ABR rate control - RM cell formats - ABR Capacity allocations – GFR traffic management**.**

Unit IV **INTEGRATED AND DIFFERENTIATED SERVICE** **9 + 0**

Integrated Services Architecture: Approach - Components – Services - Queuing Discipline: FQ - PS, BRFQ – GPS - WFQ – Random Early Detection - Differentiated Services

Unit V **PROTOCOLS FOR QOS SUPPORT** **9 + 0**

RSVP – Goals and Characteristics - Data Flow - RSVP operations - Protocol Mechanisms - Multiprotocol Label Switching – Operations - Label Stacking - Protocol details – RTP – Protocol Architecture - Data Transfer Protocol - RTCP.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to understand:

CO1	:	ATM Frame Relay Network along with comparison of TCP/IP network model.
CO2	:	The techniques involved to support real-time traffic andcongestion control.
CO3	:	The concept queuing mechanism in integrated and differentiated service architecture.
CO4	:	Different levels of quality of service (Q.S) to differentapplications.

Text Books:

1. Warland, PravinVaraiya, "High performance communication networks", SecondEdition , Jean Harcourt Asia Pvt. Ltd., , 2001.
2. William Stallings, "HIGH SPEED NETWORKS AND INTERNET", PearsonEducation, Second Edition, 2002.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Pearson Education, Third Edition, 2011
2. IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", CiscoPress, Volume 1 and 2, 2003.
3. Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.
4. Behrouz A. Foruzan, "Data communication and Networking", 4th edition, TMH, 2013.

E-References:

1. http://freevideolectures.com/Course/2278/Data-Communication/30
2. http://nptel.ac.in/courses/106105082/30
3. https://www.udacity.com/course/computer-networking--ud436

18ECPE708	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Pre-Requisite:

1. Analog Integrated Circuits

Course Objectives:

The objective of the course is, to help the students

1. To introduce graphical programming environment
2. To teach fundamentals of virtual instrumentation programming
3. To develop simple applications using VI

Unit I GRAPHICAL PROGRAMMING ENVIRONMENT 9 + 0

History of Virtual Instrumentation - Lab View and VI - Conventional and Graphical Programming - Future Perspective - Components of LabView - Owned and Free Labels - Tools and Other Palettes - Arranging Objects- Pop-up menus - Color Coding - Code Debugging - Context Sensitive Help - Types of VI's - Creating Sub-Vis - Concepts of graphical programming Lab-view software.

Unit II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION PROGRAMMING 9 + 0

Modular programming - Controlling Program execution with structure - Composite data arrays and clusters - Visual displays types - Graphs and charts - Analog and digital - Shift registers and feedback nodes - Local and Global variables - Exploring string and File input and output operations.

Unit III DATA ACQUISITION WITH LABVIEW 9 + 0

Concept of Virtual Instrumentation - PC based data acquisition - Typical on board DAQ card Resolution and sampling frequency - Multiplexing of analog inputs – Single_ended and differential inputs - Different strategies for sampling of multi- channel analog inputs - Concept of universal DAQ card - Use of timer - counter and analog outputs on the universal DAQ card - NI-DAQ mx Tasks

Unit IV CLUSTER OF INSTRUMENTS IN SYSTEM 9 + 0

Interfacing of external instruments to a PC RS232C - RS-422 - RS485 and USB standards - IEEE488standard - ISO-OSImodel for series bus-introduction to bus protocols of MOD bus and CAN bus.

Unit V ANALYSIS TOOLS AND SIMPLE APPLICATION IN VI 9 + 0

Signal Processing and manipulation - Anti-aliasing Filter - Frequency_ Domain Signal analysis (DFT and FFT) - Power Spectrum - Windowing - Practical Hints for Frequency Domain Analysis - Signal Processing Functions - Time Domain Analysis - Frequency Domain Analysis – Filters: Control design and simulation - Simulation of a simple second order system.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Apply structured programming concepts in developing VI programs and employ various debugging techniques.
CO2	:	Create applications that uses plug in DAQ boards and built in analysis functions to process the data.
CO3	:	design and analyze various applications using signal Processing tool kit
CO4	:	design and analyze various applications using control and simulation tool kit.

Text Books:

1. Jovitha Jerome "Virtual Instrumentation using LabVIEW", PHI publication, 2010
2. Jeffrey Travis Jim Kring "LabVIEW for Everyone", 3rd Edition, Pearson education

Reference Books:

1. Robert H. Bishop "Learning with Lab-View", PreticeeHall,2009
2. Sanjay Gupta "Virtual Instrumentation, LABVIEW", , TMH,NewDelhi,2003
3. Peter W Gofton,"Understanding Serial Communication", Sybes International, 2000
4. S.Gupta and J P Gupta , "PC Interfacing for Data Acquisition and Process Control" , Instrument Society of America,1994

E-Reference:

1. http://www.ni.com/white-paper/4752/en/
2. http://sine.ni.com/tacs/app/fp/p/ap/ov/lang/en/pg/1/sn/n5:selfpacedonline/
3. https://www.virtualinstruments.com/training/

18ECPE801	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Identify sources of power dissipation in an IC.
2.	To understand simulation based power estimation and analysis.
3.	Design circuit at low power and identify suitable techniques to reduce power.

Unit I	DEVICE AND TECHNOLOGY IMPACT ON LOW POWER	9	+	0

Need for low power VLSI chips - Sources of power dissipation on Digital Integrated circuits - Emerging Low power approaches - Physics of power dissipation in CMOS devices - Dynamic dissipation in CMOS - Transistor sizing and Gate oxide thickness - Impact of technology Scaling - Technology and Device innovation.

Unit II	SIMULATION POWER ANALYSIS AND PROBABILISTIC POWER ANALYSIS	9	+	0

SPICE circuit simulators - Gate level logic simulation - Capacitive power estimation - Static state power - Gate level capacitance estimation - Architecture level analysis - Monte Carlo simulation - Random logic signals - probability and frequency - probabilistic power analysis techniques - signal entropy.

Unit III	LOW POWER DESIGN	9	+	0

Circuit level: Power consumption in circuits - Flip Flops and Latches design - High capacitance nodes - Low power digital cells library - Logic level: Gate reorganization - signal gating - logic encoding - state machine encoding - pre computation logic.

Unit IV	LOW POWER ARCHITECTURES AND CLOCK DISTRIBUTION	9	+	0

Power and Performance management - switching activity reduction - Parallel architecture with voltage reduction - Flow graph transformation - Low power arithmetic components - Low power memory design - Power dissipation in clock distribution - Single driver versus Distributed buffers - Zero skew versus tolerable skew - Chip and package co-design of clock network.

Unit V	ALGORITHM AND ARCHITECTURAL LEVEL METHODOLOGIES	9	+	0

Introduction - Design flow - Algorithmic level analysis and optimization - Architectural level estimation and synthesis.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Identify sources of power dissipation in an IC.
CO2	:	Understand simulation based power estimation and analysis.
CO3	:	Design circuit at low power.
CO4	:	Identify suitable techniques to reduce power.

Text Books:

1.	Gary K. Yeap - Farid N. Najm, “Low power VLSI design and technology”, World Scientific Publishing Ltd., 1996.
2.	Kaushik Roy and Sharat C. Prasad, “Low-Power CMOS VLSI Circuit Design” ,Wiley-Interscience, 2000.

Reference Books:

1.	DimitriosSoudris, Christian Piguet, Costas Goutis, “Designing CMOS circuits for low power”, Kluwer Academic Publishers,2002.
2.	Chandrakasan, R. Brodersen , “CMOS Low Power Digital Design”, Kluwer Academic Publications. 1995.
3.	Rabaey, M. Pedram, “Low Power Design Methodologies”, Kluwer Academic Publications, 1996.
4.	Christian Piguet, “Low-power CMOS circuits: technology, logic design and CAD tools”, CRC Press, Taylor & Francis Group, 2006.

E-References:

1.	file:///C:/Users/admin/Downloads/Practical%20low%20power%20digital%20VLSI%20design%20by%20Gary%20Yeap%20(1).pdf
2.	https://drive.google.com/file/d/0BzoKWH8M1BoTQl9CUUpOYlpuYjQ/view
3.	https://nptel.ac.in/courses/106105161/58

18ECPE802	MULTIMEDIA COMPRESSION TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisite:

1. Signal Processing and basic mathematical analysis skills.

Course objective: Objective of this course is to,

1. Highlight the features of data redundancy and various compression techniques involved.
2. To understand the various challenges involved in text and audio compression.
3. To impart knowledge on various image and video compression techniques.

Unit I **INTRODUCTION** **9 + 0**

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 quantizes – Evaluation techniques -Error analysis and methodologies.

Unit II **TEXT COMPRESSION** **9 + 0**

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

Unit III **AUDIO COMPRESSION** **9 + 0**

Audio compression techniques - Frequency domain and filtering - Basic sub_bands coding - Application to speech coding - G.722 - Application to audio coding - MPEG audio - Progressive encoding for audio – Silence compression - Speech compression techniques – Vocoders.

Unit IV **IMAGE COMPRESION** **9 + 0**

Predictive techniques – PCM – DPCM - DM - Transform coding - Introduction to JPEG - JPEG-2000 - JBIG standards - Study of EZW - SPIHT algorithms.

Unit V **VIDEO COMPRESSION** **9 + 0**

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.

Total (L+T) = 45 Periods

Course Outcomes:

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

CO1	:	Represent the multimedia data in different formats for various applications.
CO2	:	To understand different coding techniques and apply various algorithms for compression.
CO3	:	To understand the quality and performance of various text and audio compression algorithms.
CO4	:	Apply various image and video compression algorithms for practical applications

Text Books:

1. SayoodKhaleed, — “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.

Reference Books:

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 multimediall, AP 84rofess, NewYork, 1995
4. Peter D. Johnson Jr., Greg A. Harris, D.C. Hankerson, “Introduction to Information Theory and Data Compression”, 2nd Edition, Chapman and Hall/CRC, February 26, 2003.

E-References:

1. http://freevideolectures.com/Course/2278/Data-Communication/30
2. http://nptel.ac.in/courses/106105082/30
3. https://www.coursera.org/lecture/algorithms-part2/introduction-to-data-compression-OtmHU

18ECPE803	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce the concept of software in radio communication.
2.	To deal with the development of community radio systems.
3.	To gain knowledge of SDR and to design communication systems.

UNIT I	INTRODUCTION TO SOFTWARE RADIO	9	+	0

Brief History - Networking and SDR – RF architectures – Processing Architectures - Software Environment – Signal representation – Signal Metrics and Visualization – Receive techniques for SDR.

Unit II	RADIO FREQUENCY TRANSLATION FOR SDR	9	+	0

Requirements and Specification – Receiver Design Considerations: Basic – Receiver Architectures – ACPR and NPR – Receiver Signal Budget – Image Rejection – Filter function within the Receiver –Transmitter Design Considerations – Candidate Architectures for SDR.

Unit III	SDR HARDWARE AND TIMING SYNCHRONIZATION	9	+	0

Components of a Communication System – Strategies for Development in MATLAB – Matched Filtering – Timing Error – Symbol Timing Compensation – Alternative Error Detection and System Requirements – Putting the pieces together.

Unit IV	DATA CONVERSION IN SDR	9	+	0

Importance of Data Converters in SDR: ADCs for SDR base stations – ADCs for SDR Handsets – DACs for SDR Applications – Converter Architectures: Flash converters – Multistage Converters - Sigma_Delta Converters – Digital to Analog Converters – Converter performance Impact on SDR.

Unit V	APPLICATIONS OF SDR	9	+	0

Cognitive Radio :Functions - Components and design rules - Cognition cycle : Orient - Plan - Decide and act phases - Inference Hierarchy - Architecture maps - Building the Cognitive Radio Architecture on Software defined Radio Architecture – Vehicular Networking

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Define the principles of Software defined Radio.
CO2	:	Study the principal Challenge of receiver design.
CO3	:	Perform hardware implementation of Smart antennas.
CO4	:	Understand the Tradeoffs in using DSPs FPGAs and ASICs.

Text Books:

1.	Travis F. Collins, Robin Getz, Di Pu, Alexander M. Wyglinski, “Software-Defined Radio for Engineers”, mobile communication series, 2018.
2.	Jeffrey H. Reed ,”Software Radio: A Modern Approach to Radio Engineering”, Pearson Education Low Price Edition,2002

Reference Books:

1.	“Implementing Software Defined Radio, Springer”,2012th Edition.
2.	JoukoVanakka, “Digital Synthesizers and Transmitter for Software Radio”, Springer, 2005.
3.	HuseyinArslan, “Cognitive Radio, SDR and Adaptive System”, Springer, 2007.
4.	“Dynamic Spectrum Access and Management in Cognitive Radio Networks”, EkramHossain, DusitNiyato, Zhu Han, Cambridge University Press.2008

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3.	https://nptel.ac.in/courses/108107107/5

18ECPE804	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

Prerequiste

- Digital Image Processing

Course Objectives:

1.	To understand pattern and unsupervised classification.
2.	To perform feature extraction and selection.
3.	To understand structural pattern recognition.

Unit I	PATTERN CLASSIFIER	9		0

Overview of pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum likelihood estimation – Bayesian parameter estimation – Perceptron algorithm – LMSE algorithm – Problems with Bayes approach – Pattern classification by distance functions – Minimum distance pattern classifier.

Unit II	UNSUPERVISED CLASSIFICATION	9		0

Clustering for unsupervised learning and classification – Clustering concept – C-means algorithm – Hierarchical clustering procedures – Graph theoretic approach to pattern clustering – Validity of clustering solutions.

Unit III	STRUCTURAL PATTERN RECOGNITION	9		0

Elements of formal grammars – String generation as pattern description – Recognition of syntactic description – Parsing – Stochastic grammars and applications – Graph based structural representation.

Unit IV	FEATURE EXTRACTION AND SELECTION	9		0

Entropy minimization – Karhunen – Loeve transformation – Feature selection through functions approximation – Binary feature selection.

Unit V	RECENT ADVANCES	9		0

Neural network structures for Pattern Recognition – Neural network based Pattern associators – Unsupervised learning in neural Pattern Recognition – Self-organizing networks – Fuzzy logic – Fuzzy pattern classifiers – Pattern classification using Genetic Algorithms.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Solve pattern and unsupervised classification problems.
CO2	:	Perform feature extraction and selection.
CO3	:	Execute structural pattern recognition.
CO4	:	Apply neural network and fuzzy logic technique in pattern recognition.

Text Books:

1.	Robert J.Schalkoff,"Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.
2.	Tou and Gonzales, "Pattern Recognition Principles", Wesley Publication Company, London, 1974

Reference Books:

1.	Duda R.O., and Har P.E., "Pattern Classification and Scene Analysis", Wiley, New York, 1973.
2.	Morton Nadier and Eric Smith P., Pattern Recognition Engineering", John Wiley & Sons, New York, 1993
3.	Theodoridis Dr., Sergios, Konstantinos Koutroumbas , "Pattern Recognition ",4th Edition, Academic Press, 6 November 2008.

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1.	https://www.geeksforgeeks.org/pattern-recognition-introduction/
2.	https://freevideolectures.com/course/3194/pattern-recognition

18ECPE805	SYSTEM ON CHIP DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To know the Concepts and methodology of System on chip.
2. To design different methodology for logic cores, memory cores and analog cores.
3. Learn design validation and SOC testing.

Unit I	INTRODUCTION	9	+	0

System trade offs and evolution of ASIC Technology – System on chip concepts and methodology – SoC design issues – SoC challenges and components.

Unit II	DESIGN METHODOLOGY FOR LOGIC CORES	9	+	0

SoC Design Flow – On-chip buses – Design process for hard cores – Soft and firm cores – Designing with hard cores, soft cores – Core and SoC design examples.

Unit III	DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES	9	+	0

Embedded memories – Simulation modes – Specification of analog circuits – A to D converter – D to A converter – Phase-located loops – High speed I/O

Unit IV	DESIGN VALIDATION	9	+	0

Core level validation – Test benches- SoC design validation – Cosimulation – Hardware/software co-verification.

Unit V	SOC TESTING	9	+	0

SoC Test issues – Testing of digital logic cores – Cores with boundary scan – Test methodology for design resuse – Testing of microprocessor cores – Built in self test method.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the Concepts and methodology of System on chip.
CO2	:	Design different methodology for logic cores, memory cores and analog cores.
CO3	:	Design SOC validation
CO4	:	Test different logic cores.

Text Books:

1. RochitRajsuman, “System-on-a-chip: Design and Test”, Artech House, London, 2000.
2. Laung-Terng Wang, Charles E Stroud and Nur A Toubq, “System on Chip Test Architectures: Nanometer Design for Testability”, Morgan Kaufmann, 2008

Reference Books:

1. WgelBadawy, Graham A Jullien, “System-on-Chip for Real-Time Applications”, Kluwer Academic Press, 2003.
2. Rajanish K Kamat, Santosh A Shinde, Vinod G Shelake, “Unleesh the System-on-Chip using FPGAs and Handle C, Spinger 2009.
3. Steve Furber, “ARM System on Chip Architecture”, 2nd Edition, Addison- Wesley Professional , Aug 2000
4. Ricardo Reis, “Design of System on a Chip: Devices and Components” Springer 1st Edition, July 2004

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2. https://freevideolectures.com/course/2341/embedded-systems/10
3. https://www.elprocus.com/difference-between-soc-system-on-chip-single-board-computer/

18ECPE806	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Pre-Requisites:

1. Computer Networks

Course Objectives:

1. To obtain a broad understanding of the sensor network architecture and design issues.
2. To understand and classify various topologies in wireless sensor networks
3. Have an exposure to sensor network programming platforms and tools.

Unit I OVERVIEW AND ARCHITECTURES 9 + 0

Challenges for Wireless Sensor Networks - Characteristics requirements-required mechanisms - Difference between mobile ad-hoc and sensor networks - Applications of sensor networks - Enabling Technologies for Wireless Sensor Networks - Single-Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes - Operating Systems and Execution Environments - Network Architecture - Sensor Network Scenarios - Optimization Goals and Figures of Merit - Gateway Concepts.

Unit II NETWORKING OF SENSORS 9 + 0

Physical Layer and Transceiver Design Considerations - MAC Protocols for Wireless Sensor Networks - Low Duty Cycle Protocols And Wakeup Concepts - S-MAC - The Mediation Device Protocol - Wakeup Radio Concepts - Address and Name Management - Assignment of MAC Addresses - Routing Protocols - Energy-Efficient Routing - Geographic Routing.

Unit III INFRASTRUCTURE ESTABLISHMENT 9 + 0

Time Synchronization – Introduction to the time synchronization problem – Protocols based on sender / receiver synchronization - Protocols based on receiver/ receiver synchronization - Localization and Positioning – Properties - possible approaches – Mathematical basis for the iteration problem - Single-hop localization – Positioning in multi-hop environments – Impact of anchor placement.

Unit IV TOPOLOGY CONTROL 9 + 0

Motivation and basic ideas – Flat network topologies – Hierarchical networks by dominating sets - Hierarchical networks by clustering – Combining hierarchical topologies and power control – Adaptive node activity – Data aggregation – Data centric storage.

Unit V SENSOR NETWORK PLATFORMS AND TOOLS 9 + 0

Sensor Node Hardware – Berkeley Motes - Programming Challenges - Node-level software platforms - Node-level Simulators - State-centric programming.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Know the basics of wireless sensor networks.
CO2	:	Identify suitable protocols for various layers of wireless sensor networks.
CO3	:	Gain knowledge on various topologies available in wireless sensor networks.
CO4	:	Be familiar with the platforms and tools for wireless sensor networks

Text Books:

1. Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2007.
2. Feng Zhao and Leonidas Guibas, “Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2014.

Reference Books:

1. KazemSohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.
2. WaltenegusDargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, John Wiley & Sons Publications, 2010
3. BhaskarKrishnamachari, ”Networking Wireless Sensors”, Cambridge Press, 2009.
4. Mohammad IlyasandImad Mahgoub,”Handbook Of Sensor Networks: Compact Wireless And Wired Sensing Systems”, CRC Press, 2004.

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18ECPE807	MICROWAVE INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

PREREQUISITE

Knowledge on Microwave Engineering,, Electromagnetic Theory, Transmission Lines.

COURSE OBJECTIVE

1.	To study about the technology of IC's and propagation of signals through Microstrip Transmission
2.	To understand how analyses of fields and microwave circuit design are performed.
3.	To learn coplanar MICs and design of microwave circuits like amplifiers, mixers etc.

Unit I	TECHNOLOGY OF HYBRID MICS & MONOLITHIC MICS	9	+	0

Hybrid MICs: Dielectric substrates - Thick film technology and materials - Thin film technology and materials – Methods of testing – Encapsulation of devices for MICs – Mounting of active devices - MMICs: Processes involved in fabrication – Eitaxial growth of semiconductor layer – Growth of dielectric layer – Diffusion_ion implantation – Electron beam technology.

Unit II	MICROSTRIP TRANSMISSION LINES	9	+	0

Strip lines- Formulas for propagation constant - Characteristic impedance and attenuation - Approximate electrostatic solution - Slot Lines and Coplanar waveguides - Static TEM parameters and design of microstrips - High frequency dispersion effects in microstrips.

Unit III	ANALYSIS OF PASSIVE RECIPROCAL AND NONRECIPROCAL MICROWAVE DEVICES	9	+	0

Passive reciprocal devices: Methods of analysis of passive reciprocal microwave devices - Even and Odd mode method and the Eigen value method - Applications to Microstrip directional couplers – Parallel coupled lines - Coupled micro strips design - Branch line couplers - Lange couplers - Hybrid ring couplers and the Wilkinson power dividers/combiners - Passive Non-Reciprocal Components: Ferromagnetic substrates for non_reciprocal devices – Design of micro strip circulators – Latching circulators – Isolators – Phase shifters.

Unit IV	COPLANAR MICS	9	+	0

Coplanar waveguides - transmission properties - Discontinuities - Introduction to Coplanar MICs - Coplanar transistors and coplanar switches - Coplanar microwave active filters - Coplanar microwave active amplifiers - Coplanar Electronic circulators and Coplanar frequency doublers.

Unit V	MICROWAVE CIRCUIT DESIGN	9	+	0

Microwave amplifier Design – Two port power gain – Stability - Single stage transistor amplifier design - Low noise amplifier design - Broad band amplifier design - Balanced and distributed amplifiers - Design of class A amplifiers - Microwave Oscillator Design - Negative resistance oscillator - Ttransistor oscillators design - Delectric resonator oscillator design - Oscillator phase noise- Microwave mixer - Single ended diode mixer - FET mixer - Balanced mixer - Image reject mixer - Double balanced mixer.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Analyse passive and non-passive reciprocal microwave devices.
CO2	:	Learn the various coplanar MICs and their applications.
CO3	:	Design various microwave circuits like amplifiers, oscillators and mixers.
CO4	:	Gain knowledge on Microwave fabrication technique and microwave transmission lines.

Text Books:

1. K.C.Gupta,, and Amarjit singh , "Microwave Integrated Circuits" , John Wiley and sons – Wiley Eastern Reprint, 2004.
2. Reinmut K. Hoffmann, "Handbook of Microwave Integrated Circuits", Artech House, 1987.

Reference Books:

1. Ingo Wolff, "Coplanar Microwave Integrated Circuits", John Wiley and Sons, 2006.
2. David M.Pozar, "Microwave Engineering", John Wiley and Sons, 2005.
3. I. Kneppo, "Microwave Integrated Circuits", Springer, 1994.
4. Leo G. Maloratsky," Passive RF and Microwave Integrated Circuits", Elsevier, 1999.

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1. http://www.microstripantenna.com/
2. http://nptel.ac.in/courses/117102012
3. https://onlinecourses.nptel.ac.in/noc16_ec02/preview

18ECPE808	PHYSICS OF SENSORS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To have knowledge of the different types of sensors commonly used on mobile robotic platforms
2.	understanding of the basic principles of operation of different types of sensors
3.	To discuss common practices and algorithms for processing raw sensor information

Unit I	INTRODUCTION AND DISPLACEMENT MEASUREMENT	9	+	0

Sensors - Basic requirements of a sensors- Classification of sensors - Static and Dynamic characteristics of sensors - Displacement Sensors - Linear and Rotary displacement sensors – Potentiometer - Capacitive and Inductive type displacement sensor - Position sensors - Optical encoder - Photoelectric sensor - Hall Effect Sensor.

Unit II	MEASUREMENT OF PROXIMITY, FORCE AND PRESSURE	9	+	0

Eddy current proximity sensor - Inductive Proximity sensor - Capacitive Proximity sensor - Pneumatic Proximity sensors - Proximity Switches - Contact and Noncontact type – Strain Gauge – Diaphragm Pressure Sensor- Capsule Pressure sensors - Bellows Pressure Sensor - Bourdon tube pressure sensor - Piezoelectric Sensor - Tactile sensor.

Unit III	MEASUREMENT OF VELOCITY, FLOW AND LEVEL	9	+	0

Tachogenerator - Pyroelectric sensors - Ultrasonic sensor – Resistive sensor - Pitot tube – Orificeplate - flow nozzle- Venturi tubes – Rotameter - Electromagnetic flow meter - Float level sensor- Pressure level sensor- Variable capacitance sensor.

Unit IV	MEASUREMENT OF TEMPERATURE, MOTION AND LIGHT SENS	9	+	0

Thermocouples - Thermistors - Thermodiodes – Thermotransistors – BimetallicStrip - Resistance Temperature Detector - Infrared Thermography - Vibrometer and accelerometer - Seismic accelerometer - Photoresistors - Photodiodes – Phototranistors - Photocondutors.

Unit V	MICRO SENSORS AND ACTUATORS	9	+	0

Micro Sensors: Principles and examples - Force and pressure micro sensors - Position and speed micro sensors - Acceleration micro sensors - Chemical sensors – Biosensors - Temperature micro sensors and flow micro sensors - Micro Actuators: Actuation principle - Shape memory effects - One way, two way and pseudo elasticity - Types of micro actuators – Electrostatic - Magnetic - Fluidic - Inverse piezo effect - Other principles.

Total (L+T)=45 Periods

Course Outcomes:

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

CO1	:	Understandthe basic principles of operation of different types of sensors
CO2	:	Discuss common practices and algorithms for processing raw sensor information
CO3	:	Configure, calibrate and use modern sensors in the context of mobile robots
CO4	:	List the reasons about limitations and advantages of different sensors in different application contexts

Text Books:

1.	Clarence W De Silva, " Sensors and actuators-Control System Instrumentation" , CRC Press, 2007
2.	O. N. Pandey, "Sensors and Instrumentation ', S.K. Kataria& Sons,2013

Reference Books:

1.	Busch-Vishniac Ilene J, "Electromechanical Sensors and Actuators " Springer-Verlag New York Inc., New Edition
2.	Andrzej M Pawlak,"Sensors and Actuators in Mechatronics: Design and Applications", 1st Edition, Kindle Edition, 2006
3.	Rupitsch**,** Stefan Johann," Piezoelectric Sensors and Actuators Fundamentals and Applications", Springer,2019.
4.	Minoru Taya, E. Van Volkenburgh , Makoto Mizunami , Shûhei Nomura, "Bioinspired Actuators and Sensors", 1st Edition, Kindle Edition,2018

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3.	https://nptel.ac.in/courses/112101099/7

18ECPE809	NETWORK SECURITY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand network security, architecture and algorithms.
2.	To study various encryption and decryption standards for network security.
3.	To familiarize with necessary approaches and techniques to build protection mechanisms in order to secure computer networks.

Unit I	INTRODUCTION	9	+	0

Security Goals - Services, Mechanisms and attacks - OSI security architecture - Model of network security - Security trends - Legal, Ethical and Professional Aspects of Security - Need for Security at Multiple levels – Mathematics of Cryptography.

Unit II	SYMMETRIC CRYPTOGRAPHY	9	+	0

Encryption and Decryption – Substitution techniques – Transposition techniques - Block ciphers - Data Encryption Standard - Differential and Linear Cryptanalysis - Block Cipher modes - Advanced Encryption Standard - Triple DES - RC5 - RC4 stream ciphers.

Unit III	PUBLIC KEY ENCRYPTION	9	+	0

Introduction to Number Theory - Public Key cryptography – Rivest_Shamir_Adleman Algorithm (RSA) - Key management - Diffie-Hellman key exchange – Elliptic curve cryptography.

Unit IV	MESSAGE AUTHENTICATION AND INTEGRITY	9	+	0

Authentication requirements and functions – MAC – Hash functions – Security of hash functions and MAC – Secure Hash Algorithms - Digital signature and authentication protocols – Digital Signature Standard.

Unit V	NETWORK AND SYSTEM SECURITY	9	+	0

Authentication applications - E-mail Security - IP security - Web security – Intruders - Malicious Software - Firewalls.

Total (L+T)= 45 Periods

Course Outcomes:

At the end of the course, the student should be able to:

CO1	:	Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
CO2	:	Apply the different cryptographic operations of symmetric cryptographic algorithms and public key cryptography.
CO3	:	Apply the various Authentication schemes to simulate different applications.
CO4	:	Understand various Security practices and System security standards.

Text Books:

1.	William Stallings, “Cryptography and Network Security”, 6th Edition, Principles and Practice”, PHI, 2013.
2.	AtulKahate, “Cryptography and Network security”, 3rd Edition, Tata McGraw-Hill, 2017.

Reference Books:

1.	C K Shyamala, N Harini and Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India Pvt.Ltd, 2011.
2.	Behrouz A Forouson, “Cryptography & Network Security”, 3rd Edition, Tata McGraw hill, 2015.
3.	Charlie Kaufman, Radia Perlman, and Mike Speciner, “Network Security: PRIVATE Communication in a PUBLIC World”, 2nd Edition Prentice Hall, 2002.
4.	Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg,“Network Security: The Complete Reference”, Tata Mcgraw-Hill, 2003.

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2.	https://nptel.ac.in/courses/106106178/10
3.	https://nptel.ac.in/courses/106105031/39

18ECPE810	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Know the different orbits based on various laws of Kepler and calculation of elevation and azimuth angle based on geostationary orbits.
2.	Describe the various subsystems and outline the fundamental concepts of control mechanism and Calculate the power requirement in satellite communication for uplink and down link.
3.	Have the knowledge of multiple access techniques, services provided by satellite communication.

Unit I **OVERVIEW OF SATELLITE SYSTEMS, ORBITS AND LAUNCHING METHODS** **9 + 0**

Introduction – Frequency Allocations for Satellite Services – INTELSAT – U.S.Domsats – Polar Orbiting Satellites. Kepler's First Law – Kepler's Second Law – Kepler's Third Law – Definitions of Terms for Earth - orbiting Satellites – Orbital Elements – Apogee and Perigee Heights – Orbital Perturbations - Local Mean Solar Time and Sun - Synchronous Orbits.

Unit II **GEOSTATIONARY ORBIT & SPACE SEGMENT** **9 + 0**

Introduction – Antenna Look Angels – The Polar Mount Antenna – Limits of Visibility – Near Geostationary Orbits – Earth Eclipse of Satellite – Sun Transit Outage – Launching Orbits - Power Supply – Attitude Control – Station Keeping – Thermal Control – TT&C Subsystem – Transponders - Antenna Subsystem – Morelos and Satmex5 – Anik-Satellites – Advanced Tiros - N Spacecraft.

Unit III **EARTH SEGMENT & SPACE LINK** **9 + 0**

Receive_Only Home TV Systems – Master Antenna TV System – Community Antenna TV System – Transmit_Receive Earth Stations - Equivalent Isotropic Radiated Power – Transmission Losses : Free-Space Transmission – Feeder Losses – Antenna Misalignment Losses – Fixed Atmospheric and Ionospheric Losses – Link Power Budget Equation – Carrier-to-Noise Ratio – Uplink – Down link - Effects of rain – Combined Uplink and Downlink C/N Ratio – Inter modulation Noise.

Unit IV **SATELLITE ACCESS** **9 + 0**

Single Access – Preassigned FDMA - Demand-Assigned FDMA - SPADE System - Bandwidth-limited and Power-limited TWT amplifier operation - TDMA -On-board signal Processing for TDMA / FDMA operation - Satellite switched TDMA - Code Division Multiple Access.

Unit V **SATELLITE TV, MOBILE AND SPECIALIZED SERVICES** **9 + 0**

Direct Broadcast Satellite (DBS) Television - Orbital Spacing - Power Rating and Number of Transponders - Frequencies and Polarization -Transponder capacity - Bit rates for digital Television -The Home Receiver Outdoor Unit(ODU)-The Home Receiver Indoor Unit(IDU) – HDTV - Satellite Mobile Services – VSATs - GPS.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the orbital laws and elements of satellite communication.
CO2	:	Understand the concept of geostationary orbit and the station keeping.
CO3	:	Know the concept of different earth segments and noise interference.
CO4	:	Know the available satellite access methods, direct satellite services and various applications.

Text Books:

1.	Dennis Roddy, Satellite Communications, Tata McGraw-Hill Education Private Limited, fourth edition, 2009
2.	Barry George Evans, Satellite communication systems, 3rd Edition, IET Publications 1999

Reference Books:

1.	Timothy Pratt – Charles Bostian& Jeremy Allmuti, Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd. 2004
2.	Wilbur L. Pritchars Henri G.SuyderHond Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd., Second edition 2003..
3.	M.Richharia, Satellite Communication Systems (Design Principles Macmillan Press Ltd. Second Edition 2003.
4.	Satellite communication engineering By Michael O. Kolawole, CRC Press, 2002.

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2.	http://nptel.ac.in/courses/106105082/33
3.	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-851-satellite-engineering-fall-2003/lecture-notes/

18ECPE811	BIO-MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To gain knowledge about various physiological parameters and their measurements.
2.	To examine the internal organs through imaging techniques.
3.	To gain knowledge about equipment used for physical medicine and various recently developed diagnostics and therapeutic techniques.

Unit I	BIOELECTRIC SIGNALS AND ELECTRODES	9	+	0

Brief introduction to human physiology - Origin of Bio electric signals- characteristics and its typical waveform [ECG, EEG, EMG, EOG, ERG] - Recording electrodes: electrode tissue interface- contact impedance - effects of high contact impedance- Types of electrodes- electrodes for ECG, EEG and EMG.

Unit II	NON ELECTRICAL PARAMETER MEASUREMENT AND PATIENT MONITORING	9	+	0

Audiometer - Electromagnetic Flow meter - Ultrasonic Flow meters - Heart rate measurement - Pulse rate measurement- Transmission and Reflectance method - Respiration rate measurement - Blood pressure measurement: Direct and indirect method - microprocessor applications in patient monitoring.

Unit III	MEDICAL IMAGING SYSTEM	9	+	0

Radiography - Computed Radiography - Computed Tomography – MRI - Nuclear medicine - Positron Emission Tomography.

Unit IV	THERAPEUTIC AND PROSTHETIC DEVICES	9	+	0

Cardiac Pacemakers – Defibrillators – Haemodialysis – Ventilators - Infant Incubators - Drug Delivery devices - Surgical Instruments - Therapeutic applications of LASER.

Unit V	PATIENT SAFETY AND CLINICAL LABORATORY INSTRUMENTATION	9	+	0

Electric Shock hazards - Leakage Currents - Safety codes and standards for electro medical equipment - electrical safety analyser - testing of biomedical equipment – Spectrophotometry - Automated chemical analysers.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Know the human body electro- physiological parameters and recording of bio-potentials.
CO2	:	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
CO3	:	Examine the internal organs through imaging.
CO4	:	Distinguish diagnostic equipment from therapeutic equipment.

Text Books:

1. Khandpur, R.S., Handbook of Biomedical Instrumentation, Third ed, Tata McGraw- Hill, 2014
2. John G. Webster, Medical Instrumentation Application and Design, John Wiley and Sons, 4th ed, 2010

Reference Books:

1. Joseph J.Carr and John M.Brown, Introduction to Biomedical equipment Technology, Fourth ed, Pearson Education, 2001.
2. Kim E.Barrett, Susan M.Barman, Scott Boitano, HeddwenL.Brooks, Ganong's Review of Medical Physiology, 24th Ed, McGraw Hill, 2012.
3. W. Mark Saltzman, Biomedical Engineering, Second ed, Cambridge University Press, 2015.
4. C.Raja Rao, S.K.Guha, Principles of Medical electronics and biomedical instrumentation, Universities Press, 2001

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2. https://ocw.mit.edu/courses/mechanical-engineering/2-996-biomedical-devices-design-laboratory-fall-2007/lecture-notes/
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18ECPE812	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

Prerequiste

- Linear Algebra

Course Objectives:

1.	To provide a strong foundation of fundamental concepts in Artificial Intelligence.
2.	To enable the student to apply these techniques in applications which involve perception, reasoning and learning.
3.	To enable Problem-solving through various searching techniques.

Unit I	**INTRODUCTION TO AI AND PRODUCTION SYSTEMS**	**9**		**0**

Introduction to AI-Problem formulation - Problem Definition - Production systems - Control strategies - Search strategies - Problem characteristics - Production system characteristics - Specialized production system - Problem solving methods - Problem graphs – Matching - Indexing and Heuristic functions - Hill Climbing - Depth first and Breath first - Constraints satisfaction - Related algorithms - Measure of performance and analysis of search algorithms.

Unit II	**REPRESENTATION OF KNOWLEDGE**	**9**		**0**

Game playing - Knowledge representation - Knowledge representation using Predicate logic - Introduction to predicate calculus – Resolution - Use of predicate calculus - Knowledge representation using other logic - Structured representation of knowledge. .

Unit III	**KNOWLEDGE INFERENCE**	**9**		**0**

Knowledge representation - Production based system - Frame based system - Inference - Backward chaining - Forward chaining - Rule value approach - Fuzzy reasoning - Certainty factors - Bayesian Theory - Bayesian Network -Dempster - Shafer theory.

Unit IV	**PLANNING AND MACHINE LEARNING**	**9**		**0**

Basic plan generation systems - Strips - Advanced plan generation systems – K strips - Strategic explanations - Why, Why not and how explanations - Learning - Machine learning - Adaptive Learning.

Unit V	**EXPERT SYSTEMS**	**9**		**0**

Expert systems - Architecture of expert systems - Roles of expert systems - Knowledge Acquisition – Meta knowledge- Heuristics - Typical expert systems – MYCIN - DART - XOON - Expert systems shells.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Provides a basic exposition to the goals and methods of Artificial Intelligence
CO2	:	Study of the design of intelligent computational agents
CO3	:	The knowledge acquired through learning can be used both for problem solving and for reasoning planning, natural language understanding, computer vision, automatic programming and machine learning.
CO4	:	To enhance their knowledge in their Research works in future.

Text Books:

1.	Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third Edition, Pearson Education / Prentice Hall of India, 2010.
2.	Elaine Rich and Kevin Knight, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill, 2010.

Reference Books:

1.	EthemAlpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning series)”, The MIT Press; Second edition, 2009.
2.	Patrick H. Winston. "Artificial Intelligence", Third edition, Pearson Edition, 2006.
3.	David L. Poole, Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, Cambridge University Press, 2010.
4.	Machine Learning by Rajiv Chopra Khanna Publishing; First edition, 2018.

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1.	https://www.coursera.org/learn/machine-learning
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3.	https://www.udemy.com/machine-learning-course-with-python/

OPEN ELECTIVES (OE)

18ECOE01	FUNDAMENTALS OF ELECTRON DEVICES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the fundamentals of semiconductor diodes.
2. To acquaint with the construction, theory and operation of the basic electronic devices such as BJT and FET.
3. To study Power control devices and Opto-electronic devices.

Unit I	SEMICONDUCTOR DIODES	9	+	0

PN junction diode - Current equations - Diffusion and drift current densities - Forward and reverse bias characteristics - Switching Characteristics.

Unit II	BIPOLAR JUNCTION TRANSISTORS	9	+	0

NPN and PNP type - Early effect-Current equations – Input and Output characteristics of CE, CB, CC configurations - Hybrid -π model - h-parameter model - Ebers Moll Model - Gummel Poon-model.

Unit III	FIELD EFFECT TRANSISTORS	9	+	0

JFETs – Drain and Transfer characteristics - Current equations - Pinch off voltage and its significance - MOSFET- Characteristics- Threshold voltage - Channel length modulation - D-MOSFET- E-MOSFET-

Unit IV	SPECIAL SEMICONDUCTOR DEVICES	9	+	0

Metal - Semiconductor Junction – MESFET - Schottky barrier diode - Zener diode -Varactor diode –Tunnel diode - Gallium Arsenide device - LASER diode - LDR.

Unit V	POWER DEVICES AND DISPLAY DEVICES	9	+	0

UJT- SCR – Diac – Triac - Power BJT- Power MOSFET- DMOS – VMOS – LED – LCD - Photo transistor - Opto Coupler - Solar cell - CCD.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the characteristics of diodes and special semiconductor devices.
CO2	:	Describe the various configurations and equivalent circuits of Bipolar Junction Transistors.
CO3	:	Have in depth knowledge on working principles and characteristics of FET.
CO4	:	Acquire knowledge on Power and display devices.

Text Books:

1. Donald A Neaman, “Semiconductor Physics and Devices”, 4th Edition, Tata McGraw Hill, 2017.
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory” 11th edition, PHI, 2013.

Reference Books:

1. Yang, “Fundamentals of Semiconductor devices”, McGraw Hill International Edition, 1978.
2. Jacob Millman, Christos C. Halkias and SatyabrataJit, “Electronic Devices and Circuits” 4th Edition, McGraw Hill Education, 2015
3. S. Salivahanan and N. Suresh kumar, “Electronic Devices and Circuits”, 4th edition, McGraw Hill Education, 2017.
4. Ben G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson, 2014.

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1. http://www.radio-electronics.com/info/data/semicond/semiconductor/semiconductor-materials-types-list.php
2. http://911electronic.com/
3. http://www.electronics-tutorials.ws/

18ECOE02	PRINCIPLES OF MODERN COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To have the knowledge of the basic concepts of AM, FM and PM.
2.	To gain knowledge about different pulse modulation and digital modulation techniques.
3.	To gain knowledge about technical information on satellite communication and .wireless communication

UNIT I	FUNDAMENTALS OF ANALOG COMMUNICATION	9	+	0

Modulation: Introduction - Amplitude modulation: Modulator and demodulator with waveforms - Angle Modulation: Frequency modulation - Phase modulation - Equivalence between PM and FM - FM transmitters and receivers (Block diagram approach only) - Comparison of various Analog Communication System (AM – FM – PM).

UNIT II	BASICS OF DIGITAL COMMUNICATION AND PULSE MODULATION	9	+	0

Pulse Amplitude Modulation (PAM) – Pulse Width Modulation (PWM) – Pulse code Modulation (PCM)–Differential Pulse Code Modulation - Pulse Position modulation: Generation and detection - Comparison of various Pulse Communication System (PAM – PWM – PCM -PPM).

Unit III	DIGITAL MODULATION TECHNIQUES	9	+	0

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) - Minimum Shift Keying (MSK) –Binary Phase Shift Keying (BPSK) – QPSK –M-ary PSK- Quadrature Amplitude Modulation (QAM) – M_ary QAM(Block diagram approach only) - Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

Unit IV	SATELLITE COMMUNICATION	9	+	0

History of Satellites-Kepler's laws - Satellite Orbits-Geosynchrous Satellites - Satellite Classification - Footprints - Satellite system link models: Uplink model and down link model - Muliple Access Techniques: TDMA - FDMA-CDMA - Comparison of Multiple Access Schemes - various satellite services.

Unit V	CELLULAR MOBILE COMMUNICATION	9	+	0

Cellular concept - Frequency reuse-Channel Assignment Strategy - Hand off mechanism - Example for wireless communication systems Basic propagation models:Reflection - diffraction and scattering - Blue Tooth-WLL-Global System for Mobile Communications (GSM) –GPRS.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Understand the need for modulation and how analog modulation takes place
CO2	:	Know the advantage of digital communication and digital modulation schemes.
CO3	:	Have the knowledge about satellite communication.
CO4	:	Have the basics of wireless and mobile communication.

Text Books:

1.	Dennis Roddy, John Coolen, "Electronic Communications", Prentice Hall of India, 4th Edition.,2016
2.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2010

Reference Books:

1.	Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
2.	H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
3.	B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
4.	Anokh Singh , "Principles of Communication Engineering" ,S.CHAND Publication, 2002

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1.	http://www.nptelvideos.in/2012/11/communication-engineering.html
2.	https://www.tutorialspoint.com/analog_communication/analog_communication_introduction.htm
3.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-973-communication-system-design-spring-2006/lecture-notes/

18ECOE03	MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Understand the basic architecture of 8051 microcontroller.
2.	To Understand the interrupt system of 8051 and the use of interrupts.
3.	To develop skill in simple applications development with programming 8051.

Unit I	8051 ARCHITECTURE	9	+	0

8051 Microcontroller - 8051 Architecture- Registers - Pin diagram - I/O ports functions - Internal Memory organization - External Memory (ROM & RAM) interfacing.

Unit II	8051 INSTRUCTION SET	9	+	0

Addressing Modes - Data Transfer instructions - Arithmetic instructions - Logical instructions - Branch instructions - Bit manipulation instructions - Simple Assembly language program examples (without loops) to use these instructions.

Unit III	ASSEMBLY LANGUAGE PROGRAMMING Of 8051	9	+	0

Assembly language programming - Jump Loop and Call Instructions - I/O Port Programming - Addressing Modes - Arithmatical and Logical Instructions.

Unit IV	8051 TIMERS AND SERIAL PORT	9	+	0

8051 Timers and Counters – Operation and Assembly language programming to generate a L1, L2, L3 pulse using Mode-1 and a square wave using Mode - 2 on a port pin - 8051 Serial Communication - Basics of Serial Data Communication - RS-232 standard - 9 pin RS232 signals - Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

Unit V	8051 INTERRUPTS AND INTERFACING APPLICATIONS	9	+	0

8051 Interrupts - 8051 Assembly language programming to generate an external interrupt using a switch - 8051 C programming to generate a square waveform on a port pin using a Timer interrupt - Interfacing 8051 to ADC-0804 - LCD and Stepper motor and their 8051 Assembly language interfacing programming.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Knowledge on architecture and programming concepts 8051 Microcontroller.
CO2	:	Knowledge on peripheral interfacing concepts.
CO3	:	Classify and understand assembly language instructions and skills for assembly language programming.
CO4	:	Apply assembly language programming to interface develop microcontroller applications.

Text Books:

1.	"The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
2.	"The 8051 Microcontroller", Kenneth J. Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1.	John Uffenbeck, The 80x86 Family, Design, Programming and Interfacing,3rd Edition. Pearson Education, 2002.
2.	A.K. Ray and K.M.Burchandi, "Intel Microprocessors Architecture Programming and Interfacing", McGraw Hill International Edition, 2000
3.	Manish K Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
4.	Raj Kamal,"Microcontrollers: Architecture, Programming, Interfacing and System Design", , Pearson Education, 2005

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1.	http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html
2	https://www.eit.edu.au/cms/resources/technical-resourses/types-and-applications-of-microcontrollers
3	https://www.edgefx.in/8051-microcontroller-architecture/

18ECOE04	BASIC VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To familiarize with the VLSI fabrication technology.
2. To design MOS circuits.
3. To get knowledge on FPGA and VHDL.

Unit I **VLSI FABRICATION TECHNOLOGY** **9 + 0**

Material Preparation – Fabrication processes - Fabrication process sequence for basic devices – BiCMOS process flow.

Unit II **MOS TRANSISTOR THEORY** **9 + 0**

nMOS transistor – Derivation of drain current – channel length modulation – threshold voltage – CMOS inverter - DC characteristics.

Unit III **DATA PATH SYSTEMS** **9 + 0**

Datapath Subsystems - Addition/Subtraction - One/Zero Detectors - Comparators - Counters - Boolean Logical Operations - Coding - Shifters - Multiplication.

Unit IV **FPGA AND ITS APPLICATIONS** **9 + 0**

FPGA structural classification – FPGA classification on user programmable switch technologies – logic block and routing techniques – FPGA design flow.

Unit V **INTRODUCTION TO VHDL** **9 + 0**

Introduction – VHDL versus conventional programming languages – The VHDL design flow - Basic structure – entity declaration – architecture body – VHDL signal and signal assignment – Basic statements – Simulation versus synthesis – Functions and procedures.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1 : Know the VLSI fabrication technology.
CO2 : Design MOS transistor circuits.
CO3 : Analyze CMOS circuits
CO4 : Write simple programs in VHDL and know FPGA and its applications

Text Books:

1. Douglas A Pucknell, Kamran Eshraghian, “Basic VLSI Design Principles and Applications”, PHI, 2006.
2. V.G.Kirankumar, H.R.Nagesh, “Introduction to VLSI design”, Pearson, 2011.

Reference Books:

1. Neil H.E.Weste, David Harris, Ayan Banerjee, “CMOS VLSI Design A Circuits and Systems Perspective”, Pearson, 2012.
2. K.Lal Kishore, VSV Prabhakar, “VLSI design”, I.K. Int. Pub., 2010.
3. M. Michael Vai, “VLSI design”, CRC press, 2001.
4. ParthaPratimSahu, “VLSI design”, TMH, 2013.

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2. https://www.tutorialspoint.com/vlsi_design/vlsi_design_useful_resources.htm
3. https://nptel.ac.in/courses/117101058/

18ECOE05	BASICS OF EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3
Prerequisite: Microcontrollers					

Course Objectives:

1.	To impart knowledge on embedded system architecture and embedded development Strategies
2.	To understand the bus Communication in processors and peripheral interfacing
3.	To understand basics of Real Time Operating System

Unit I	**BASICS OF EMBEDDED SYSTEMS**	**8**	**+**	**0**

Introduction - Fundamental Components of Embedded Systems - Challenges for Embedded Systems - Examples - Programming Languages - Recent Trends in Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Selection Process - Hardware Software Partitioning - Development Environment.

Unit II	**MEMORY MANAGEMENT AND INTERRUPTS**	**9**	**+**	**0**

Memory Access Procedure - Types of Memory - Memory Management Methods - DMA - Memory Interfacing - Polling Vs Interrupts - Types of Interrupts - Interrupt Latency - Interrupt Priority - Programmable Interrupt Controllers - Interrupt Service Routines.

Unit III	**COMMUNICATION INTERFACES**	**9**	**+**	**0**

Interfacing Buses - Serial Interfaces - RS232/UART - RS422/RS485 - I2C Interface - SPI Interface - USB – CAN - IRDA - Ethernet - IEEE 802.11 – Bluetooth.

Unit IV	**REAL TIME OPERATING SYSTEMS**	**10**	**+**	**0**

Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Inter Task Communication - Mutex - Semaphores - Message Queues - Timers - Commercial RTOS.

Unit V	**VALIDATION AND DEBUGGING**	**9**	**+**	**0**

Host and Target Machines - Validation Types and Methods - Host Testing - Host-Based Testing Setup - Target Testing - Remote Debuggers and Debug Kernels - ROM Emulator - Logical Analyzer - Background Debug Mode - InCircuit Emulator CASE STUDY: RFID Systems - GPS Navigation System - Development of Protocol Converter

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Outline the concepts of embedded systems.
CO2	:	Understand the concept of memory management system and interfaces.
CO3	:	Understand real time operating system
CO4	:	Design and Analyze the real-time applications of embedded-systems

Text Books:

1.	Arnold S Berger, —Embedded Systems Design - An Introduction to Processes, Tools and Techniques, Elsevier, New Delhi, 2011.
2.	Prasad K V K K, —Embedded/Real-Time Systems: Concepts, Design and Programming - The Ultimate Reference, Himal Impressions, New Delhi, 2003.

Reference Books:

1.	Sriram V Iyer and Pankaj Gupta, —Embedded Real-time Systems Programming‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2.	Steve Heath, —Embedded Systems Design‖, Newnes an Imprint of Elsevier, Massachusetts, 2003.
3.	Tammy Noergaard, —Embedded Systems Architecture‖, Newnes an Imprint of Elsevier, Massachusetts, 2006.
4.	Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013

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1	https://lecturenotes.in/subject/225/embedded-system-es
2	https://nptel.ac.in/courses/108102045/19
3	https://www.coursera.org/learn/introduction-embedded-systems.

18ECOE06	BASICS OF INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To gain knowledge on M2M and IoT design methodology.
2.	To understand the various IoT components.
3.	To Build small system using Raspberry Pi.

UNIT I	FUNDAMENTALS OF IOT	9	+	0

Introduction-Definition and Characteristics of IoT- Physical design- IoT Protocols-Logical design - IoT communication models, IoT Communication APIs- Enabling technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates – Domain specific IoTs.

UNIT II	M2M AND IOT DESIGN METHODOLOGY	9	+	0

IoT and M2M- difference between IoT and M2M – Software defined networks, Network function virtualization– IoT design methodology.

UNIT III	IOT COMPONENTS	9	+	0

Sensors and actuators – Communication modules – Zigbee- RFID-Wi-Fi-Power sources.

UNIT IV	BUILDING IOT WITH HARDWARE PLATFORMS	9	+	0

IoT Systems-Logical Design using Python –IoT Physical Devices and End Points- IoT Device - Raspberry Pi-Interfaces – Programming – Other IoT devices.

Unit V	REAL TIME APPLICATIONS	9	+	0

Home automation-Automatic lighting-Home intrusion detection- Cities-Smart parking-Environment-Weather monitoring system-Air pollution Monitoring-Forest Fire Detection- Agriculture- Smart irrigation.

Total (L+T)= 45 Periods

Course Outcomes:

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

CO1	:	Differentiate M2M and IoT design methodology.
CO2	:	Describe the various IoT components.
CO3	:	Design small system using Raspberry Pi.
CO4	:	Discuss the various applications of IoT.

Text Books:

1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things-A hands-on approach”, Universities Press, 2015
2.	Olivier Hersent, davidBoswarthick, Omar Elloumi, ‘The Internet of Things Applications to the smart grid and building automation’, John Wiley & Sons, 2012.

Reference Books:

1.	Marco Schwartz, — Internet of Things with the Arduino Yun, Packt Publishing, 2014
2.	Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley Publications, 2012.
3.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd edition, 2013.
4.	HakimaChaouchi, ‘The Internet of Things Connecting Objects’, John Wiley & Sons, 2010.

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1.	Introduction to IoT NPTEL video lectures by Dr. Sudip Misra, IIT Kharagpur 2017.
2.	https://nptel.ac.in/courses/106105166
3.	https://nptel.ac.in/courses/108108098