Miracle Educational Society Group of Institutions(A)

Bhoghapuram-535216

DEPARTMENT OF BASIC SCIENCE & HUMANITIES

===

Course Structure & Syllabus for

BS&H- ELECTRONICS & COMMUNICATION ENGINEERING

(Regular-Full time)

(Effective for the students admitted into I year from the Academic Year 2024-25 onwards)

Academic Regulations (R23)

Academic Regulations (R23) for B. Tech (Regular-Full time)

(Effective for the students admitted into I year from
the Academic Year **2023-24** onwards)

1. **Award of the Degree**
   (a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:
      (i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).
      (ii) Registers for 160 credits and secures all 160 credits.

   (b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:
      (i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 160 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. This clause shall be read along with clause 1 a) i).

3. **Admissions**
   Admission to the B. Tech Program shall be made subject to the eligibility, qualifications and specialization prescribed by the A.P. State Government/University from time to time. Admissions shall be made either based on the merit rank obtained by the student in the common entrance examination conducted by the A.P. Government/University or any other order of merit approved by the A.P. Government/University, subject to reservations as prescribed by the Government/University from time to time.

4. **Program related terms**
   Credit: A unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit Definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hrs. Practical (Lab) per week	1 credit

a) ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

b) ***Choice Based Credit System (CBCS):*** The CBCS provides a choice for students to select from the prescribed courses.

5. **Semester/Credits:**

   i) A semester comprises 90 working days and an academic year is divided into two semesters.

   ii) The summer term is for eight weeks during summer vacation. Internship/ apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.

   iii) Regular courses may also be completed well in advance through MOOCs satisfying prerequisites.

6. **Structure of the Undergraduate Programme**
   All courses offered for the undergraduate program (B. Tech.) are broadly classified as follows:

S.No.	Category	Breakup of Credits (Total 160)	Percentage of total credits	AICTE Recommendation (%)
1.	Humanities and Social Science including Management (HM)	13	8 %	8 – 9%
2.	Basic Sciences (BS)	20	13 %	12 - 16%
3.	Engineering Sciences (ES)	23.5	14%	10 – 18%
4.	Professional Core (PC)	54.5	34 %	30 – 36%
5.	Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SEC)	33	21 %	19 - 23%
6.	Internships & Project work (PR)	16	10 %	8 – 11%
7.	Mandatory Courses (MC)	Non-credit	Non-credit	-

7. **Course Classification:**
   All subjects/ courses offered for the undergraduate programme in Engineering & Technology (B.Tech. degree programmes) are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Foundation Courses	Foundation courses	Includes Mathematics, Physics and Chemistry; fundamental engineering courses; humanities, social sciences and management courses
2.	Core Courses	Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
3.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include interdisciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
		Domain specific skill enhancement courses (SEC)	interdisciplinary/job-oriented/domain courses which are relevant to the industry
4.	Project & Internships	Project	B.Tech. Project or Major Project
		Internships	Summer Internships – Community based and Industry Internships; Industry oriented Full Semester Internship
5.	Audit Courses	Mandatory non-credit courses	Covering subjects of developing desired attitude among the learners

8. Programme Pattern

i. Total duration of the of B. Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for freshers, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.
vi. Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
vii. Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
viii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.

ix. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.

x. A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the courses offered through various verticals/tracks under Open Electives.

xi. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.

xii. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain/interdisciplinary courses and the other shall be a soft skills course.

xiii. Students shall undergo mandatory summer internships, for a minimum of eight weeks duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.

xiv. There shall also be mandatory full internship in the final semester of the programme along with the project work.

xv. Undergraduate degree with Honors is introduced by the University for the students having good academic record.

xvi. Each college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

xvii. Each college shall assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/career growth/placements/opportunities for higher studies/GATE/other competitive exams etc.

xviii. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

9. Evaluation Process

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. Summer Internships shall be evaluated for 50 marks, Full Internship &Project work in final semester shall be evaluated for 200 marks, mandatory courses with no credits shall be evaluated for 30 mid semester marks.

A student has to secure not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester and end examination marks taken together for the theory, practical, design, drawing subject or project etc. In case of a mandatory course, he/she should secure 40% of the total marks.

Theory Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

i) For theory subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination.
ii) For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination.
iii) If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.
iv) If any subject is having both theory and practical components, they will be evaluated separately as theory subject and practical subject. However, they will be given same subject code with an extension of 'T' for theory subject and 'P' for practical subject.

a) Continuous Internal Evaluation

i) For theory subjects, during the semester, there shall be two midterm examinations. Each midterm examination shall be evaluated for 30 marks of which 10 marks for objective paper (20 minutes duration), 15 marks for subjective paper (90 minutes duration) and 5 marks for assignment.
ii) Objective paper shall contain for 05 short answer questions with 2 marks each or maximum of 20 bits for 10 marks. Subjective paper shall contain 3 either or type questions (totally six questions from 1 to 6) of which student has to answer one from each either-or type of questions. Each question carries 10 marks. The marks obtained in the subjective paper are condensed to 15 marks.

Note:

- The objective paper shall be prepared in line with the quality of competitive examinations questions.
- The subjective paper shall contain 3 either or type questions of equal weightage of 10 marks. Any fraction shall be rounded off to the next higher mark.
- The objective paper shall be conducted by the respective institution on the day of subjective paper test.
- Assignments shall be in the form of problems, mini projects, design problems, slip tests, quizzes etc., depending on the course content. It should be continuous assessment throughout the semester and the average marks shall be considered.

iii) If the student is absent for the mid semester examination, no re-exam shall be conducted and mid semester marks for that examination shall be considered as zero.

iv) First midterm examination shall be conducted for I, II units of syllabus with one either or type question from each unit and third either or type question from both the units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.

v) Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage given to the better mid exam and 20% to the other.

For Example:

Marks obtained in first mid: 25
Marks obtained in second mid: 20
Final mid semester Marks: (25x0.8) + (20x0.2) = 24

If the student is absent for any one midterm examination, the final mid semester marks shall be arrived at by considering 80% weightage to the marks secured by the student in the appeared examination and zero to the other. For Example:

Marks obtained in first mid: Absent
Marks obtained in second mid: 25
Final mid semester Marks: (25x0.8) + (0x0.2) =20

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern:

i) There shall be 6 questions and all questions are compulsory.
ii) Question I shall contain 10 compulsory short answer questions for a total of 20marks such that each question carries 2 marks.
iii) There shall be 2 short answer questions from each unit.
a) In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.

End examination of theory subjects consisting of two parts of different subjects, for Example: Basic Electrical &Electronics Engineering shall have the following pattern:

i) Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
ii) In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.
iii) In each part, questions from 2 to 4, there shall be either/or type questions of 10 marks each. Student shall answer any one of them.
iv) The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

Practical Courses

Assessment Method	Marks
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

b) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.

c) Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the record/viva and 15 marks for the internal test.

d) The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.
   - Procedure: 20 marks
   - Experimental work & Results: 30 marks
   - Viva voce: 20 marks.

   In a practical subject consisting of two parts (Eg: Basic Electrical &Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a single laboratory in 3 hours. Mid semester examination shall be evaluated as above for 30 marks in each part and final mid semester marks shall be arrived by considering the average of marks obtained in two parts.

e) For the subject having design and/or drawing, such as Engineering Drawing, the distribution of marks shall be 30 for mid semester evaluation and 70 for end examination.

Assessment Method	**Marks**
Continuous Internal Assessment	30
Semester End Examination	70
Total	**100**

   Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class. And there shall be two midterm examinations in a semester for duration of 2 hours each for 15 marks with weightage of 80% to better mid marks and 20% for the other. The subjective paper shall contain 3 either or type questions of equal weightage of 5 marks. There shall be no objective paper in mid semester examination. The sum of day-to-day evaluation and the mid semester marks will be the final sessional marks for the subject.

   The end examination pattern for Engineering Graphics, shall consists of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination. However, the end examination pattern for other subjects related to design/drawing , multiple branches, etc is mentioned along with the syllabus.

f) There shall be no external examination for mandatory courses with zero credits. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 40% or more in the internal examinations. In case, the student fails, a reexamination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in item 1 & 2 of the regulations.

g) The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

10. Skill oriented Courses

i) There shall be five skill-oriented courses offered during III to VII semesters.

ii) Out of the five skill courses two shall be skill-oriented courses from the same domain. Of the remaining three skill courses, one shall be a soft skill course and the remaining two shall be skill-advanced courses from the same domain/Interdisciplinary/Job oriented.

iii) The course shall carry 100 marks and shall be evaluated through continuous assessments during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the class / laboratory shall be evaluated for 30 marks by the concerned teacher based on the regularity/assignments/viva/mid semester test. The end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the subject nominated by the principal.

iv) The Head of the Department shall identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process. The marks/grades shall be assigned to the students by the above committee based on their performance.

v) The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

vi) The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the University at the beginning of the semester. The principal of the respective college shall forward such proposals to the University for approval.

vii) If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the University.

11. Massive Open Online Courses (MOOCs):

A Student has to pursue and complete one course compulsorily through MOOCs approved by the University. A student can pursue courses other than core through MOOCs and it is mandatory to complete one course successfully through MOOCs for awarding the degree. A student is not permitted to register and pursue core courses through MOOCs.

A student shall register for the course (Minimum of either 8 weeks or 12 weeks) offered through MOOCs with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the student's progression. The student needs to earn a certificate by passing the exam. The student shall be awarded the credits assigned in the curriculum only by submission of the certificate. Examination fee, if any, will be borne by the student.

Students who have qualified in the proctored examinations conducted through MOOCs platform can apply for credit transfer as specified and are exempted from appearing internal as well as external examination (for the specified equivalent credit course only) conducted by the university.

Necessary amendments in rules and regulations regarding adoption of MOOC courses would be proposed from time to time.

12. Credit Transfer Policy

Adoption of MOOCs is mandatory, to enable Blended model of teaching-learning as also envisaged in the NEP 2020. As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e., maximum of 32 credits through MOOCs platform.

i) The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses.
ii) Student registration for the MOOCs shall be only through the respective department of the institution, it is mandatory for the student to share necessary information with the department.
iii) Credit transfer policy will be applicable to the Professional & Open Elective courses only.
iv) The concerned department shall identify the courses permitted for credit transfer.
v) The University/institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer.
vi) The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.
vii) The university shall ensure no overlap of MOOC exams with that of the university examination schedule. In case of delay in results, the university will re-issue the marks sheet for such students.
viii) Student pursuing courses under MOOCs shall acquire the required credits only

after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

ix) The institution shall submit the following to the examination section of the university:
   a) List of students who have passed MOOC courses in the current semester along with the certificate of completion.
   b) Undertaking form filled by the students for credit transfer.

x) The universities shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall be permitted to register for MOOCs offered through online platforms approved by the University from time to time.

13. Academic Bank of Credits (ABC)

The University has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

i. provide option of mobility for learners across the universities of their choice
ii. provide option to gain the credits through MOOCs from approved digital platforms.
iii. facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
iv. execute Multiple Entry and Exit system with credit count, credit transfer and credit acceptance from students' account.

14. Mandatory Internships

Summer Internships : Two summer internships either onsite or virtual each with a minimum of 08 weeks duration, done at the end of second and third years, respectively are mandatory. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the Undergraduate program. One of the two summer internships at the end of second year (Community Service Project) shall be society oriented and shall be completed in collaboration with government organizations/NGOs & others. The other internship at the end of third year is Industry Internship and shall be completed in collaboration with Industries. The student shall register for the internship as per course structure after commencement of academic year. The guidelines issued by the APSCHE / University shall be followed for carrying out and evaluation of Community Service Project and Industry Internship.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. The report and the oral presentation shall carry 50% weightage each. It shall be evaluated for 50 external marks. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the University.

Full Semester Internship and Project work: In the final semester, the student should mandatorily register and undergo internship (onsite/virtual) and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship.

The project report shall be evaluated with an external examiner. The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the University and is evaluated for 140 marks.

The college shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

15. Guidelines for offering a Minor

To promote interdisciplinary knowledge among the students, the students admitted into B.Tech. in a major stream/branch are eligible to obtain degree in Minor in another stream.

i) The Minor program requires the completion of 12 credits in Minor stream chosen.
ii) Two courses for 06 credits related to a Minor are to be pursued compulsorily for the minor degree, but maybe waived for students who have done similar/equivalent courses. If waived for a student, then the student must take an extra elective course in its place. It is recommended that students should complete the compulsory courses (or equivalents) before registering for the electives.
iii) Electives (minimum of 2 courses) to complete a total of 12 credits.

Note: A total of 04 Open Electives are offered in the curriculum. A student can complete the requirement for Minor by opting for the courses offered through various verticals/tracks under Open Electives.

16. Guidelines for offering Honors

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The programme is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B. Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.
ii) A student shall earn additional 15 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline (i.e., 160 credits).
iii) A student is permitted to register for Honors in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to the Honors from V Semester onwards.
iv) The concerned Principal of the college shall arrange separate class work and timetable of the courses offered under Honors program.
v) Courses that are used to fulfil the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.
vi) Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.
vii) The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.
viii) A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
ix) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree programme.
x) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
xi) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering

Enrolment into Honors:

i) Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline
ii) The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to III semester in case of regular entry students and only III semester in case of lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.
iii) If a student is detained due to lack of attendance either in Major or in Honors, registration shall be cancelled.

iv) Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.
v) Honors is to be completed simultaneously with a Major degree program.

Registration for Honors:

i) The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors.
ii) The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.
iii) The students enrolled in the Honors courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.
iv) There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

17. Attendance Requirements:

i) A student shall be eligible to appear for the University external examinations if he/she acquires a minimum of 40% attendance in each subject and 75% of attendance in aggregate of all the subjects. b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.
ii) Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.
iii) A stipulated fee shall be payable towards condonation of shortage of attendance to the University.
iv) Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.
vi) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
vii) If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

18. For induction programme attendance shall be maintained as per AICTE norms. Promotion Rules:

The following academic requirements must be satisfied in addition to the attendance requirements mentioned in section 16.

i) A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per university norms.

ii) A student will be promoted from II to III year if he/she fulfils the academic requirement of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) up to in the subjects that have been studied up to III semester.

iii) A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any ***decimal*** fraction should be ***rounded off*** to ***lower*** digit) in the subjects that have been studied up to V semester.

And in case a student is detained for want of credits for a particular academic year by ii) & iii) above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V semester or VII semester respectively as the case may be.

iv) When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

19. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	**Grade**	**Grade points Assigned**
90 & above	Superior	10
80 - 89	A (Excellent)	9
70 - 79	B (Very Good)	8
60 - 69	C (Good)	7
50 - 59	D (Average)	6
40 - 49	E (Pass)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.

ii) For non-credit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative GradePoint Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$$

where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

$$CGPA = \Sigma (C_i \times S_i)/ \Sigma C_i$$

where "S_i" is the SGPA of the i^{th} semester and C_i is the total numberof credits up to that semester.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.
Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters S, A, B, C, D and F.

Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree, he/she shall be placed in one of the following four classes:

Class Awarded	**CGPA Secured**
First Class with Distinction	≥ 7.5
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 5.0 < 5.5

CGPA to Percentage conversion Formula – (CGPA – 0.5) x 10

20. With–holding of Results

If the candidate has any dues not paid to the university or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld in such cases.

21. Multiple Entry / Exit Option

(a) Exit Policy:

The students can choose to exit the four-year programme at the end of first/second/third year.

i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.

iii) **Bachelor of Science (in Field of study/discipline)** i.e., **B.Sc. Engineering in (Field of study/discipline)**- Programme duration: First three years (first six semesters) of the undergraduate programme, 120 credits.

(b) Entry Policy:

Modalities on multiple entry by the student into the B.Tech. programme will be provided in due course of time.

Note: The Universities shall resolve any issues that may arise in the implementation of Multiple Entry and Exit policies from time to time and shall review the policies in the light of periodic changes brought by UGC, AICTE and State government.

22. Gap Year Concept:

Gap year concept for Student Entrepreneur in Residence is introduced and outstanding students who wish to pursue entrepreneurship / become entrepreneur are allowed to take a break of one year at any time after II year to pursue full-time entrepreneurship programme/to establish startups. This period may be extended to two years at the most and these two years would not be counted for the time for the maximum time for graduation. The principal of the respective college shall forward such proposals submitted by the students to the University. An evaluation committee constituted by the University shall evaluate the proposal submitted by the student and the committee shall decide whether to permit the student(s) to avail the Gap Year or not

23. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

Candidates who are permitted to avail Gap Year shall be eligible for re-joining into the succeeding year of their B. Tech from the date of commencement of class work, subject to Section **2** and they will follow the academic regulations into which they are readmitted.

24. Minimum Instruction Days for a Semester:

The minimum instruction days including exams for each semester shall be 90 days.

25. Medium of Instruction:

The medium of instruction of the entire B. Tech undergraduate programme in Engineering &Technology (including examinations and project reports) will be in English only.

26. Student Transfers:

Student transfers shall be as per the guidelines issued by the Government of Andhra Pradesh and the Universities from time to time.

27. General Instructions:

i. The academic regulations should be read as a whole for purpose of any interpretation.
ii. Malpractices rules-nature and punishments are appended.
iii. Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.
iv. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
v. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.
vi. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final.

*** *** ***

ACADEMIC REGULATIONS (R23)

FOR B. TECH. (LATERAL ENTRY SCHEME)

*(Effective for the students admitted into II year through Lateral Entry Scheme from the Academic Year **2024-25** onwards)*

1. **Award of the Degree**
   (a) Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:
      (i) Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).
      (ii) Registers for 120 credits and secures all 120 credits.

   (b) **Award of B.Tech. degree with Honors** if he/she fulfils the following:
      (i) Student secures additional 15 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors is to be completed simultaneously with B.Tech. programme.

2. Students, who fail to fulfil the requirement for the award of the degree within six consecutive academic years from the year of admission, shall forfeit their seat.

3. **Minimum Academic Requirements**
   The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.**2**
   i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

   ii. A student shall be promoted from III year to IV year if he/she fulfils the academic requirements of securing 40% of the credits (any decimal fraction should be rounded off to lower digit) in the subjects that have been studied up to V semester.

   And in case if student is already detained for want of credits for particular academic year, the student may make up the credits through supplementary exams of the above exams before the commencement of IV year I semester class work of next year.

4. Course Pattern

i) The entire course of study is three academic years on semester pattern.

ii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

5. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA
VIZIANAGARAM-535 003, A.P
(Established by Andhra Pradesh Act No.22 of 2021)
==

B. Tech (Regular-Full time)

Electronics and Communication Engineering

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

B.TECH. - COURSE STRUCTURE – R23
(Applicable from the academic year 2023-24 onwards)

INDUCTION PROGRAMME

S.No.	Course Name	Category	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches -- career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

I Year I Semester						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS01	Linear Algebra & Calculus	3	0	0	3
2.	R23BS04	Chemistry	3	0	0	3
3.	R23ES07	Introduction to Programming	3	0	0	3
4.	R23ES03	Engineering Graphics	1	0	4	3
5.	R23ES04	Basic Electrical & Electronics Engineering	3	0	0	3
6.	R23BS04	Chemistry Lab	0	0	2	1
7.	R23ES07	Computer Programming Lab	0	0	3	1.5
8.	R23ES05	Electrical &Electronics Engineering Workshop	0	0	3	1.5
9.	R23MC02	NSS/NCC/Scouts &Guides/Community Service	0	0	1	0.5
		Total				**19.5**

I Year II Semester						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BS02	Differential Equations and Vector Calculus	3	0	0	3
2.	R23BS03	Engineering Physics	3	0	0	3
3.	R23HS01	Communicative English	2	0	0	2
4.	R23ES01	Basic Civil & Mechanical Engineering	3	0	0	3
5.	R23PC01	Network Analysis	3	0	0	3
6.	R23HS01	Communicative English Lab	0	0	2	1
7.	R23BS03	Engineering Physics Lab	0	0	2	1
8.	R23ES06	IT workshop	0	0	2	1
9.	R23ES02	Engineering Workshop	0	0	3	1.5
10.	R23PC01	Network Analysis And Simulation Laboratory	0	0	3	1.5
11.	R23MC01	Health and Wellness, Yoga and Sports	0	0	1	0.5
		Total				**20.5**

I Year-I Semester

L	T	P	C
3	0	0	3

LINEAR ALGEBRA & CALCULUS

(Common to All Branches of Engineering)

Course Objectives:

To equip the students with standard concepts and tools of mathematics to handle various real-world problems and their applications.

Course Outcomes:

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

- develop matrix algebra techniques that is needed by engineers for practical applications.
- to find the eigen values and eigen vectors and solve the problems by using linear transformation
- learn important tools of calculus in higher dimensions.
- familiarize with functions of several variables which is useful in optimization.
- familiarize with double and triple integrals of functions of several variables in two and three dimensions.

UNIT - I: Matrices

Rank of a matrix by echelon form, normal form. Cauchy –Binet formulae (without proof). Inverse of Non- singular matrices by Gauss-Jordan method

System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT- II: Linear Transformation and Orthogonal Transformation:

Eigen values, Eigen vectors and their properties(without Proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation

UNIT- III : Calculus

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT- IV : Partial differentiation and Applications (Multi variable calculus)

Partial derivatives, total derivatives, chain rule, change of variables, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

UNIT – V : Multiple Integrals (Multi variable Calculus)

Duble integrals - change of variables (Cartesian and Polar coordinates), Change of order of integration, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text books:

1. B.S.Grewal,HigherEngineeringMathematics,44/e,KhannaPublishers,2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley & Sons, 2018.

Reference Books:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd.,2021 (9th reprint).
2. George B. Thomas, Maurice D.Weir and Joel Hass, Thomas Calculus,14/e, Pearson Publishers, 2018.
3. Glyn James, Advanced Modern Engineering Mathematics, 5/e, Pearson publishers, 2018.
4. Michael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
5. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand,2021

I Year-I Semester

L	T	P	C
3	0	0	3

CHEMISTRY

Course Objectives:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- To introduce instrumental methods, molecular machines and switches.

Course Outcomes: At the end of the course, the students will be able to:
CO1: Compare the materials of construction for battery and electrochemical sensors.
CO2: Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers.
CO3: Explain the principles of spectrometry, slc in separation of solid and liquid mixtures.
CO4: Apply the principle of Band diagrams in the application of conductors and semiconductors.
CO5: Summarize the concepts of Instrumental methods.

UNIT I Structure and Bonding Models:

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ^2, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II Modern Engineering materials

Semiconductors – Introduction, basic concept, application

Super conductors-Introduction basic concept, applications.

Supercapacitors: Introduction, Basic Concept-Classification – Applications.

Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon nano tubes and Graphines nanoparticles.

UNIT III Electrochemistry and Applications

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygenfuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

UNIT IV Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation.

Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications. Bio-Degradable polymers - Poly Glycolic Acid (PGA), Polyl Lactic Acid (PLA).

UNIT V Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. J.D. Lee, Concise Inorganic Chemistry, 5^{th} Edition, Wiley Publications, Feb.2008
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

L	T	P	C
3	0	0	3

I Year-I Semester

INTRODUCTION TO PROGRAMMING
(Common to All branches of Engineering)

Course Objectives:

The objectives of this course is to acquire knowledge on the
i. To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
ii. To enable effective usage of Control Structures and Implement different operations on arrays.
iii. To demonstrate the use of Strings and Functions.
iv. To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
v. To understand structures and unions and illustrate the file concepts and its operations.
vi. To impart the Knowledge Searching and Sorting Techniques

UNIT-I Introduction to Computer Problem Solving:
Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II Introduction to C Programming:
Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion. Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement**.**

UNIT-III Arrays:
Introduction, Operations on Arrays, Arrays as Function Arguments, Two Dimensional Arrays, Multidimensional Arrays. Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments.

UNIT-IV Functions:
Introduction Function : Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion. Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

UNIT-V
Structures, Unions, Bit Fields:Introduction, Nested Structures, Arrays of Structures, Structures

and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields. Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Note: The syllabus is designed with C Language as the fundamental language of implementation.

Course Outcomes:

At the end of the Course, Student should be able to:

i . Illustrate the Fundamental concepts of Computers and basics of computer programming and problem-solving approach

ii. Understand the Control Structures, branching and looping statements

iii. Use of Arrays and Pointers in solving complex problems.

iv. Develop Modular program aspects and Strings fundamentals.

v. Demonstrate the ideas of User Defined Data types, files. Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

1. A Structured Programming Approach Using C, Forouzan, Gilberg, Cengage.
2. How to solve it by Computer, R. G. Dromey, and Pearson Education.
3. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson

References:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2. Computer Programming. Reema Thareja, Oxford University Press
3. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
4. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.
5. Let us C ,YaswanthKanetkar, 16th Edition,BPB Publication.
6.Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008

Web References:

1. http://www.c4learn.com/
2. http://www.geeksforgeeks.org/c/
3. http://nptel.ac.in/courses/122104019/
4. http://www.learn-c.org/
5. https://www.tutorialspoint.com/cprogramming/

I Year-I Semester

L	T	P	C
1	0	4	3

ENGINEERING GRAPHICS

(Common to All branches of Engineering)

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

Course Outcomes:

CO1: Understand the principles of engineering drawing, including engineering curves, scales, orthographic and isometric projections.
CO2: Draw and interpret orthographic projections of points, lines, planes and solids in front, top and side views.
CO3: Understand and draw projection of solids in various positions in first quadrant.
CO4: Explain principles behind development of surfaces.
CO5: Prepare isometric and perspective sections of simple solids.

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D&3D drawings ofobjects including PCB and Transformations using Auto CAD (*Not for end examination*).

Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

I Year-I Semester

L	T	P	C
3	0	0	3

BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common to All branches of Engineering)

Course Objectives

To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

Course Outcomes: After the completion of the course students will be able to

Course Outcomes:
CO1: Remember the fundamental laws, operating principles of motors, generators, MC and MI instruments.
CO2: Understand the problem solving concepts associated to AC and DC circuits, construction and operation of AC and DC machines, measuring instruments; different power generation mechanisms, Electricity billing concept and important safety measures related to electrical operations.
CO3: Apply mathematical tools and fundamental concepts to derive various equations related to machines, circuits and measuring instruments; electricity bill calculations and layout representation of electrical power systems.
CO4: Analyze different electrical circuits, performance of machines and measuring instruments.
CO5: Evaluate different circuit configurations, Machine performance and Power systems operation.

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Textbooks:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

- To teach the fundamentals of semiconductor devices and its applications, principles of digital electronics.

UNIT I SEMICONDUCTOR DEVICES

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Textbooks:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009

L	T	P	C
0	0	2	1

I Year-I Semester

CHEMISTRY LAB

Course Objectives:

- Verify the fundamental concepts with experiments.

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

CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer Bakelite materials.
CO3: Measure the strength of an acid present in secondary batteries.
CO4: Analyse the IR spectra of some organic compounds.
CO5: Calculate strength of acid in Pb-Acid battery.

List of Experiments:

1. Measurement of 10Dq by spectrophotometric method
2. Conductometric titration of strong acid vs. strong base
3. Conductometric titration of weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a Bakelite
8. Verify Lambert-Beer's law
9. Wavelength measurement of sample through UV-Visible Spectroscopy
10. Identification of simple organic compounds by IR
11. Preparation of nanomaterials by precipitation method
12. Estimation of Ferrous Iron by Dichrometry

Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

I Year-I Semester

L	T	P	C
0	0	3	1.5

COMPUTER PROGRAMMING LAB
(Common to All branches of Engineering)

Course Objectives:

The course aims to give students hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes:
CO1: Read, understand, and trace the execution of programs written in C language.
CO2: Select the right control structure for solving the problem.
CO3: Develop C programs which utilize memory efficiently using programming constructs like pointers.
CO4: Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

UNIT I

WEEK 1
Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:
Tutorial 1: Problem-solving using Computers.
Lab1: Familiarization with programming environment
- i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- ii) Exposure to Turbo C, gcc
- iii) Writing simple programs using printf(), scanf()

WEEK 2
Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:
Tutorial 2: Problem-solving using Algorithms and Flow charts.
Lab 1: Converting algorithms/flow charts into C Source code.
Developing the algorithms/flowcharts for the following sample programs
- i) Sum and average of 3 numbers
- ii) Conversion of Fahrenheit to Celsius and vice versa
- iii) Simple interest calculation

WEEK 3
Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:
Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.
- i) Finding the square root of a given number
- ii) Finding compound interest
- iii) Area of a triangle using heron's formulae
- iv) Distance travelled by an object

UNIT II

WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:
Lab4: Simple computational problems using the operator' precedence and associativity
- i) Evaluate the following expressions.
  - a. A+B*C+(D*E) + F*G
  - b. A/B*C-B+A*D/3
  - c. A+++B---A
  - d. J= (i++) + (++i)
- ii) Find the maximum of three numbers using conditional operator
- iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:
Tutorial 5: Branching and logical expressions:
Lab 5: Problems involving if-then-else structures.
- i) Write a C program to find the max and min of four numbers using if-else.
- ii) Write a C program to generate electricity bill.
- iii) Find the roots of the quadratic equation.
- iv) Write a C program to simulate a calculator using switch case.
- v) Write a C program to find the given year is a leap year or not.

WEEK 6
Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and For loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops
Lab 6: Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

UNIT III

WEEK 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2’s complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8:
Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:
Tutorial 8: 2 D arrays, sorting and Strings.
Lab 8: Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT IV

WEEK 9:
Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation
Lab 9: Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

WEEK 10:
Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10 : Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:
Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

WEEK 12:
Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:
Tutorial 12: Recursion, the structure of recursive calls
Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.

iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13:
Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:
Tutorial 13: Call by reference, dangling pointers
Lab 13: Simple functions using Call by reference, Dangling pointers.
i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14:
Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:
Tutorial 14: File handling
Lab 14: File operations
i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Textbooks:
1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

I Year-I Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Course Outcomes:

CO1: Understand the Electrical circuit design concept; measurement of resistance, power, power factor; concept of wiring and operation of Electrical Machines and Transformer.
CO2: Apply the theoretical concepts and operating principles to derive mathematical models for circuits, Electrical machines and measuring instruments; calculations for the measurement of resistance, power and power factor.
CO3: Apply the theoretical concepts to obtain calculations for the measurement of resistance, power and power factor.
CO4: Analyse various characteristics of electrical circuits, electrical machines and measuring instruments.
CO5: Design suitable circuits and methodologies for the measurement of various electrical parameters; Household and commercial wiring.

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
    - Provide some exercises so that hardware tools and instruments are learned to be used by the students.

2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
    - Provide some exercises so that measuring instruments are learned to be used by the students.

3. Components:
    - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package,

symbol, cost etc.

- Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed.

PART B: ELECTRONICS ENGINEERING LAB

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

Course Outcomes: At the end of the course, the student will be able to
CO1: Identify & testing of various electronic components.
CO2: Understand the usage of electronic measuring instruments.
CO3: Plot and discuss the characteristics of various electron devices.
CO4: Explain the operation of a digital circuit.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.

2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

References:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4^{th} Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software

I Year-I Semester

L	T	P	C
0	0	1	0.5

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE
(Common to All branches of Engineering)

Course Objectives:
The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the students will be able to
CO1: Understand the importance of discipline, character and service motto.
CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3: Explore human relationships by analyzing social problems.
CO4: Determine to extend their help for the fellow beings and downtrodden people.
CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation
General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:
i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care
Activities:
i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III Community Service
Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authoritiesexperts-etc.

ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

*** *** ***

I Year-II Semester

L	T	P	C
3	0	0	3

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All Branches of Engineering)

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them in to advanced level by handling various real-world applications.

Course Outcomes:

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

- solve the differential equations related to various engineering fields.
- model engineering problems as higher order differential equations and solve analytically.
- identify solution methods for partial differential equations that model physical processes.
- interpret the physical meaning of different operators such as gradient, curl and divergence.
- estimate the work done against a field, circulation and flux using vector calculus.

UNIT- I : Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits

UNIT – II : Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general particular integral, Wronskean, method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT – III : Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT - IV : Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions - Divergence and Curl, vector identities

UNIT –V : Vector integration

Line integral- circulation- work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley & Sons, 2018.
2. B.S.Grewal,HigherEngineeringMathematics,44/e,Khanna publishers,2017.

Reference Books:

1. Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2. Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
5. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017

L	T	P	C
3	0	0	3

I Year-II Semester

ENGINEERING PHYSICS

(Common for all branches of Engineering)

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes:

CO1: Analyze the intensity variation of light due to polarization, interference and diffraction.
CO2: Familiarize with the basics of crystals and their structures.
CO3: Explain fundamentals of quantum mechanics and apply it to one dimensional motion of particles.
CO4: Summarize various types of polarization of dielectrics and classify the magnetic materials.
CO5: Explain the basic concepts of Quantum Mechanics and the band theory of solids.
CO6: Identify the type of semiconductor using Hall effect.

UNIT I Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.
Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation

polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT IV Quantum Mechanics and Free electron Theory

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT V Semiconductors

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

Textbooks:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

L	T	P	C
2	0	0	2

I Year-II Semester

COMMUNICATIVE ENGLISH

(Common to All Branches of Engineering)

Course Objectives:

The main objective of introducing this course, *Communicative English*, is to facilitate using Listening, Reading, Speaking and Writing skills effectively by the students. It should result in their better comprehending abilities, oral presentations, reporting useful information and with enhanced knowledge of grammatical structures and vocabulary. This course helps the students in using speaking and writing (productive) skills more efficiently and to make them industry-ready

Course Outcomes

- **By the end of the course the students will have** Learned how to understand the context, topic, and specific information from social or transactional dialogues.
- Remedially learn applying grammatical structures to formulate sentence sand use appropriate words and correct word forms.
- Using discourse markers to speak clearly on a specific topic in formal as well as informal discussions.(not required)
- Improved communicative competence in formal and informal contexts and for social and academic purposes.
- Critically comprehending and appreciatingading /listening texts and to write summaries based on global comprehension of these texts.
- Writing coherent paragraphs essays, letters/e-mails and resume.

Instructions:

1. The reading texts can be given as podcasts to the students so that their listening skills can be enhanced
2. While listening and reading to the text can be given as homework, the classwork for the students can be to discuss and critically evaluate the texts based on the context, purpose or writing the text and understanding it from the author's as well as reader's point of view.
3. Reading as habit for both academic and non-academic (pleasure) purposes has to be inculcated in the students. So training has to be given in intensive and extensive reading strategies.
4. Writing for both academic (assignments, examinations, reports, e-mails/letters etc)
5. The writing tasks given in the class are to be self and peer evaluated by the students before they are finally graded by the faculty.

Note: Please note that the texts given here are just contexts for teaching various language skills and sub skills. The students' ability to use language cannot be confined to comprehending or using the language related to the given texts (textbooks). The given texts can be used only for practice.

6. All the activities to develop language skills have to be integrated and interconnected, within each unit and across the units.

7. Use as many supplementary materials as possible in various modes (Audio, visual and printed versions) in the classroom so that the students get multimode input and will how to use language skills in the absence of the teacher.

UNIT I

Lesson: HUMAN VALUES: A Power of a Plate of Rice by Ifeoma Okoye (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.(That has to be part of the bridge course- 2 weeks before the actual academic programme starts)

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNITII

Lesson: NATURE: Night of the Scorpion by Nissim Ezekiel (Indian and contemporary)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices -linkers,use of articles and zero article prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNITIII

Lesson: BIOGRAPHY Steve Jobs

Listening: Listening for global comprehension and summarizing what is listened.

Speaking: Discussing specific topics in pairs or small groups and reporting whatis discussed

Reading: Readingatextindetailbymakingbasicinferences-recognizingandinterpretingspecific contextclues;strategies touse textclues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses;subject-verbagreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing :Official Letters, Resumes
Grammar: Reporting verbs, Direct & Indirect speech, Active& Passive Voice
Vocabulary: Words often confused, Jargons

UNIT V
Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic on texts
Reading: Reading comprehension.
Writing: Writings structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject-verb agreement)
Vocabulary: Technical Jargons

Textbooks:
1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition,Orient BlackSwan, 2023 (Units 1,2 & 3)
2. Empowering English by Cengage Publications, 2023 (Units 4 & 5)

Suggestion: Instead of giving the syllabus in the form of textbooks it would be better toprocurethe soft copies of individual texts (stories or poems or biographies and non-fiction texts)by the university and make them available on the university website for registered students to access and download

Reference Books:
1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:
GRAMMAR:
1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/

5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

L	T	P	C
3	0	0	3

I Year-II Semester

BASIC CIVIL & MECHANICAL ENGINEERING
(Common to All branches of Engineering)

Course Objectives:
- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

Course Outcomes: On completion of the course, the student should be able to:
CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.
CO2: Know the concepts of surveying and to understand the measurement of distances, angles and levels through surveying.
CO3: Realize the importance of Transportation in nation's economy and the engineering measures related to Transportation.
CO4: Understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated.
CO5: Understand the basic characteristics of Civil Engineering Materials and attain knowledge on prefabricated technology.

UNIT I
Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II
Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III
Transportation Engineering Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives: The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

Course Outcomes: On completion of the course, the student should be able to
CO1: Understand the different manufacturing processes.
CO2: Explain the basics of thermal engineering and its applications.
CO3: Describe the working of different mechanical power transmission systems and power plants.
CO4: Describe the basics of robotics and its applications.

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.
Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.
Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.
Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.
Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.

I Year-II Semester

L	T	P	C
3	0	0	3

NETWORK ANALYSIS
(ECE & allied branches)

Course Objectives:

- To introduce basic laws, mesh & nodal analysis techniques for solving electrical circuits
- To impart knowledge on applying appropriate theorem for electrical circuit analysis
- To explain transient behavior of circuits in time and frequency domains
- To teach concepts of resonance
- To introduce open circuit, short circuit, transmission, hybrid parameters and their interrelationship.

Course Outcomes: At the end of this course students will demonstrate the ability to

CO1: Understand basic electrical circuits with nodal and mesh analysis.
CO2: Analyse the circuit using network simplification theorems.
CO3: Find Transient response and Steady state response of a network.
CO4: Analyse electrical networks in the Laplace domain.
CO5: Compute the parameters of a two-port network.

UNIT I

Types of circuit components, Types of Sources and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources also. Principal of Duality with examples.

Network Theorems: Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens - problem solving using dependent sources also.

UNIT II

Transients: First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots.

Laplace transform: introduction, Laplace transformation, basic theorems, problem solving using Laplace transform, partial fraction expansion, Heaviside's expansions, problem solving using Laplace transform.

UNIT III

Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L-C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving using Laplace transforms also.

UNIT IV

Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies.

Coupled Circuits: Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, conductively coupled equivalent circuits- problem solving.

UNIT V

Two-port Networks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solving using dependent sources also.

Image and iterative impedances. Image and iterative transfer constants. Insertion loss. Attenuators and pads. Lattice network and its parameters. Impedance matching networks.

Textbooks:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.
2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020.
3. Network lines and Fields by John. D. Ryder 2nd Edition, PHI

Reference Books:

1. D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013.
2. Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017

Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku,McGraw-Hill Education

I Year-II Semester

L	T	P	C
0	0	2	1

COMMUNICATIVE ENGLISH LAB

(Common to All Branches of Engineering)

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

Course Outcomes:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2: Apply communication skills through various language learning activities.
CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5: Create effective Course Objectives:

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Suggested Software:

- Walden Infotech
- Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed), Kindle, 2013

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

I Year-II Semester

L	T	P	C
0	0	2	1

ENGINEERING PHYSICS LAB
(Common to All Branches of Engineering)

Course Objectives:

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

Course Outcomes: The students will be able to
CO1: Operate optical instruments like travelling microscope and spectrometer.
CO2: Estimate the wavelengths of different colours using diffraction grating.
CO3: Plot the intensity of the magnetic field of circular coil carrying current with distance.
CO4: Evaluate dielectric constant and magnetic susceptibility for dielectric and magnetic materials respectively.
CO5: Calculate the band gap of a given semiconductor.
CO6: Identify the type of semiconductor using Hall effect.

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's

experiment.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

References:

- A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

Web Resources

- www.vlab.co.in

https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

I Year-II Semester

L	T	P	C
0	0	2	1

IT WORKSHOP

(Common to all branches of Engineering)

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSS
- To teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

Course Outcomes:

CO1: Perform Hardware troubleshooting.
CO2: Understand Hardware components and inter dependencies.
CO3: Safeguard computer systems from viruses/worms.
CO4: Document/ Presentation preparation.
CO5: Perform calculations using spreadsheets.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

2. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
3. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
4. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
5. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
6. LaTeX Companion, Leslie Lamport, PHI/Pearson.
7. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
8. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

I Year-II Semester

L	T	P	C
0	0	3	1.5

ENGINEERING WORKSHOP
(Common to All branches of Engineering)

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

I Year-II Semester

L	T	P	C
0	0	3	1.5

NETWORK ANALYSIS AND SIMULATION LABORATORY
(ECE & allied branches)

Course Objectives:
- To gain hands on experience in verifying Kirchoff's laws and network theorems
- To analyze transient behavior of circuits
- To study resonance characteristics
- To determine 2-port network parameters

Course Outcomes:
CO1: Verify Kirchoff's laws and network theorems.
CO2: Measure time constants of RL & RC circuits.
CO3: Analyze behavior of RLC circuit for different cases.
CO4: Design resonant circuit for given specifications.
CO5: Characterize and model the network in terms of all network parameters.

The following experiments need to be performed using both Hardware and simulation Software.

The experiments need to be simulated using software and the same need to be verified using the hardware.

1. Study of components of a circuit and Verification of KCL and KVL.
2. Verification of mesh and nodal analysis for AC circuits
3. Verification of Superposition, Thevenin's & Norton theorems for AC circuits
4. Verification of maximum power transfer theorem for AC circuits
5. Verification of Tellegen's theorem for two networks of the same topology.
6. Study of DC transients in RL, RC and RLC circuits
7. To study frequency response of various 1^{st} order RL & RC networks
8. To study the transient and steady state response of a 2^{nd} order circuit by varying its various parameters and studying their effects on responses
9. Find the Q Factor and Bandwidth of a Series and Parallel Resonance circuit.
10. Determination of open circuit (Z) and short circuit (Y) parameters
11. Determination of hybrid (H) and transmission (ABCD) parameters
12. To measure two port parameters of a twin-T network and study its frequency response.

Hardware Requirements:

Regulated Power supplies, Analog/Digital Function Generators, Digital Multimeters, Decade Resistance Boxes/Rheostats, Decade Capacitance Boxes, Ammeters (Analog or Digital), Voltmeters (Analog or Digital), Active & Passive Electronic Components

Software requirements:

Multisim/ Pspice/Equivalent simulation software tool, Computer Systems with required specifications

References:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.
2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020.

I Year-II Semester

L	T	P	C
0	0	1	0.5

HEALTH AND WELLNESS, YOGA AND SPORTS
(Common to All branches of Engineering)

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and

Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

****

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Department of Electronics and Communication Engineering

COURSE STRUCTURE

(Applicable from the academic year 2023-24 onwards)

B.Tech.– II Year I Semester

S. No	Category	Title	L	T	P	Credits
1	BS	Random Variables and Stochastic	3	0	0	3
2	HSMC	Universal Human Values– Understanding Harmony and Ethical Human Conduct	2	1	0	3
3	ES	Signals and Systems	3	0	0	3
4	PCC	Electronic Devices and Circuits	3	0	0	3
5	PCC	Digital Circuits Design	3	0	0	3
6	PCC	Electronic Devices and Circuits Lab	0	0	3	1.5
7	PCC	Digital Design & Signal Simulation lab	0	0	3	1.5
8	SEC	Python Programming	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	-
		Total	**16**	**02**	**08**	**20**

B.Tech.– II Year II Semester

S. No	Category	Title	L	T	P	Credits
1	HSMC	Managerial Economics and Financial Analysis	2	0	0	2
2	ES	Linear Control Systems	3	0	0	3
3	PCC	EM Waves and Transmission Lines	3	0	0	3
4	PCC	Analog Circuits Design	3	0	0	3
5	PCC	Analog and Digital Communications	3	0	0	3
6	PCC	Analog Circuits Design Lab	0	0	3	1.5
7	PCC	Analog and Digital Communications	0	0	3	1.5
8	SEC	Soft Skills	0	1	2	2
9	ES	Design Thinking and Innovation	1	0	2	2
		Total	**15**	**01**	**10**	**21**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

RANDOM VARIABLES AND STOCHASTIC PROCESSES

Course Objectives:

- To give students an introduction to elementary probability theory, in preparation to learn the concepts of statistical analysis, random variables and stochastic processes.
- To mathematically model the random phenomena with the help of probability theory concepts.
- To introduce the important concepts of random variables and stochastic processes.
- To analyze the LTI systems with stationary and om process as input.
- To introduce the types of noise and modelling noise sources.

Unit-I

The Random Variable

Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

Unit-II

Operation On One Random Variable-Expectations

Introduction, Expected Value of a Random Variable, function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebyshev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non-monotonic Transformations of Continuous Random Variable.

Unit-III

Multiple Random Variables

Vector Random Variables , Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions.

Operations On Multiple Random Variables

Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly

Gaussian Random Variables: Two Random Variables case, N Random Variables case, properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

Unit-IV

Random Processes–Temporal Characteristics

The Random Process Concept, Classification of Processes, Deterministic and Non deterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict- Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.

Unit-V

Random Processes-Spectral characteristics

The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Auto correlation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function.

Linear Systems with Random Inputs

Random Signal Response of Linear Systems: SystemResponse–Convolution,MeanandMean-squaredValueofSystemResponse, Auto correlation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output.

Text Books:

1. Probability, Random Variables & Random Signal Principles, PeytonZ.Peebles, TMH,4thEdition,2001.
2. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S.Unnikrisha, PHI,4thEdition,2002.
3. Probability and Random Processes with Applications to Signal Processing, Henry Stark and JohnW.Woods, Pearson Education, 3rdEdition, 2001.

Reference Books:

1. Schaum's Outline of Probability, Random Variables, and Random Processes,1997.
2. An Introduction to Random Signals and Communication Theory, B.P.Lathi, International Textbook, 1968.
3. Probability Theory and Random Processes, P.Ramesh Babu, McGrawHill, 2015.

Course Outcomes:

After completion of the course, the student will be able to

- Mathematically model the random phenomena and solve simple probabilistic problems.
- Identify different types of random variables and compute statistical averages of single random variable.
- Understand multiple random variable concepts, compute statically average of multiple random variables
- Characterize the random processes in the time
- Characterization in frequency domain and analyze the LTI systems with random inputs.

****

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one’s self, and one’s surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher’s Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I

Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9: The body as an Instrument of the self

Lecture 10: Understanding Harmony in the self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self

Lecture 11: Harmony of the self with the body

Lecture 12: Programme to ensure self-regulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction

Lecture 14: 'Trust' – the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' – as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship

Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among

the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for

UNIT I – Introduction to Value Education

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being

PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self

PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

Readings:

Textbook and Teachers Manual

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up ”ordinary” situations rather than” extra-ordinary” situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf

2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

SIGNALS AND SYSTEMS

Course Objectives:

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, correlation and sampling.

UNIT-I

Signals & Systems: definition of signal & system, basic operations on signals, classification of signals, basic continuous time signals and continuous time systems, classification of discrete time signals and systems. Analogy between vectors and signals, Orthogonality, mean square error, complete set of orthogonal functions.Vector spaces, Inner Product spaces, Schwartz inequality, Hilbert spaces, Bessel's inequality and Parseval's relations.

UNIT-II

Linear Time Invariant (LTI) Systems: Time-Domain representation & Characterization of LTI systems, Impulse response representation, Convolution integral & Convolution sum, properties of LTI systems, Stability criteria for LTI systems, Elements of Continuous time & Discrete-time LTI systems. Circular Convolution. Concepts of Correlation of signals, properties, applications.

UNIT-III

Fourier Representation of Signals: Fourier representation of Signals, Continuous -time Fourier series and their properties, Application of Fourier series to LTI systems, Fourier Transform & its properties, Applications of Fourier Transform to LTI systems, Discrete-time Fourier Transform & its properties, Relationship to other transforms. Hilbert transform and its properties.

UNIT-IV

Laplace Transform: Introduction & Definition, Region-of- convergence, Properties of Laplace transform, Inverse Laplace Transform, Applications of Laplace Transform in analysis of LTI systems, Unilateral Laplace transform & its applications to solve differential equations, Analysis of Electric circuits.

Z-Transform: The Z-Transform, Region-of-convergence, properties of Z-Transform, Inverse Z-Transform, Transform Analysis of Discrete-time LTI systems, Unilateral Z-Transform & its applications to LTI systems described by difference equations.

UNIT-V

Sampling: Graphical & Analytical proof of Band-limited signals, Low pass and band pass sampling theorems, sampling and reconstruction of band limited signals, Aliasing, Anti-aliasing filter, Illustrative Problems.

Textbooks:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. Signals, Systems & Communications - B.P. Lathi, B S Publications, 2003.
3. S.Haykin and B.VanVeen "Signals and Systems, Wiley, 1998.

Reference Books:

1. Signals and Systems – K Deergha Rao, Springer International Edition, 2018.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
3. Hwei Hsu, "Schaum's Outline of Signals and Systems", 4thEdition, TMH, 2019.
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.

Course Outcomes:

After completion of the course, the student will be able to

- Understand the mathematical description and representation of continuous-time and discrete-time signals and systems, also apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
- Classify systems based on their properties and determine the response of LTI system using convolution.
- Analyze the frequency spectra of various continuous-time signals using Fourier Analysis.
- Apply sampling theorem to convert continuous-time signals to discrete-time signals and reconstruct back, different transform techniques to solve signals and system related problems.
- Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.

****

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ELECTRONIC DEVICES & CIRCUITS

Course Objectives:

- The students can understand the basic principles and characteristics of semiconductor devices like Diode, BJT, JFET and MOSFET.
- The students can able to analyze diode & transistor circuits, various biasing methods, equivalent circuits of transistor amplifiers and their comparison.
- The students can able to study and analyze various applications such as rectifiers, filters, transistor amplifiers with necessary equivalent circuits.

UNIT-I:

P-N Junction Diode Characteristics

Qualitative theory of the p-n junction, open circuited p-n Junction, the p-n junction as a Diode, Diode act as a Rectifier, V-I characteristics and its temperature dependence, the current components in a p-n Diode, Diode Resistance and Diode Capacitance**,** piece-wise linear model**,** Diode current equation, Quantitative analysis of Half-wave and Full-wave Rectifiers with and without filters, Breakdown mechanisms, Zener diode, Zener diode as a voltage Regulator, LED, LCD, photo diode, solar cell.

UNIT-II:

Bipolar Junction Transistor (BJT) Characteristics

The junction transistor-construction, symbols and operation, transistor current components, transistor current equation, transistor configurations, characteristics of CB, CE and CC configurations and their comparison, the early effect, punch through/reach through, transistor as an amplifier, Ebers-Moll model of a transistor, large signal, dc and small signal CE values of current gain, analytical expressions for transistor characteristics, typical transistor-junction voltages, transistor as a switch, transistor switching times, maximum voltage rating, photo transistor.

UNIT-III:

Field Effect Transistor (FET) Characteristics

The Junction Field-effect Transistor (JFET)-types, construction and operation, the pinch-off voltage, JFET characteristics, JFET parameters, JFET equivalent circuits, JFET applications, comparison between BJT and JFET, Metal-oxide-Semiconductor FET (MOSFET)- types, Construction, operation and characteristics, comparison between JFET and MOSFET, introduction to MOS, CMOS and Bi-CMOS logics, nMOS, CMOS and Bi-CMOS inverter circuits and their operation.

UNIT-IV:

Transistor Biasing and Thermal Stabilization

Need for biasing, the operating point, load line analysis, BJT biasing- methods, fixed bias, collector to base bias, self-bias, bias stability, stabilization against variations in V_{BE}, I_C, and β, stability factors, (S, S', S''), bias compensation, thermal runaway, thermal stability, Biasing of FETs, Introduction to two-port network, transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier using h-parameters (exact analysis & approximate analysis).

UNIT-V:

Small Signal Transistor Amplifier Circuits

Low Frequency BJT & FET Amplifier Circuits: Analysis of CB, CE and CC amplifiers using h-parameter model, comparison of BJT transistor amplifiers, FET small signal model, analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

High Frequency BJT & FET Amplifier Circuits: Transistor at high frequencies, Hybrid- π model, Hybrid-π conductance's, Hybrid-π capacitances, Hybrid-π parameters in terms of h-parameters, CE short circuit current gain, current gain with resistive load, high frequency analysis of FET common source and common drain amplifier circuits.

Text Books:

1. Integrated Electronics – JacobMillman, C. Halkias, C.D.Parikh , Tata Mc-Graw Hill Education (India) Private Limited, Second Edition, 2011.

2. Electronic Devices and Circuits- J. Millman, C. Halkias, Mc-Graw HillEducation (India) Private Limited, Fourth Edition, 2015.

References:

1. Electronic Devices and Circuits- S Salivahanan, N Suresh Kumar, Tata Mc-Graw Hill, Third Edition, 2012.

2. Electronic Devices and Circuit Theory-R.L. Boylestad and LouisNashelsky, Pearson Publications, Tenth Edition.

Course Outcomes:

After the completion of the course students could be able to

- Understand the principle of operation and characteristics of semiconductor devices of Diode, BJT, JFET and MOSFET.

- Analyze the diode & transistor circuits with respect to various biasing methods and equivalent circuits and their performance comparison.

- Analyze various applications of electronic circuits like rectifiers, rectifiers with filters, transistor amplifiers with relevant equivalent circuits.

*****

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

DIGITAL CIRCUITS DESIGN

Course Objectives:

- Understand the properties of Boolean algebra, logic operations, and minimization of Boolean functions.
- Analyze the design concepts of combinational circuits
- Analyze the concepts of sequential logic circuits.
- Understand the concepts of FSM and compare various Programmable logic devices.
- Apply Verilog HDL on implementing Combinational and Sequential circuits.

UNIT-I

Boolean algebra, logic operations, and minimization of Boolean functions

Number Systems and Codes, Representation of unsigned and signed integers, Floating Point representation of real numbers, Laws of Boolean Algebra, Theorems of Boolean Algebra, Realization of functions using logic gates, Canonical forms of Boolean Functions, Minimization of Functions using Karnaugh Maps, QM algorithm.

UNIT-II

Combinational Logic Circuits

Combinational circuits, Design with basic logic gates, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look- a-head adder, magnitude comparator, multiplexers, demultiplexers, decoders, encoders and priority encoders.

UNIT-III

Sequential Logic Circuits

Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, timing and triggering consideration,

conversion of flip- flops, registers, shift registers, universal shift register, design of synchronous and asynchronous counters, ring counter, Johnson counter.

UNIT-IV

Finite State Machines and Programmable Logic Devices

Types of FSM, capabilities and limitations of FSM, state assignment, realization of FSM using flip-flops, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique, Design of sequence detector, Introduction to logic families, Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGAs.

UNIT-V

Hardware Description Language

Introduction to Verilog- gate level, behavioral level and structural level modeling of logic circuits, specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop, Verilog Operators, using Verilog constructs for storage elements, Blocking and Non-blocking Assignments, flip-flop with clear capability, Using Verilog Constructs for Registers and Counters.

Text Books:

1. M. Morris Mano, "Digital Design", 3rd Edition, PHI. (Unit I to IV)
2. Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGraw-Hill (Unit V)

Reference Books:

1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. ZviKohavi and NirajK.Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2^{nd}Edition, Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, "Digital Principles and Applications", TMH, 7th Edition.

Course Outcomes:

After completing the course, the student should be able to

- Understand the properties of Boolean algebra, logic operations, and minimization of the Boolean functions (L2)
- Analyze combinational circuits (L3)
- Analyze sequential circuits (L4)
- Analyze the concepts of finite state machines and Compare various Programmable logic devices. (L4)
- Design and Model combinational and sequential circuits using HDLs. (L5, L6)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ELECTRONIC DEVICES & CIRCUITS LAB

Course Objectives:

- Verify the theoretical concepts by conduct suitable experiment using necessary hardware.
- Analyze the characteristics of Diodes, Rectifiers, BJT, FET by conduct experiments.
- Design an amplifier circuit using specifications and obtain the performance parameters experimentally.
- Simulate the electronic circuits using EDA tools like PSPICE/Multisim.

PART A: Electronic Workshop Practice

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Coils, Gang Condensers, Relays, Bread Boards.

2.Identification, Specifications and Testing of active devices like Diode, LED, BJT, FET and MOSFET.

3.Soldering Practice- Simple circuits using active and passive components.

4.Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.

PART B: List of Experiments: (Minimum Twelve Experiments has to be performed)

1. P-N Junction Diode Characteristics

Part A: Germanium Diode (Forward bias& Reverse bias)

Part B: Silicon Diode (Forward Bias only)

2. Zener Diode Characteristics

Part A: V-I Characteristics

Part B: Zener Diode as Voltage Regulator

3. Rectifiers (without and with c-filter)

Part A: Half-wave Rectifier

Part B: Full-wave Rectifier

4. BJT Characteristics (CE Configuration)

Part A: Input Characteristics

Part B: Output Characteristics

5. FET Characteristics (CS Configuration)

Part A: Drain Characteristics

Part B: Transfer Characteristics

6. Transistor Biasing

Part A: Operating Point

Part B: Load line analysis

7. Design and analysis of voltage- divider bias/self-bias circuit using BJT.
8. Design and analysis of self-bias circuit using FET/MOSFET.
9. CRO Operation and its Measurements
10. Determination of h-parameters of a given BJT using hybrid model.
11. Frequency response of BJT-CE Amplifier
12. Frequency response of Emitter Follower-CC Amplifier
13. Frequency response of FET-CS Amplifier
14. Frequency response of FET-CD Amplifier

PART C:

Hardware Required: Regulated Power supplies, Analog/Digital Storage Oscilloscopes, Analog/Digital Function Generators, Digital Multimeters, Decade Résistance Boxes/Rheostats, Decade Capacitance Boxes, Ammeters (Analog or Digital), Voltmeters (Analog or Digital), Active & Passive Electronic Components

Software Required: Software like Multisim/ PSPICE or Equivalent EDA Tool.

Course Outcomes:

After completing the course, the student should be able to

- The theoretical concepts shall be verified by conducting experiment using hardware.
- Analyze the characteristics of Diodes, Rectifiers, BJT, FET by conducting experiments.
- Design an amplifier circuit using specifications and obtain the performance parameters using hardware equipment.
- Simulate the electronic circuits using EDA tools like PSPICE/Multisim or equivalent.

*****

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

DIGITAL DESIGN & SIGNAL SIMULATION LAB

Course Objectives:

- Verify the truth tables of various logic circuits.
- Design sequential/combinational circuit using Hardware Description Language and verify their functionality.
- Simulate various Signals and Systems through MATLAB
- Analyze the output of a system when it is excited by different types of deterministic and random signals.

List Of Experiments:

PART A

1. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table.
2. Verify the of functionality of 3 to 8-line Decoder
3. 4 variable logic function verification using 8 to1 multiplexer.
4. Design and verify the functionality of full adder circuit, full subtractor.
5. Draw the circuit diagram of a single bit comparator and verify the output.
6. Design and verify the functionality of different flipflops
7. Design and verify the operation of 4-bit Universal Shift Register for different Modes of operation.
8. Design up counter and down counters
9. Design MOD–8 synchronous counter /asynchronous counters.

Note: Any seven experiment are to be simulated using Hardware Description Language.

References:

1. M. Morris Mano, “Digital Design”, 3rd Edition, PHI

PART B:

1. Generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings- Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences.
6. Write a program to find autocorrelation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous System.
8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
10. Note: Any seven experiments are to be simulated using MATLAB or equivalent software.

References:

Stephen J. Chapman, “MATLAB Programming for Engineers”, Cengage, November 2012.

Course Outcomes:

After completing the course, the student should be able to:

- Design and verify the functionality of various combinational logic circuits using HDL. (L2)
- Design and verify the functionality of various sequential logic circuits using HDL. (L2)
- Understand how to simulate different types of signals and system response. (L2)
- Analyze the response of different systems when they are excited by different signals and plot power spectral density of signals. (L4)
- Generate different random signals for the given specifications. (L5)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

Python Programming
(Skill Enhancement Course)

Course Objectives:

The main objectives of the course are to

• Introduce core programming concepts of Python programming language.

• Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries

• Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these

Course Outcomes:

After completion of the course, students will be able to

1. showcase adept command of Python syntax, deftly utilizing variables, data types, control structures, functions, modules, and exception handling to engineer robust and efficient code solutions. (L4)
2. apply Python programming concepts to solve a variety of computational problems (L3)
3. understand the principles of object-oriented programming (OOP) in Python, including classes, objects, inheritance, polymorphism, and encapsulation, and apply them to design and implement Python programs (L3)
4. become proficient in using commonly used Python libraries and frameworks such as JSON, XML, NumPy, pandas (L2)
5. exhibit competence in implementing and manipulating fundamental data structures such as lists, tuples, sets, dictionaries (L3)

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions,

Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list:

i. Addition ii. Insertion iii. slicing

12. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

18. Write a program to sort words in a file and put them in another file. The output files should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to

calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

24. Python program to check whether a JSON string contains complex object or not.
25. Python Program to demonstrate NumPy arrays creation using array () function.
26. Python program to demonstrate use of ndim, shape, size, dtype.
27. Python program to demonstrate basic slicing, integer and Boolean indexing.
28. Python program to find min, max, sum, cumulative sum of array
29. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:

a) Apply head () function to the pandas data frame

b) Perform various data selection operations on Data Frame

30. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

UNIT I

Multidisciplinary Nature of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem.
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT III

Environmental Pollution: Definition, Cause, effects and control measures of :

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

References:

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice Hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes:

- Define the concepts related to Managerial Economics, financial accounting and management(L2)
- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets (L2)
- Apply the Concept of Production cost and revenues for effective Business decision (L3)
- Analyze how to invest their capital and maximize returns (L4)
- Evaluate the capital budgeting techniques. (L5)
- Develop the accounting statements and evaluate the financial performance of business entity (L5)

UNIT - I

Managerial Economics

Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

UNIT - II

Production And Cost Analysis

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least- cost combination– Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

UNIT - III

Business Organizations and Markets

Introduction – Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies

UNIT - IV

Capital Budgeting

Introduction – Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT - V

Financial Accounting and Analysis

Introduction – Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH.

Reference Books:

1. Ahuja Hl Managerial economics Schand.
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

Online Learning Resources:

https://www.slideshare.net/123ps/managerial-economics-ppt

https://www.slideshare.net/rossanz/production-and-cost-45827016

https://www.slideshare.net/darkyla/business-organizations-19917607

https://www.slideshare.net/balarajbl/market-and-classification-of-market

https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396

https://www.slideshare.net/ashu1983/financial-accounting

******

LINEAR CONTROL SYSTEMS

Course Objectives:

- Introduce the basic principles and applications of control systems.
- Learn the time response and steady state response of the systems.
- Know the time domain analysis and solutions to time invariant systems.
- Understand different aspects of stability analysis of systems in frequency domain.
- Understand the concept of state space, controllability and observability.

UNIT I

Control Systems Concepts: Open loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula. Controller components, DC Servomotor and AC Servomotor- their transfer functions, Synchros.

UNIT II

Time Response Analysis: Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, Study of effects and Design of P, PI, PD and PID Controllers on second order system.

UNIT III

Stability Analysis in Time Domain: The concept of stability – Routh's stability criterion – Stability and conditional stability - limitations of Routh's stability. The Root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT IV

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode Diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram - Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain Margin-Stability Analysis.

Compensation techniques – Study of Effects and Design of Lag, Lead, Lag-Lead Compensator design in frequency Domain on a second order system.

UNIT V

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, solving the Time invariant state Equations- State Transition Matrix and its Properties. System response through State Space models. The concepts of controllability and observability, Duality between controllability and observability.

Textbooks:

1. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5thedition, 2010.
2. Control Systems Engineering by I. J. Nagrath and M. Gopal, New Age International (P) Limited Publishers, 5th edition, 2007.

References:

1. Control Systems Principles & Design by M.Gopal, 4th Edition, McGraw Hill Education,2012.
2. Automatic Control Systems by B. C. Kuo and Farid Golnaraghi, John wiley and sons, 8th edition,2003.
3. Feedback and Control Systems, Joseph J Distefano III, Allen R Stubberud& Ivan J Williams, 2nd Edition, Schaum's outlines, McGraw Hill Education,2013.
4. Control System Design by Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson, 2000.
5. Feedback Control of Dynamic Systems by Gene F. Franklin, J.D. Powell and Abbas Emami- Naeini, 6th Edition, Pearson,2010.

Course Outcomes:

After completing the course, the student should be able to:

- Summarize the basic principles and applications of control systems. (L2)
- Understand the time response and steady state response of the systems. (L2)
- Understand the concept of state space, controllability and observability. (L2)
- Apply time domain analysis to find solutions to time invariant systems. (L3)
- Analyze different aspects of stability analysis of systems in frequency domain. (L4)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

EM WAVES AND TRANSMISSION LINES

Course Objectives:

- To understand and analyze different laws and theorems of electrostatic fields.
- To introduce fundamentals of static and time varying electromagnetic fields.
- To analyze the wave concept with the help of Maxwell's equations.
- To demonstrate the concepts of wave theory and propagation of waves through various mediums.
- To develop skills in solving various problems related to transmission lines.

UNIT I

Review of Co-ordinate Systems, Electrostatics: Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

UNIT II

Magnetostatics: Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems**.**

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in all possible forms and related Word Statements, Conditions at a Boundary Surface, Illustrative Problems.

UNIT III

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossy dielectrics, lossless dielectrics, free space, wave propagation in good conductors, skin depth, Polarization & Types, Illustrative Problems.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem, Illustrative Problems.

UNIT IV

Transmission Lines - I: Types, Parameters, T & π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Illustrative Problems.

UNIT V

Transmission Lines – II: Input Impedance Relations, Reflection Coefficient, VSWR, Average Power, Shorted Lines, Open Circuited Lines, and Matched Lines, Low loss radio frequency and UHF Transmission lines, UHF Lines as Circuit Elements, Smith Chart – Construction and Applications, Quarter wave transformer, Single Stub Matching, Illustrative Problems.

Textbooks:

1. Elements of Electromagnetics, Matthew N.O. Sadiku, 4th Edition, Oxford University Press, 2008.
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, 2nd Edition, PHI, 2000.
3. Transmission Lines and Networks, Umesh Sinha, 8th Edition, Satya Prakashan Tech. India Publications, New Delhi, 2003.

References:

1. Electromagnetic Field Theory and Transmission Lines, G. S. N. Raju, 2nd Edition, Pearson Education, 2013.
2. Engineering Electromagnetics, William H. Hayt Jr. and John A. Buck, 7th Edition, Tata McGraw Hill, 2006.
3. Electromagnetics, John D. Krauss, 3rd Edition, McGraw Hill, 1988.
4. Networks, Lines, and Fields, John D. Ryder,2nd Edition, PHI publications, 2012.

COURSE OUTCOMES:

At the end of this course the student will be able to:

- Apply the laws & theorems of electrostatic fields to solve the related problems. (L3)
- Demonstrate the behavior of time-varying electromagnetic fields using Maxwell's equations. (L3)
- Analyze the electromagnetic wave propagation in different mediums. (L4)
- Determine the parameters of transmission lines for various frequencies. (L3)
- Apply various impedance matching techniques to solve problems in transmission lines. (L3)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ANALOG CIRCUITS DESIGN

Course Objectives:

- Understand the characteristics of multi stage, differential amplifiers, feedback, power and tuned amplifiers.
- Analyze the performance parameters of various amplifier circuits.
- Analyze different oscillator circuits based on the frequency of operation.
- Study and analyze the various pulse electronic circuits.

UNIT-I
Multistage Amplifiers: Classification of amplifiers, distortion in amplifiers, frequency response of an amplifier, step response of an amplifier, methods of coupling, band pass of cascaded stages, analysis of **c**ascaded transistor amplifier, two stage RC coupled amplifier, Darlington pair amplifier, Boot-strap emitter follower, Cascode amplifier, differential amplifier.
UNIT -II
Feedback Amplifiers: Classification of basic amplifiers**,** Feedback concept, types of feedback, feedback topologies, characteristics of negative feedback amplifiers, generalized analysis of feedback amplifiers, performance comparison of feedback amplifiers, method of analysis of feedback amplifiers.
Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wein bridge oscillators using BJT and FET, generalized analysis of LC oscillators, Hartley and Colpitt's oscillators using BJT and FET, crystal oscillator, frequency stability of oscillators.
Unit-III
Power Amplifiers: Classification of amplifiers, Class A power Amplifiers, harmonic distortions, Class B amplifier, Push-pull amplifier, Complementary symmetry push pull amplifier, Class AB amplifier, Class-C amplifier, thermal stability and heat sink, distortion in power amplifiers.
Unit-IV
Tuned Amplifiers: Introduction, Q-Factor, small signal tuned amplifiers, effect of cascading single tuned and doubled tuned amplifiers on band width, stagger tuned amplifiers, comparison of tuned amplifiers, large signal tuned amplifiers, stability of tuned amplifiers.

Unit-V
Pulse Electronic Circuits: Wave shaping circuits, diode clippers, diode comparator, diode clampers, astable, mono stable and bi-stable multivibrators using BJT, Schmitt trigger using BJT, Tunnel diode, UJT, Blocking oscillator, time base circuits.

Text Books:

1. Electronic Devices and Circuits - J.Millman, C.C. Halkias & S.Jit, TMH, 4th Edition, 2015.
2. Pulse and Digital Circuits- A.Anand Kumar, PHI Learning Private Limited, 2012.

References:

1. Integrated Electronics- Jacob Millman, C. Halkies&C.D.Parikh, TMH, 2nd Edition,2010.
2. Electronic Devices and Circuits- S.Salivahanan& N.Suressh Kumar,TMH,3rd Edition, 2012.
3. Electronic Devices and Circuits – A.K.Maini & V.Agarawal, Wiley India Pvt.Ltd., First Edition, 2009.

Course Outcomes:

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

- Understand the characteristics of differential amplifiers, feedback and power amplifiers. (L2)
- Examine the frequency response of multistage and differential amplifier circuits using BJT & FETs at low and high frequencies. (L3)
- Investigate different feedback and power amplifier circuits based on the application. (L4)
- Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillator circuits. (L4)
- Evaluate the performance of different tuned amplifiers (L5)
- Design pulse analog circuits for the given specifications and application. (L6)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ANALOG AND DIGITAL COMMUNICATIONS

Course Objectives:

- To develop a fundamental understanding on Communication Systems
- To analyse various analog modulation & demodulation schemes
- Analyze the performance of various modulation techniques in the presence of AWGN
- To understand operation of AM & FM radio receivers

UNIT I

Amplitude Modulation- Basic blocks of Communication System, Need for modulation, Amplitude (Linear) Modulation – AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection, Comparison of different AM techniques, Application of different AM techniques.

UNIT II

Angle (Non-Linear) Modulation - Frequency and Phase modulation. Frequency Modulation: Single tone frequency modulation, Narrow band FM, Wide band FM, Transmission bandwidth of FM signals. Generation: Direct Method, Indirect Method. Detection: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop, Comparison of FM & AM, Applications.

UNIT III

Noise Analysis - Internal and External Noise, Noise Calculation, Noise Figure, Noise temperature, Noise analysis in AM receivers, Noise analysis in FM receivers, Threshold effect, Pre-emphasis and De-emphasis.

Transmitters& Receivers: Classification of Transmitters, AM Transmitters, FM Transmitters. Tuned radio frequency receiver, Super heterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, Image frequency, AGC, Amplitude limiting, FM Receiver, Comparison of AM and FM Receivers.

UNIT IV

Pulse Analog Modulation techniques – Pulse Amplitude Modulation, Pulse width Modulation, Pulse Position Modulation, Methods of generation and detection. Time division multiplexing, Frequency Division Multiplexing, Noise performance.

Pulse Digital Modulation techniques- Elements of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM). Delta modulation, its draw backs, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems.

UNIT V

Digital Modulation Techniques: BASK, BFSK, BPSK, QPSK, generation and detection.

Baseband transmission: Base band signal receiver, probability of error and its mathematical analysis, the optimum receiver, matched filter, coherent and non-coherent reception.

Text Books:

1. Communication Systems - Simon Haykin, John Wiley& Sons, 2nd Edition.
2. B. P. Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", Oxfordpress, 2011.
3. Digital Communication- Simon Haykin, John Wiley, 2005.

Reference Books:

1. Digital Communications – John Proakis, TMH, 1983
2. Digital and Analog Communication Systems - Sam Shanmugam,JohnWiley& Sons, 1999.
3. Digital Communications: Fundamentals and Applications -Bernard Sklar, F. J. Harris, Pearson Publications, 2020.
4. Principles of Communication Systems- Taub and Schilling,Tata McGraw Hill, 2007.

Course Outcomes:

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

- Understand the basics of communication system and analog modulation techniques.
- Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
- Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM and FM systems.
- Understand TDM and Pulse Modulation techniques
- Evaluate the performance of digital modulation techniques.

******

ANALOG CIRCUITS DESIGN LAB

Course Objectives:

- Design and analysis of multistage, differential, feedback, power and tuned amplifiers.
- Design and analysis of diode clippers, diode clampers, astable, monostable multivibrators and Schmitt trigger using BJT.
- Categorize different oscillator circuits based on the application.
- Design the electronic circuits for the given specifications and for a given application.

List Of Experiments:

1. Design and analysis of Two-Stage RC-Coupled Amplifier
2. Design and Analysis of Darlington Pair Amplifier.
3. Design and Analysis of Cascode Amplifier.
4. Design and analysis of Differential Amplifier.
5. Design and Analysis of Voltage-Series/Voltage-Shunt Feedback Amplifier.
6. Design and Analysis of Current-Series/Current-Shunt Feedback Amplifier.
7. Design and Analysis of RC Phase Shift Oscillator
8. Design and Analysis of LC Heartley/Colpitts Oscillator
9. Design and Analysis of Class A power amplifier
10. Design and Analysis of Class AB amplifier
11. Design and analysis of Single Tuned amplifier.
12. Diode Clippers and Diode clampers
13. Astable and Monostable Multivibrators using BJT
14. Schmitt Trigger using BJT

Note: At least twelve experiments shall be performed using BJT/FET/ MOSFET devices and the relevant circuits shall be designed and perform the analysis using both hardware and equivalent EDA software tools.

Faculty members who are handling the laboratory shall see that students are given design specifications for a circuit appropriately and monitor the design and analysis aspects of the circuit.

Course Outcomes:

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

- Know about the usage of equipment/components/software tools used to conduct experiments in analog circuits. (L2)
- Conduct the experiment based on the knowledge acquired in the theory about various analog circuits using BJT/FET/MOSFETs to find the important parameters of the circuit experimentally. (L3)
- Analyze the given analog circuit to find required important metrics of it theoretically. (L4)
- Compare the experimental results with that of theoretical ones and infer the conclusions. (L4)
- Design the circuit for the given specifications. (L6)

******

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

ANALOG AND DIGITAL COMMUNICATIONS LAB

Course Objectives:

- Understand the basics of analog and digital modulation techniques.
- Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course.
- Design and implement different modulation and demodulation techniques and their applications.
- Develop cognitive and behavioral skills for performance analysis of various modulation techniques.

List Of Experiments:

Design the circuits and verify the following experiments taking minimum of six from each section shown below.

Section-A

1. AM Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. FM Modulation and Demodulation
4. Radio receiver measurements
5. PAM Modulation and Demodulation
6. PWM Modulation and Demodulation
7. PPM Modulation and Demodulation

Section-B

1. Sampling Theorem.
2. Time Division Multiplexing
3. Frequency Division Multiplexing
4. Delta Modulation and Demodulation
5. PCM Modulation and Demodulation
6. BPSK Modulation and Demodulation
7. BFSK Modulation and Demodulation
8. QPSK Modulation and Demodulation
9. DPSK Modulation and Demodulation

Note: Faculty members (who are handling the laboratory) are requested to instruct the students not to use readymade kits for conducting the experiments. They are advised to make the students work in the laboratory by constructing the circuits and analyzing them during the lab sessions.

Course Outcomes:

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

- Know about the usage of equipment/components/software tools used to conduct experiments in analog and digital modulation techniques. (L2)
- Conduct the experiment based on the knowledge acquired in the theory about modulation and demodulation schemes to find the important metrics of the communication system experimentally. (L3)
- Analyze the performance of a given modulation scheme to find the important metrics of the system theoretically. (L4)
- Compare the experimental results with that of theoretical ones and infer the conclusions. (L4)

*****

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

SOFT SKILLS

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking and problem-solving skills
- To enhance healthy relationship and understanding within and outside an organization
- To function effectively with heterogeneous teams

Course Outcomes

- List out various elements of soft skills (L1, L2)
- Describe methods for building professional image (L1, L2)
- Apply critical thinking skills in problem solving (L3)
- Analyse the needs of an individual and team for well-being (L4)
- Assess the situation and take necessary decisions (L5)
- Create a productive workplace atmosphere using social and work-life skills ensuring personal and emotional well-being (L6)

UNIT I

Soft Skills & Communication Skills

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills -Significance, process, types - Barriers of communication - Improving techniques.

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self-expression – articulating with felicity.

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation.

UNIT II

Critical Thinking

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT III

Problem Solving & Decision Making

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

UNIT IV

Emotional Intelligence & Stress Management

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT V

Corporate Etiquette

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette - Corporate grooming tips -Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

NOTE-:

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear.

Prescribed Books:

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018

Reference Books:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018
5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher : Vayu Education of India, 2014

Online Learning Resources:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
(Established by Andhra Pradesh Act No.22 of 2021)

DESIGN THINKING & INNOVATION

Course Objectives:

The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

Course Outcomes:

- Define the concepts related to design thinking. (L1, L2)
- Explain the fundamentals of Design Thinking and innovation (L1, L2)
- Apply the design thinking techniques for solving problems in various sectors. (L3)
- Analyse to work in a multidisciplinary environment (L4)
- Evaluate the value of creativity (L5)
- Formulate specific problem statements of real time issues (L3, L6)

UNIT I

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT II

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT IV

Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown,Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Online Learning Resources:

https://nptel.ac.in/courses/110/106/110106124/

https://nptel.ac.in/courses/109/104/109104109/

https://swayam.gov.in/nd1_noc19_mg60/preview

B.Tech. – III Year I Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC	R2331041	Microprocessors and Microcontrollers	3	0	0	3
2	PC	R2331042	Information Theory and Error Control Coding	3	0	0	3
3	PC	R2331043	Digital Signal Processing	3	0	0	3
4	PCE-1	R2331044A	Computer Architecture & Organization	3	0	0	3
		R2331044B	Antenna Analysis and Design				
		R2331044C	Electronic Measurements and Instrumentation				
5	OE-1	R2331045A	Global Navigation Satellite Systems	3	0	0	3
		R2331045B	Internet of Things				
		R2331045C	Communication Systems				
6	PC Lab-1	R2331046	Microprocessors and Microcontrollers	0	0	3	1.5
7	PC Lab-2	R2331047	Digital Signal Processing Lab	0	0	3	1.5
8	SEC	R233104SC	Data Structures with Python	0	1	2	2
9	ES	R233104ES	PCB Design Practice	0	0	3	1.5
10	Internship		Evaluation of Community Service Internship	0	0	0	1
11	MC	R233104MC	Constitution of India	2	0	0	0
Total				**17**	**1**	**11**	**22.5**

III Year – I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
MICROPROCESSORS AND MICROCONTROLLERS					

Course Objectives:

- To impart knowledge of the architecture and functioning of 8086 microprocessor and 8051 microcontrollers.
- To familiarize students with assembly language programming concepts and their practical implementation.
- To understand memory interfacing and peripheral device interfacing with 8086 and 8051.
- To develop the ability to interface microcontrollers with external hardware components and sensors.
- To provide hands-on experience for designing embedded systems using 8051.

Unit I

8086 Microprocessors:

Introduction to microcomputer, evolution of processors and semiconductor memories (RAM, ROM, EPROM, EEPROM), Architecture of 8086 microprocessor, register organization of 8086, Pipelining concept, Memory segmentation, Addressing Modes.

Unit II

Assembly Language Programming:

Instruction Set and Programming: Instruction set of 8086 microprocessors: Data transfer instructions, Arithmetic instructions, Logical Instructions, String instructions, Stack related instructions, Branching instructions, Assembler directives. Data transfer instructions of 8085 microprocessor,

Unit III

8086 Operational Modes and Memory Interfacing

Minimum and Maximum mode operations of 8086 with timing diagrams, Procedures and macros, Stack Structure of 8086, Static RAM Interfacing, Interfacing of 8255 Programmable Peripheral Interface with 8086 microprocessors. Dynamic RAM, Direct memory access.

Unit IV

8051 Microcontroller

Comparison between microprocessor and microcontroller, 8051 family microcontroller, RAM architecture of 8051, Integrated Development Environment (IDE), Pin description of 8051 microcontroller, Machine cycle. Addressing Modes, Instruction set of 8051: Data transfer instructions, Arithmetic instructions, Logical Instructions, Stack related instructions, Branching instructions. Programing and Applications of Timers, Interrupts, Universal Asynchronous Receiver Transmitter (UART). External memory interfacing with 8051 microcontroller, various constituents of hex file

Unit V

Interfacing 8051 with Peripherals

Interfacing 8051 with: Matrix Keypad, LCD, Seven-segment displays, L293D Motor Driver, Stepper motor, Analog-to-Digital Converter (ADC 0804) and Digital-to-Analog Converter (DAC 0808)

Sensor and Relay Interfacing with 8051

Interfacing of temperature sensor LM35 with 8051, Relay interfacing with 8051, Case studies and practical applications using 8051.

Course Outcomes

After completion of the course, the student will be able to

- Understand the internal architecture and operations of 8086 microprocessor and write assembly language programs.
- Analyze and design memory and peripheral interfacing techniques for microprocessors and microcontrollers.
- Develop embedded applications using 8051 microcontroller and its instruction set.
- Interface 8051 with external peripherals such as LCDs, motors, keypads, ADCs/DACs, and sensors.
- Design simple embedded systems integrating sensors and actuators using the 8051 microcontrollers.

***

III Year – I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
INFORMATION THEORY AND ERROR CONTROL CODING					

Course Objectives:

- To introduce the fundamental principles of source coding and channel coding for efficient and reliable data transmission.
- To understand the construction and performance of linear block codes and cyclic codes for error detection and correction.
- To explain the principles of convolutional codes and their decoding techniques, including ARQ protocols.
- To provide a comprehensive understanding of turbo codes, their structure, encoding and iterative decoding mechanisms.
- To study the theory and implementation of LDPC codes and their applications in modern communication systems.

Unit I: Source Coding

Introduction to source coding, Instantaneous codes, Kraft's inequality, coding efficiency and redundancy, source coding theorem, construction of basic source codes, Shannon Fano coding, Huffman coding, Lempel-Ziv Coding, Channel coding theorem for Discrete memoryless channel, Binary Symmetric Channel, Binary Erasure Channel. Rate-distortion function, Quantization

Unit II: Linear Block Codes

Codes for error detection and correction: Parity check coding, Hamming codes, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Cyclic codes: Generator polynomial, encoding of cyclic codes, Syndrome decoding of cyclic codes.RS Codes, LDPC codes

Unit III: Convolutional Codes and ARQ Protocols

Encoding and state Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes, Viterbi algorithm, Automatic repeat request (ARQ), Performance of ARQ, Probability of error and throughput, Applications: Concatenated Codes, Interleavers, Compact Disc, Codes for Magnetic recording. Turbo codes, Hybrid ARQ

Unit IV: Turbo Codes: Types of Turbo Codes, Structure and Encoding of Turbo Codes, Interleaver Design, Iterative Decoding of Turbo Codes. Hybrid Turbo Codes,

Unit V: LDPC Codes: Introduction to LDPC Codes, Structure and Graph Representation, LDPC Code Construction and Encoding, LDPC Code Decoding Algorithm-Belief Propagation (Sum-Product Algorithm). Spatially coupled LDPC codes

Textbooks:

1. Bernard Sklar, Digital communications: Fundamentals and applications, 2nd edition, Prentice Hall, 2008.
2. R Bose, Information Theory Coding and Cryptography, 2nd edition, McGraw-Hill, 2017.

Reference Books:

1. John G. Proakis, Digital Communication, 5th edition, McGraw Hill, 2014.
2. William Stallings, Cryptography and Network Security: Principles and Practices, 7th edition, Pearson education, 2019.
3. R.P. Singh, SP Sapre, Communication Systems, 3rd edition, McGraw Hill, 2017.

Course Outcomes:

After completion of the course, the student will be able to

- Apply fundamental source coding techniques such as Huffman and Lempel-Ziv coding and analyze channel capacity for different types of channels.
- Construct and analyze linear block codes and cyclic codes and implement error detection and correction techniques using syndrome decoding.
- Explain convolutional encoding techniques, decode using Viterbi algorithm, and evaluate performance using ARQ protocols.
- Design and decode turbo codes using iterative decoding and interleaving techniques for robust communication.
- Construct and decode LDPC codes using belief propagation and analyze their performance in high-throughput applications

***

<table>
<tr><td rowspan="2">III Year – I SEMESTER</td><td rowspan="2">Professional Core</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">DIGITAL SIGNAL PROCESSING</td></tr>
</table>

Course Educational Objectives:

• To introduce the frequency analysis of discrete time LTI systems.

• To identify different hardware structures for IIR systems.

• To explain the numerical computation of DFT / FFT along with their properties and applications.

• To expose the design of IIR filters.

• To expose the design of FIR filters.

UNIT I:

Discrete Time Systems: Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations: Stability, causality, impulse response for rational system functions. Structures for IIR Discrete Time Systems: Direct, parallel and cascade form.

UNIT II:

Discrete And Fast Fourier Transform: The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method. Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

UNIT III:

Design Of IIR Filters: Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation.

UNIT IV:

Design Of FIR Filters: Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hamming, Hanning, Blackman and Kaiser) frequency sampling technique.

UNIT V:

Processor Fundamentals: Features of DSP processors - DSP processor packaging (Embodiments)- Fixed point Vs floating point DSP processor data paths - Fixed point Vs floating point DSP processor data paths – pipelining - TMS320 family of DSPs (architecture of C5x)- Memory architecture of a DSP processor (Von Neumann - Harvard) - Addressing modes.

Textbook(s):

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing, Prentice Hall of India, 2004

Reference(s):

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson

Education, 2007

2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011

3. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002

***

III Year – I SEMESTER	Professional Core Elective- I	L	T	P	C
		3	0	0	3
COMPUTER ARCHITECTURE & ORGANIZATION					

Course Objectives

- To impart basic concepts of computer architecture and organization,
- To explain key skills of constructing cost-effective computer systems.
- To familiarize the basic CPU organization.
- To help students in understanding various memory devices.
- To facilitate students in learning IO communication

UNIT – I:

Structure of Computers: Computer types, Functional units, Basic operational concepts, VonNeumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.

Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations.

UNIT – II:

Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC

UNIT - III

Register Transfer and Micro-Operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. **Micro-Programmed Control:** Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

UNIT - IV

Memory Management System: Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.

UNIT – V

Input Output Organization: I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA. MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.

Textbooks:

1.M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.

2. David A. Patterson and John L. Hennessey, "Computer organization and design: The hardware /software interface", Morgan Kauffman / Elsevier, Fifth edition, 2014

Reference books:

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.

2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.

3. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,

4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill.

Course Outcomes:

After completion of the course, the student will be able to

- Identify various components of computer and their interconnection
- Identify basic components and design of the CPU: the ALU and control unit.
- Compare and select various Memory devices as per requirement.
- Compare various types of IO mapping techniques
- Critique the performance issues of cache memory and virtual memory.

III Year – I SEMESTER	Professional Core Elective- I	L	T	P	C
		3	0	0	3
ANTENNA ANALYSIS AND DESIGN					

Course Objectives:

- To introduce the basic characteristics and fundamental parameters of antennas
- To familiarize the concepts of wire antennas
- To acquaint the student with knowledge of high frequency antennas
- To impart knowledge about types of antenna arrays and their analysis and synthesis
- To introduce antennas for mobile communications

UNIT 1:

Antenna Characteristics: Introduction, historical advancements, types, radiation mechanism, review of fundamental parameters – radiation pattern, power density, intensity, directivity, gain, beam width, band width, efficiency, polarization, impedance, effective height, equivalent areas, Friis transmission equation

UNIT 2:

Wire Antennas: Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields

UNIT 3:

Aperture Antennas: Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, Increased Directivity, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

UNIT 4:

Antenna Arrays and Synthesis: Antenna Synthesis: Introduction, Continuous Sources, Schelkunoff Polynomial Method and Fourier transform Method

UNIT 5:

Antennas for Mobile Applications: Antennas for Mobile Communication: Introduction, Characteristics of MSAs, Feeding Techniques, Methods of Analysis Regularly Shaped Broadband MSAs: Introduction, RMSAs

Text Books:

1. Contantine A. Balanis, Antenna Analysis and Design, 3/e, Wiley Publications, 2009.
2. Broadband Microstrip Antennas, Girish Kumar,K. P. Ray, Artech House antennas and propagation library)

References:

1.A.R. Harish, M. Sachidananda, Antennas and Wave Propagation, 1/e, Oxford University Press, 2007.

***

III Year – I SEMESTER	Professional Core Elective- I	L	T	P	C
		3	0	0	3
ELECTRONIC MEASUREMENTS AND INSTRUMENTATION					

Course Objectives:

- It provides an understanding of various measuring system functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz.signal generators, signal analyzers, recorders and measuring equipment.
- Understanding the concepts of various measuring bridges and their balancing conditions.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Unit I:

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

Unit II:

Signal Generators and Analyzers: Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator, Video Signal Generators, and Specifications.

Unit III:

Cathode Ray Oscilloscope: Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications. Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

Unit IV:

Transducers: Transducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchronous, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

Unit V:

Bridges and Measurement of Physical parameters.

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure - High Pressure, Vacuum level, Temperature - Measurements, Data Acquisition Systems.

Text Books:

1. H.S.Kalsi, Electronic instrumentation, Tata McGraw Hill, 2^{nd} Edition, 2004.
2. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI,5th Edition, 2002.

Reference Books:

1. David A. Bell, Electronic Instrumentation & Measurements, PHI, 2^{nd} Edition, 2003.
2. Robert A.Witte Electronic Test Instruments, Analog and Digital Measurements, Pearson Education, 2 Edition, 2004.
3. K. Lal Kishore, Electronic Measurements & Instrumentations, Pearson Education, 1
4. Bell Electronic measurements and Instrumentation – B. M. Oliver and J.M. Cage, TMH, 2009.

Course Outcomes:

After completion of the course, the student will be able to

- Measure electrical parameters with different meters and understand the basic definition of measuring parameters.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.
- Operate an Oscilloscope to measure various signals.
- Interpret the measurement of passive component values using bridges
- Measure various physical parameters by appropriately selecting the transducers.

III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
GLOBAL NAVIGATION SATELLITE SYSTEMS					

Course Objectives:

- To introduce the fundamental principles and architecture of GNSS.
- To familiarize students with various satellite navigation systems and their working.
- To understand GPS signal structure, positioning techniques, and error mitigation.
- To explore GNSS augmentation methods and their applications.
- To equip students with knowledge of real-world GNSS-based applications and innovations.

Unit I:

Introduction to GNSS: Evolution of satellite navigation systems, Overview of Global Navigation Satellite Systems: GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC, Basic concepts: Segments of GNSS (Space, Control, and User segments), GNSS signals and frequencies, Applications of GNSS in navigation, surveying, and timing.

Unit II:

GPS Fundamentals: GPS constellation and orbital characteristics, GPS signal structure (C/A and P codes), GPS coordinate systems: WGS-84, Satellite ranging and pseudorange calculation, Error sources in GPS: ionospheric, tropospheric, multipath, clock and ephemeris errors

Unit III:

GNSS Data Processing and Positioning Techniques: Receiver architecture and measurement principles, Positioning techniques: single-point positioning, differential GPS (DGPS), real-time kinematic (RTK), Precise Point Positioning (PPP), Geometric Dilution of Precision (GDOP), GPS data formats: NMEA, RINEX, Introduction to GNSS simulators and software tools

Unit IV:

GNSS Augmentation and Integration: GNSS augmentation systems: SBAS (WAAS, EGNOS, GAGAN), GBAS, GNSS integration with Inertial Navigation Systems (INS), Carrier phase-based positioning, RAIM (Receiver Autonomous Integrity Monitoring), GNSS spoofing and jamming – concepts and mitigation techniques.

Unit V:

Applications of GNSS: Applications in land, air, and marine navigation, Surveying and geodesy, Disaster management and precision agriculture, Fleet and asset management, Emerging applications: IoT, autonomous vehicles, smart cities, and drones.

Textbooks:

- B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, Global Positioning System: Theory and Practice, Springer, 5th Edition.
- Pratap Misra and Per Enge, Global Positioning System: Signals, Measurements and Performance, Ganga-Jamuna Press, 2nd Edition.
- G.S. Rao, Global Navigation Satellite Systems, McGraw-Hill Publications, New Delhi, 2010
- Ahmed El-Rabbany, Introduction to GPS: the Global Positioning System,Artech House, 2002

Reference Books:

- E.D. Kaplan and C.J. Hegarty, Understanding GPS: Principles and Applications, Artech House, 2nd Edition.
- B. Parkinson and J.J. Spilker Jr., Global Positioning System: Theory and Applications, Volume I & II, AIAA.
- Leick, GPS Satellite Surveying, John Wiley & Sons, 4th Edition.
- P. Teunissen and O. Montenbruck, Springer Handbook of Global Navigation Satellite Systems, Springer, 2017.
- Scott Gleason and DemozGebre- Egziabher, GNSS Applications and Methods, Artech House, 685 Canton Street, Norwood, MA 02062, 2009
- James Ba-Yen Tsui, Fundamentals of GPS receivers-A software approach, John Wiley &Sons, 2001.

***

III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
INTERNET OF THINGS					

Objectives:

1 To study the fundamentals about IoT

2 To study about IoT Access technologies

3 To study the design methodology and different IoT hardware platforms.

4 To study the basics of IoT Data Analytics and supporting services.

5 To study about various IoT case studies and industrial applications.

UNITI:

Fundamentals Of IOT: Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II:
IOT Protocols: IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT III:
Design And Development: Design Methodology, Embedded Computing Logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details

UNIT IV:
Data Analytics and Supporting Services: Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT V:

Case Studies/Industrial Applications:
IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment's, Industry 4.0 concepts.

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education

Reference Books:
1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition,Michael Margolis,Arduino Cookbook and O‟Reilly Media,2011.

e-resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs65

2. The Internet of Things in the Cloud | A Middleware Perspective | Honbo (taylorfrancis.com)

Course Outcomes:

After completion of the course, the student will be able to

- Understand the basics of IoT.
- Implement the state of the Architecture of an IoT.
- Understand design methodology and hardware platforms involved in IoT.
- Understand how to analyze and organize the data.
- Interpret IOT Applications in Industrial & real world

***

III Year – I SEMESTER	Open Elective-I	L	T	P	C
		3	0	0	3
COMMUNICATION SYSTEMS					

Course Objectives:

- To introduce the need for modulation to communicate signals
- To familiarize the generation and detection of different analog modulation schemes
- To impart knowledge of specifications and real-world applications of analog broadcasting systems
- To expose the noise performance analysis and comparison of analog modulation schemes.

UNIT 1

Fourier Transforms and Signal Transmission Through Systems: Electromagnetic Spectrum, Ranges and Application Areas, Continuous-Time Fourier Transform, Convolution and Correlation, Hilbert Transform, Signal Transmission through Systems. Need for Modulation

UNIT 2

Amplitude Modulation: Amplitude Modulation, Demodulation of AM Signals, AM Broadcast Transmitters, AM Broadcast Receivers, Double Sideband Suppressed Carrier (DSB-SC) Modulation, Single Sideband Modulation, Single Sideband Transmission and Reception, Compatible Single Sideband (CSSB) System, Communication Receivers, Vestigial Sideband Modulation, Comparison of Various Varieties of Amplitude Modulation.

UNIT 3

Angle Modulation: Angle Modulated Signals, Narrowband Angle Modulation, Spectrum of an Angle-Modulated Signal, Power of an Angle-Modulated Signal and Effective Bandwidth, Generation of Wideband Angle-Modulated Signals, effects of Channel Non-Linearities on FM Signals Detection of FM Signals, FM Broadcasting, FM Transmitters and Receivers, Radio and Television Broadcasting: AM Radio Broadcasting, FM Radio Broadcasting, Television Broadcasting.

UNIT 4

Noise in Analog Communication Systems: Noise Performance of AM and FM Systems, Effects of Transmission Losses and Noise in Analog Communication Systems.

UNIT 5

Analog to Digital Conversion: Advantages of Digital Communication over Analog Communication Systems. Analog to Digital Conversion: sampling process, pulse modulation schemes- pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

Textbooks:

1. P. Ramakrishna Rao, Communication Systems, 2/e, Tata McGraw Hill Publications, 2018.

2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010.

3. Lathi, Modern Analog and Digital Communication Systems, 4/e, Oxford University Press,2012.

References:

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications,2/e Wiley, 2007

2. Simon Haykin, Communication Systems 4/e, Wiley, 2001.

3. Kennedy,David, Electronic Communication System 4/e, Tata McGraw Hill,2012.

***

III Year – I SEMESTER	Professional Core Lab - 1	L	T	P	C
		0	0	3	1.5
MICROPROCESSORS AND MICROCONTROLLERS LAB					

Course Objectives

- To understand the architecture and operation of 8086 microprocessor and 8051 microcontroller.
- To develop assembly language programs for 8086 and 8051.
- To interface memory and peripherals with 8086 and 8051.
- To understand the operation of programmable interface devices like 8255.
- To implement real-time applications using microcontrollers interfaced with sensors, motors, and displays.

List of Experiments:

1. Write a data transfer program using different addressing modes in assembly language programming.
2. Perform arithmetic operations on 8 bit and 16-bit numbers in assembly language programming.
3. Data transfer program using string instruction in assembly language programming.
4. Program for data conversion in assembly language programming.
5. Implement stack operations using PUSH and POP instructions.
6. Write assembly language program using procedure.
7. Write assembly language program using macro.
8. Program to reject negative numbers from a series of bytes.
9. Interfacing 8086 with 8255 PPI to display data on LEDs.
10. Perform Arithmetic operations on 8bit numbers in assembly language programming using 8051 microcontrollers.
11. Program to toggle the LED.
12. Programming and interfacing of traffic light logic.
13. Program to generate square wave using interrupts.
14. Programming and interfacing of the key pad matrix.
15. Programming and interfacing of seven-segment display.
16. Programming and interfacing of the LCD
17. Programming and interfacing of the relay.
18. Programming and interfacing of the dc/Stepper motor.

Text Books

1 Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, Tata McGraw-Hill.
2 Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International.
3 Muhammad Ali Mazidi & Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education.

Reference Books:

1 Kenneth Ayala, The 8051 Microcontroller, Cengage Learning.
2 Barry B. Brey, The Intel Microprocessors 8086/88, 80186/188, 80286, 80386, and 80486, Pearson Education.
3 Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, PHI.

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

- Describe the internal architecture of 8086 and 8051.
- Develop and execute assembly language programs for 8086 and 8051.
- Interface peripheral devices such as LCDs, keypads, and motors with 8051.
- Demonstrate interfacing of RAM, ROM, ADC, DAC, and sensor modules with microprocessors and microcontrollers.
- Analyze and implement microcontroller-based real-world applications.

***

III Year – I SEMESTER	Professional Core Lab - 1	L	T	P	C
		0	0	3	1.5
Digital Signal Processing Lab					

List of Experiments

1 Generation of discrete time signals in time domain.

2 Implementation of discrete time systems in time domain.

3 Frequency analysis of discrete time signals using DTFT.

4 Frequency analysis of discrete time systems using DTFT

5 Discrete Fourier transform (DFT) and properties

6 FIR filter design.

7 IIR filter design.

8 Study of TMS320C6478 DSK and code composer studio.

9 Sinusoidal waveform generation.

10 FIR filter implementation on LCDK Kit.

11 IIR filter implementation on LCDK Kit.

12 Mini project on DSP (Example: DTMF generation and detection using correlation processing/FFT).

Textbook(s):

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing , Prentice Hall of India, 2004

Reference(s):

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007

2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011

3. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002.

***

III Year – I SEMESTER	Skill Enhancement course	L	T	P	C
		0	1	2	2
Data Structures with Python					

Course Educational Objectives:

1. Introduce object-oriented concepts.

2. Introduction to sort and search methods.

3. Familiarize with linear data structures and operations on them.

4. Demonstrate the organization of data as trees and various operations on trees.

5. Teach various graph representations.

6. Enable to perform graph traversal and find shortest path and minimal spanning tree for a graph.

7. Expose common sorting techniques and their complexities.

UNIT 1 Object Oriented Programming

Object-oriented concepts in Python: Creating a class, objects, methods, constructor, encapsulation, inheritance, polymorphism, operator overloading.

UNIT 2 Searching and Sorting

Searching: Sequential Search, binary search. Sorting: Insertion sort, selection sort, bubble sort. Linked lists: Single linked list, double linked list, circular linked list.

UNIT 3 Stacks and Queues

Stacks: Definition, operations: array implementation, linked implementation. queues: Definition, operations: array implementation, linked list implementation and applications, Priority Queue, Double-Ended Queues

UNIT 4 Trees

Trees: Definition, Tree properties, Binary trees: properties, implementation, tree traversals, Heap tree, Heap sort, binary search tree and operations.

UNIT 5 Graph Algorithms

Graphs: ADT, data structure for graphs, properties of graphs, types of graphs, graph representations, graph traversals, directed acyclic graph, shortest path algorithms, spanning trees and min spanning tree.

List of Assignments:

1. Write a program to create

• Student class with data members student roll no, name, address, course. Include a constructor to initialize data members. Add a method to print the student details.

●Book class with data members book_id, name, cost and publisher. Include constructor and a method to display the book details. Create 3 objects and display their details.

• Account class with data members acc_no, name, balance. Include a constructor and methods to perform deposit and withdraw operations on account. Create account object perform some operations and display the account details.

• Product class with data members product id, product name, price, expiry date. Include constructor to initialize data members and a method to print products details.

• Complex Number with data members real_part and imaginary_part. Include constructor to initialize complex number. Add a method which adds two complex numbers.

• Employee class with data members eno,ename,sal,designation. Include constructor to initialize employee details and count the number of employee objects created.

2. Create a class called Distance. A person has to travel a certain distace and he used two cars.

Now create two objects “cardist1” and “cardist2” for the class Distance. Add the two objects' distances and put the total distance in the third object of class Distance “totaldist”. Take one data member, which will accept the distance input in km. Take two functions, for accepting the distance and the other for displaying. Display the total distance in meters.

3. Develop a program to Perform Python Multi-Level and multiple inheritances.

4. Design a program to overload “+” operator for

- Concatenating two strings
- Adding two complex numbers

5. Develop a program to overload “area” method to calculate area of different polygon

shapes.

Write a program to

• Implement Method Overriding

• Perform Linear Search on an array.

• Perform Binary Search on a list stored in an array.

6. Develop a program to implement various sorting techniques
   - Insertion sort
   - Selection Sort
   - Bubble Sort
7. Design a program to create a singly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display
8. Design a program to create a doubly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display
9. Create a Circular singly linked list for adding and deleting a Node.
10. Create a stack and perform various operations on it.
11. Convert the infix expression into postfix form.
12. Perform String reversal using stack
13. Create a queue and perform various operations on it.
14. Construct a binary tree and perform various traversals.
15. Construct a binary search tree and perform search operation.
16. Implement Depth First Search, Breadth First Search traversals on a graph.
17. Implement Dijkstra's Shortest Path Algorithm

Textbooks:

1. Michel T.Goodrich ,Roberto Tamassia, Michel H.Goldwasser, Data Structures and Algorithms in Python, Willey March, 2013. ISBN:978-1-118-29027-9.

2. RanceD.Necaise, Data Structures and Algorithms using Python, John Willey & Sons, India. 2011, ISBN 9788126562169.

References: Wesly J. Chun, Core Python Programming, 2/e, Prenctice Hall, 2006.

III Year – I SEMESTER	Engineering Science	L	T	P	C
		0	0	3	1.5
PCB Design Practice					

Course Objectives:

- To introduce students to the fundamentals of PCB design, layout, and fabrication processes using industry-standard EDA (Electronic Design Automation) tools.
- To develop competency in schematic capture, circuit simulation, and PCB layout creation for analog and digital circuits such as power supplies, amplifiers, filters, and control systems.
- To enable students to understand the practical aspects of PCB design, including parameter setting, component placement, routing, and thermal management.
- To promote hands-on experience in designing real-world application circuits, such as sensor-based systems and security circuits, using both simulation and physical prototyping.
- To provide exposure to thermal design concepts and heat dissipation techniques in PCB design to ensure circuit reliability and performance.

List of experiments:

1. Introduction to PCB DESIGN and EDA Tool Software

2. Parameter setting for PCB Design.

3. Design of a ±5V Power supply.

4. Schematic Creation and simulation of an electronic circuit

5. Design and Simulate ON/OFF Switches Circuits

6. Design and simulation of a Half and Full Wave Rectifier

7. Design of a PCB layout of Low pass filter

8. Design of a PCB layout of CE Amplifier

9. Design and Simulate Simple 7 Segment Circuits

10. Design of an IR Proximity Sensor – Touchless Door Bell using Zero PCB

11. Design of a Laser Light Security Alarm.

12. Design of a Mobile Phone Detector Circuit.

13. Study of PCB Thermal management techniques.

14. Study of Transistor Heat dissipation using PCB.

Textbooks:

1. Simon Monk, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards (Electronics)" 2017

Reference books:

1. S. Yogesh, "OSCAD: An Open-Source EDA Tool for Circuit Design, Simulation, Analysis and PCB Design", Shroff Publishers & Distributors Pvt. Ltd, 2013.

e.sourses:

1. https://www.udemy.com/course/circuit-design-simulation-and-pcb-manufacturing-bundle

2. https://www.allaboutcircuits.com/technical-articles/pcb-thermal-management-techniques/

Course Outcomes:

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

- Determine appropriate components to make circuits.
- Design of a Power Supply Module
- Design of types of Rectifiers
- Analyze the Design of a Security System
- Design of an electronic printed circuit board for a specific application using standard software.

***

III Year – I SEMESTER	Mandatory Course	L	T	P	C
		2	0	0	0
CONSTITUTION OF INDIA					

Course Objectives

- Understand the historical development and philosophy behind the Indian Constitution.
- Gain insights into the structure, functioning, and powers of Union and State Governments.
- Comprehend the scope of fundamental rights, duties, and directive principles.
- Recognize the functioning of constitutional bodies and their roles in governance.
- Appreciate the significance of local self-governance and recent constitutional amendments.

Unit I: Constitutional Foundation and Historical Background
Constitutional history and the making of the Indian Constitution, Role of the Constituent Assembly, Salient features of the Indian Constitution, Significance of the Preamble, Process of constitutional amendments (Article 368)

Unit II:
Fundamental Rights, Duties, and Directive Principles
Citizenship provisions under the Constitution, Fundamental Rights (Articles 12–35), Directive Principles of State Policy (Articles 36–51), Fundamental Duties (Article 51A)

Unit III:
Union Government
President and Vice President: election, powers, and removal, Prime Minister and Council of Ministers, Structure and functions of Parliament, Judiciary: Structure and powers of the Supreme Court, Centre-State relations: legislative, administrative, and financial, Emergency provisions (Articles 352, 356, 360)

Unit IV:
State Government and Local Governance
Governor: Appointment, powers, and functions, State Legislature and Chief Minister, Role of High Courts, Rural and Urban Local Governments, 73rd and 74th Constitutional Amendment Acts (Panchayati Raj and Municipalities)

Unit V:
Constitutional and Statutory Bodies
Comptroller and Auditor General (CAG), Election Commission of India, Finance Commission, Attorney General and Advocate General, Union and State Public Service Commissions (UPSC & SPSC), Tribunals and National Human Rights Commission (NHRC)

Textbooks:

1. J.C.Johari,IndianGovernmentandPolitics,VishalPublications,Delhi,2009.Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2012,MIT Press (Unit-2&3)
2. M. V. Pylee, Introduction to the Constitution of India, 5th Ed., Vikas Publishing House, Mumbai, 2007.

Reference Books:

1. D.D. Basu, Introduction to the Indian Constitution, 21st Ed., Lexis Nexis, Gurgaon, India, 2011. 2. Subhas C. Kashyap, Our Constitution, 2nd Ed., National Book Trust India, New Delhi, 2013

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_lw02/preview Evaluation of Industry Internship

Course Outcomes (COs)
After completion of the course, the student will be able to

- Explain the evolution and salient features of the Indian Constitution.
- Describe the structure of the Indian Government and its functioning at the Union and State levels.
- Analyze the significance of the Preamble, Fundamental Rights, and Duties.
- Evaluate the role of statutory and constitutional bodies in democratic governance.
- Interpret the importance of decentralization through Panchayati Raj and urban local bodies.

***

B.Tech. – III Year II Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC	R2332041	VLSI Design	3	0	0	3
2	PC	R2332042	Advanced Digital Communications	3	0	0	3
3	PC	R2332043	Communication Networks	3	0	0	3
4	PE - II	R2332044A	DSP Processors and Architectures	3	0	0	3
		R2332044B	Biomedical Signal Processing				
		R2332044C	Neural Networks				
5	PE - III	R2332045A	Optimization Techniques	3	0	0	3
		R2332045B	Mobile and Cellular Communication				
		R2332045C	Artificial Intelligence				
6	OE - II	R2332046A	Machine Learning- Chip Design	3	0	0	3
		R2332046B	Block chain Technologies				
		R2332046C	Drone Technology				
7	PC Lab-1	R2332047	VLSI Design Lab (with FPGA Implementation)	0	0	3	1.5
8	PC Lab-2	R2332048	Advanced Communications Lab	0	0	3	1.5
9	SEC	R233204SC	Hardware Modelling with HDL's	0	1	3	1.5
10	AC	R233204AC	Technical Paper Writing & IPR	2	0	0	0
Total				**20**	**1**	**9**	**22.5**
Mandatory Industry Internship of 08 weeks duration during summer vacation							

III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
VLSI DESIGN					

Course Objectives:

- Explain the basic MOSFET circuits' operation and MOS fabrication Process
- Implement the layout diagrams for CMOS circuits
- Assess the effects of parasitics and Scaling of MOS circuits
- Interpret the operation of basic analog and digital MOSFET circuits
- Implement the Digital and Analog circuits with Full-custom and Semi-custom design flows.
- Interpret the VLSI implementation flows and the basics of VLSI testing

UNIT I:

Introduction and basic electrical properties of MOS circuits: Introduction to VLSI Design Flow, Introduction to IC technology, Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor conductance, Output Conductance and Figure of Merit. Fabrication process: nMOS, pMOS and CMOS. Alternate pull up forms in inverter circuits, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, basic current mirror, CMOS Inverter, Latch-up in CMOS circuits.

UNIT II:

Basics of VLSI: Driving large capacitive loads, Cascaded CMOS inverters for delay optimization, Wiring Capacitances, Stick Diagrams, Design Rules and Layout, Layout Diagrams for MOS circuits, Sheet resistance, Gate capacitance, The Delay Unit, Inverter Delays, Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling: performance improvement by CMOS scaling.

UNIT III:

Basic Digital and Analog Circuits: Cascode Voltage Switch Logic, Transmission Gates, Pass Transistor Logic, Domino logic, Metastability, setup time, hold time, small signal Modeling of transistor, body bias effect, biasing styles of MOSFET FET amplifiers, single stage amplifier with resistive load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier.

UNIT IV:

MOS Transistor Principles and CMOS Inverter MOSFET: Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

UNIT V:

VLSI Implementation Strategies and Testing: Introduction, ASIC Design flow, types of ASICs- Full custom, Standard cell-based Asics, Gate array-based ASICs, FPGAs, FPGA design flow, Basic FPGA Design Structure FPGA Programming Technologies: SRAM, EPROM, EEPROM; Introduction to testing, Manufacturing test principles, Design for testability (DFT) -Adhoc testing, Scan design, Built in self-test (BIST)

Textbooks:

1. Kamran Eshraghian, Douglas, A. Pucknell And Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems" Prentice-Hall of India Private Limited, 2005 Edition.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2003
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits, Pearson Education, 2nd edition, 2016.
4. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 3rdEdition, 1999
5. Michael john Sebastian smith, Application specification integrated circuits, Addition Wesley,1st edition,1997

Reference Books:

1. John P. Uyemura "Introduction to VLSI Circuits and Systems, John Wiley & Sons, reprint 2009.
2. Vinod Kumar Khanna, Integrated Nanoelectronics: Nanoscale CMOS, Post-CMOS and Allied Nanotechnologies, Springer India, 1st edition, 2016.
3. Michael John Sebastian Smith, Application Specific Integrated Circuits, Addison-Wesley, 1997.

Course Outcomes:

- Explain the basic MOSFET circuits operation and MOS fabrication Process
- Implement the layout diagrams for CMOS circuits
- Assess the effects of parasitic and scaling of MOS circuits
- Interpret the operation of basic analog and digital MOSFET circuits
- Implement the Digital and Analog circuits with Full-custom and Semi-custom design flows.
- Interpret the VLSI implementation flows and the basics of VLSI testing.

***

III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
ADVANCED DIGITAL COMMUNICATIONS					

Course Objectives:

1. Provide an in-depth understanding of advanced digital modulation techniques and their performance in various channel conditions.
2. Introduce the fundamental principles of information theor
3. y including entropy, mutual information, and channel capacity.
4. Explore the architecture and implementation of multicarrier communication systems like OFDM.
5. Study spread spectrum techniques and their role in modern wireless communication systems.
6. Analyze the behavior of communication systems over fading channels and introduce diversity and MIMO techniques to enhance performance.

UNIT I:

Advanced Modulation Techniques: Review of basic digital modulation, M-ary Modulation Techniques: M-ASK, M-PSK, M-QAM, Power spectra and bandwidth efficiency, Performance analysis in AWGN and fading channels, Coherent vs Non-coherent detection.

UNIT II:

Information Theory: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties, Information rate, Mutual information and its properties, Channel capacity: AWGN and binary symmetric channel

UNIT III:

Multicarrier Systems: Multi Carrier Communications, Orthogonal Frequency Division Multiplexing (OFDM), Modulation and Demodulation of OFDM system, Algorithm implementation IFFT/FFT of OFDM, Peak to average Power Ratio in multi carrier Modulation.

UNIT IV:

Spread Spectrum and Multi-Carrier Systems: Spread spectrum principles, Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiplexing (OFDM), Applications in LTE, Wi-Fi, and 5G

UNIT V:

Digital Communication over Fading Channels: Channel models: Rayleigh, Rician, Nakagami, Diversity techniques: Time, Frequency, Spatial diversity, Equalization techniques: Linear, Decision feedback, Performance analysis with fading, MIMO systems and spatial multiplexing

Textbooks:

1. **Simon Haykin**, *Digital Communications*, Wiley India, 3rd Edition, 2005.
2. **John G. Proakis and Masoud Salehi**, *Digital Communications*, McGraw-Hill Education, 5th Edition, 2007.
3.

Reference Books:

1. **Bernard Sklar and Fredric J. Harris**, *Digital Communications: Fundamentals and Applications*, Pearson, 2nd Edition, 2020.
2. **Andrea Goldsmith**, *Wireless Communications*, Cambridge University Press, 1st Edition, 2005.
3. **Theodore S. Rappaport**, *Wireless Communications: Principles and Practice*, Pearson, 2nd Edition, 2010.
4. **S. Haykin and Michael Moher**, *Modern Wireless Communications*, Pearson Education, 1st Edition, 2005.
5. **Robert G. Gallager**, *Information Theory and Reliable Communication*, Wiley, 1st Edition, 1968.
6.

Course Outcomes:

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

- Analyze and compare the performance of M-ary modulation techniques in both AWGN and fading environments.
- Apply the principles of information theory to compute entropy, mutual information, and determine channel capacity for various channels.
- Understand and implement multicarrier modulation systems like OFDM, including practical concerns such as PAPR.
- Explain the functioning of spread spectrum techniques and their applications in CDMA and modern wireless standards.
- Evaluate and improve digital communication system performance over fading channels using diversity and equalization techniques.

***

III Year – II SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
COMMUNICATION NETWORKS					

Course Objectives:

• To introduce the basics of computer network technology, typical network scenarios, layering models and service
descriptions

• To demonstrate the data link layer aspects and physical layer technologies enabling the internet.

• To acquaint the unicast and multicast routing aspects of network layer

• To acquaint the principles and design issues of transport layer services and the protocols supporting the services for different network applications

• To familiarize the principles and usage of networking applications including web, HTTP, DNS

UNIT1:

Overview Of Communication and Networking: Analog and digital signal, Data communications, Networks, Circuit switching, Packet switching, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture.

UNIT2:

Physical Layer: Guided media, Unguided media, baseband and passband transmission of signals(briefly), Telephone modems, FDM, WDM, TDM, Telephone networks, DSL technology, Cable modem, Bluetooth, SONET, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Connecting devices, Backbone network, Virtual LAN

UNIT3:

Data Link Layer: Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Random access, Controlled access, Channelization

UNIT 4:

Network And Transport Layer: Network Layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols. Transport layer: Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP)

UNIT 5:

Application Layer: DNS (ARP and RARP), Mail protocol (SMTP, POP, IMAP), DHCP, Web services (WWW, HTTP, HTTPS, FTP), telnet, DHCP, Client server and P2P application, Relation between Application layer and Transport Other technologies overview: PSTN, ISDN and its type, Frame relay, DSL and ADSL, VoIP, Bluetooth, Wi-Fi, Overview of GSM, Wi-Max, 3G and 4G(LTE), Near field Communication (NFC).

Textbook(s):

1. Ferouzan, Behrouz A., Data Communications and Networking, 5/e, TATA McGraw Hill, 2017
2. Stallings William, Data and Computer Communication, 10/e, Pearson Education, 2017

Reference(s):

1. Black, Ulylers D, Data Communication and Distributed Networks, 3/e, PHI, 1999
2. Tanenbaum, Andrew S., Computer Networks, 6/e, PHI, 2022.

Course Outcomes:

1. Distinguish Analog and digital signal in communication, and explain basics of networks and, role of each layer of OSI model and TCP/IP model.
2. Explain transmission media and network devices, multiplexing, data networks.
3. Apply channel allocation, framing, error and flow control techniques.
4. Describe about addressing, subnetting & Routing Mechanism in network layer, and process to process communication in transport layer with TCP and UDP protocols.

***

III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
DSP PROCESSORS AND ARCHITECTURES					

Course objectives

- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

UNIT- I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT- II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT- III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT – IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT – V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/Ointerface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Textbooks:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran,Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan,Sen M. Kuo, Wiley-IEEE Press, 2007

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005

Course Outcomes:

After completion of the course, the student will be able to

1. To distinguish between the architectural features of general-purpose processors and DSP processors
2. Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices
3. Able to write assembly language programs using instruction set of TMS320C54XX
4. Can interface various devices to DSP Processors

***

III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
BIOMEDICAL SIGNAL PROCESSING					

Course Objectives

- Understand the nature and sources of key biomedical signals such as ECG, EEG, and EMG.
- Apply signal processing techniques to analyze and extract features from cardiological and neurological signals.
- Learn methods for the classification and interpretation of biomedical signals using statistical and modeling techniques.
- Explore adaptive filtering techniques for noise and artifact removal in biomedical signals.
- Gain insight into diagnostic imaging technologies and their role in biomedical signal analysis.

Unit I:

Introduction to Biomedical Signals: The nature of biomedical signals, action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Basic electrocardiography, the brain and its potentials, the electrophysiological origin of brain waves, EEG signals and its characteristics, EEG analysis. Basic EMG. Electroneurogram, Phono cardiogram

Unit II:

Cardiological Signal Processing: Basic ECG, Electrical Activity of the heart, ECG data acquisition, ECG lead system, ECG parameters & their estimation, Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, arrhythmia analysis monitoring, long-term continuous ECG recording, direct ECG data compression techniques. Cardiotocography

Unit III:

Neurological Signal Processing: Basic EEG, Linear prediction theory, the autoregressive method, spectral error measure, adaptive segmentation, Sleep EEG: data acquisition and classification of sleep stages, the markov model and markov chains, template matching for EEG-spike-and-wave detection. Dynamics of sleep-wake transitions, Hypnogram model parameters

Unit IV:

Adaptive Interference/Noise Cancellation: The wiener filtering problem, principle of an adaptive filter, the Widrow Hoff least mean square adaptive algorithm, Adaptive noise canceller: cancellation of 50/60hz interference in ECG, cancelling donor heart interference in heart-transplant ECG, cancellation of high frequency noise in electro-surgery.

UNIT V:

Diagnostic Imaging and Integration: Overview of diagnostic imaging modalities: X-ray imaging, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Role of signal processing in imaging, Integration of biomedical signals and imaging data, Data formats, storage, and ethical considerations in biomedical analysis

Textbooks:

1. D.C.Reddy, Biomedical Signal Processing: Principles and Technique's Tata McGraw Hill, 2005.
2. E.N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley and Sons, 2007.
3. MetinAkay, Biomedical Signal Processing, Academic Press, 2012.

Reference Books:

1. Sörnmo,Bioelectrical Signal Processing in Cardiac & Neurological Applications, Academic Press,2005.
2. Rangayyan,Biomedical Signal Analysis,Wiley 2002.
3. I Enderle, Introduction to Biomedical Engineering, Elsevier, 2nd Edition, 2005

Course Outcomes

- **After completion of the course, the student will be able to**
- Explain the nature and origin of common biomedical signals and the physiological systems that generate them.
- Understand cardiological signals such as ECG and fetal heart rate using signal acquisition and processing techniques.
- Apply modeling and prediction techniques for processing neurological signals like EEG, including sleep stage classification.
- Design and implement adaptive filters for biomedical noise removal using LMS and Wiener filtering methods.
- Discuss and compare diagnostic imaging modalities and evaluate their integration with biomedical signal analysis in clinical settings.

III Year – II SEMESTER	Professional Core Elective-II	L	T	P	C
		3	0	0	3
NEURAL NETWORKS					

Course Objectives

- Understand the architecture and functioning of biological and artificial neural networks.
- Analyze and implement feedback on neural networks and their learning algorithms.
- Apply various supervised, unsupervised, and reinforcement learning methods.
- Understand and implement convolutional and recurrent neural network architectures.
- Explore real-world applications of neural networks including classification, prediction, and anomaly detection.

UNIT I:

Introduction to Neural Networks: Introduction, structure and working of Biological Neural Network , Artificial Neuron Models, Trends in Computing Comparison of BNN and ANN Characteristics of ANN, McCulloch-Pitts Model, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, Classification Taxonomy of ANN-Connectivity, Neural Dynamics: Activation and Synaptic, Learning Strategy: Supervised, Unsupervised, Reinforcement, Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning.Applications of Memory Based Learning.

UNIT II:

Single & Multilayer Feed Forward Neural networks: Perception Models: Discrete, Continuous and Multi -Category, Training Algorithms: Discrete and Continuous Perception Networks, Perception Convergence theorem, Limitations of the Perception Model, Credit Assignment Problem, Generalized Delta Rule, Gradient Descent, Back propagation neural network, Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Feature Detection. Applications of BPNN

UNIT III:

Leaning Algorithms: Supervised learning: Linear Regression, Logistic Regression, K Nearest Neighbour (KNN), Random Forest, Support Vector Machines (SVM), Un supervised learning: k-means, c-means, Apriori, Reinforcement learning: Q-Learning, Case Study. Risk Evaluation, Anomaly Detection

UNIT IV:

Convolutional Neural Networks and Recurrent Neural Networks: Introduction to CNNs, Convolution, Correlation, Filtering, Kernel filter, Principles behind CNNs, Multiple Filters, CNN architectures, Detection and Segmentation, Visualizing and Understanding, Advanced CNNs for computer vision, Introduction to RNNs, Unfolded RNNs. *RNN applications, CNN* *applications*

UNIT V:

Recurrent Neural Networks (RNNs) and Applications: Introduction to RNNs: structure, unfolding through time, Types of RNNs: Vanilla RNN, LSTM, GRU, Training RNNs: backpropagation through time, Applications of RNNs in NLP and time-series prediction, Comparison: RNNs vs CNNs, Real-world use cases and integration of neural networks in AI systems

Textbooks:

1. James A Freeman and Davis Skapura, Neural Networks, Pearson Education, 2002.
2. Simon Haykin, Neural Networks-Acomprehensive foundation, Pearson Education, 2001
3. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

Reference Books:

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, Neural Networks using MATLAB 6.0, TMH, 2006
2. B Yegnanarayana, Artificial neural networks, Prentice Hall of India, 1stEdition, 2005.

Course Outcomes:

After completion of the course, the student will be able to

- Describe the structure and function of artificial and biological neural networks, including neuron models and learning mechanisms.
- Design and implement single-layer and multilayer feedforward networks using algorithms like Perceptron and Backpropagation.
- Apply various machine learning algorithms (supervised, unsupervised, reinforcement) to solve practical classification and prediction tasks.
- Develop and analyze convolutional neural network architectures for computer vision applications
- Understand and utilize recurrent neural networks for sequence modeling, natural language processing, and temporal data analysis.

***

<table>
<tr><td rowspan="2">III Year – II SEMESTER</td><td rowspan="2">Professional Core Elective-III</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">OPTIMIZATION TECHNIQUES</td></tr>
</table>

Course Objectives

- Understand the basic principles of optimization and formulate real-world problems using design variables, constraints, and objective functions.
- Apply linear programming methods and analyze optimal solutions using classical techniques like Simplex and duality.
- Explore numerical methods for single-variable optimization and understand convergence behavior.
- Learn and implement multivariable and constrained optimization techniques using gradient-based and direct search approaches.
- Examine and apply intelligent optimization algorithms such as Genetic Algorithms, PSO, and Simulated Annealing for complex problem-solving.

Unit-I

Introduction to optimization: Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit-II

Linear Programming Problem: Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Unit-III

Single Variable Optimization: Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Unit-IV

Multivariable and Constrained Optimization Techniques: Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

Unit-V

Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Textbooks:

1. S. S. Rao, Engineering Optimisation: Theory and Practice, Wiley, 2008.
2. K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall, 2 nd edition 2012.

Reference Books

1. C.J. Ray, Optimum Design of Mechanical Elements, Wiley, 2007.
2. R. Saravanan, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

Course Outcomes

After completion of the course, the student will be able to

- Formulate optimization problems with appropriate objective functions and constraints for engineering and applied science domains.
- Solve linear and integer programming problems using methods like Simplex, Big-M, and Dynamic Programming, and interpret dual solutions.
- Apply bracketing and gradient-based methods to identify optimal solutions in single-variable optimization problems.
- Implement multivariable and constrained optimization techniques, including search methods and penalty approaches for nonlinear problems.
- Employ intelligent optimization techniques like GA, PSO, and GP to solve complex, non-deterministic, or large-scale optimization problems.

***

III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
MOBILE AND CELLULAR COMMUNICATION					

Course Objectives:

- To provide the students with an understanding of the cellular concept frequency reuse, handoff strategies.
- To enable the students to analyze and understand wireless and mobile cellular communication systems over stochastic fading channels.
- To provide the students with an understanding of Co-channel and Non-Co channel Interference.
- To give students an understanding of cell coverage for signal and traffic diversity techniques and mobile antennas.
- To give the students an understanding of frequency management channel assignment and types of handoff.

UNIT I:

Cellular Systems: Limitations of Conventional System, Basic Cellular Mobile System, First, second, third and fourth Generation cellular wireless systems. Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system. Trunking and grade of service.

UNIT II:

Co-Channel & Non-Co-Channel Interference: Measurement of Real Time Co-Channel Interference, design of Antenna system, Antenna parameters and their effects, diversity techniques: Space Diversity, Polarization diversity, frequency diversity and time diversity. Non-co channel interference-adjacent channel interference, Near End far end interference, effect on coverage and interference by power decrease, antenna height decrease

UNIT III:

Cell Coverage for Signal and Traffic: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation.

UNIT IV:

Cell Site and Mobile Antennas: Space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, Mobile Antennas. Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment

UNIT V:

Handoffs: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft handoff. Intersystem handoff.

Textbooks:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006.

2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.

Reference Books:

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2001.

2. Modern Wireless Communication –Simon Haykin Michael Moher, Persons Eduction,2005.

3. Wireless Communication theory and Techniques, Asrar U.H .Sheikh ,Springer,2004.

Course Outcomes:

After completion of the course, the student will be able to

- Understand impairments due to multipath fading channel
- Understand the fundamental techniques to overcome the different fading effects
- Understand co-channel and non-co-channel interferences
- Demonstrate cell coverage/signal and traffic, diversity techniques and mobile antennas
- Understand the frequency management, channel assignment and types of handoffs

***

III Year – II SEMESTER	Professional Core Elective-III	L	T	P	C
		3	0	0	3
ARTIFICIAL INTELLIGENCE					

Course Objectives:

1 Understand the foundational principles and techniques of Artificial Intelligence.
2 Apply AI techniques for solving problems such as search, planning, and reasoning.
3 Gain insight into knowledge representation and inference mechanisms.
4 Explore machine learning and AI applications in real-world systems.
5 Analyze the ethical and societal implications of deploying AI technologies.

UNIT I:

Introduction to AI and Intelligent Agents: Definition and history of AI, Applications of AI: games, robotics, NLP, computer vision, expert systems, Foundations of AI: logic, probability, learning, biology, neuroscience, Types of AI: narrow vs general, weak vs strong, Rationality and structure of intelligent agents, PEAS framework, types of environments and agents

UNIT II:

Problem Solving and Search Techniques, Problem formulation and state space representation, Uninformed search strategies: Breadth-First Search (BFS), Depth-First Search (DFS), Uniform Cost Search, Informed search: Greedy Best-First, A* search, Heuristics and performance analysis, Constraint Satisfaction Problems (CSPs), Adversarial search and game playing: Minimax, Alpha-Beta Pruning

UNIT III:

Knowledge Representation and Reasoning: Propositional logic and inference, First-order predicate logic: syntax and semantics, Knowledge representation techniques: semantic networks, frames, ontologies, Forward and backward chaining, Rule-based systems and logic programming (introduction to Prolog), Resolution and unification.

UNIT IV:

Machine Learning Basics,Supervised vs unsupervised learning, Decision trees, k-nearest neighbours, Naïve Bayes classifiers, Neural networks (basic concepts), Introduction to reinforcement learning and Q-learning, Applications: classification, pattern recognition, spam filtering, recommendation systems

UNIT V:

Advanced Topics and Ethical Aspects: Natural Language Processing (NLP): parsing, sentiment analysis, Robotics and computer vision: sensing, mapping, object recognition, Planning: classical planning, STRIPS, AI in healthcare, education, business, and industry, Ethical issues in AI: fairness, transparency, bias, privacy, AI and the future: risks, regulations, and human-AI interaction

Textbooks:

1 Artificial Intelligence: A Modern Approach- Stuart Russell and Peter Norvig, 4th Edition, Pearson
2 Artificial Intelligence- Elaine Rich, Kevin Knight, Shivashankar B. Nair, 3rd Edition, McGraw Hill

Reference Books:

1 Introduction to Artificial Intelligence and Expert Systems- Dan W. Patterson, Pearson
2 Introduction to Machine Learning- Ethem Alpaydin, MIT Press
3 Machine Learning: A Probabilistic Perspective- Kevin Murphy, MIT Press
4 Machine Learning, Tom Mitchell, McGraw Hill
5 Artificial Intelligence: Foundations of Computational Agents- David L. Poole and Alan Mackworth. Cambridge University Press

Course Outcomes)

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

- Explain the core concepts and historical evolution of AI and intelligent systems.
- Apply classical AI search techniques to solve problem-solving tasks and optimize solutions.
- Represent knowledge and perform logical reasoning using propositional and predicate logic systems.
- Implement and evaluate machine learning algorithms for pattern recognition and classification problems.
- Discuss advanced AI topics and assess the ethical and societal impacts of AI applications.

***

III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
Machine Learning - Chip Design					

Course Objectives:

- To introduce the fundamentals of Machine Learning and its application in hardware design.
- To explore the integration of ML algorithms into ASIC/FPGA-based systems.
- To understand Hardware-aware ML and ML-driven EDA tools.
- To design and optimize ML accelerators and inference engines at chip-level.
- To expose students to industry trends in ML-SoC co-design, including edge AI.

UNIT I: Introduction to ML and Hardware Co-Design

Overview of Machine Learning: Supervised, Unsupervised, Reinforcement learning. Digital design basics: ASIC vs FPGA. Motivation for ML in hardware design. Embedded AI and edge computing.

UNIT II: Machine Learning Models and Hardware Mapping

Neural Networks, SVMs, Decision Trees overview. Model compression: pruning, quantization. Fixed-point arithmetic and bit-precision trade-offs. Case Study: Mapping ML models to hardware (e.g., CNN on FPGA).

UNIT III: Hardware-Aware ML & ML for EDA

Design space exploration using ML. ML for placement, routing, power and timing estimation. Bayesian optimization, reinforcement learning in EDA. ML-based RTL-level synthesis improvements.

UNIT IV: ML Accelerators Design

Architectural components: PE array, systolic arrays, buffers, DMA. Design of TPU-like architectures. Memory access optimization and dataflow mapping. FPGA implementation of ML inference engines.

UNIT V: Emerging Trends & Projects

Neuromorphic computing, spiking neural networks. Open-source ML hardware frameworks (e.g., TVM, MLIR). Case Studies: NVIDIA DLA, Google TPU, Intel NNP. Project-based learning: Deploying a trained model on embedded hardware (Raspberry Pi/Jetson Nano).

Textbooks

1. Hebron, P. (2016). *Machine Learning for Designers*. O'Reilly Media.
2. Fernandez-Baca, E. (2022). *AI Hardware Design: Challenges and Opportunities*. Springer.
3. Choi, D. (2021). *Machine Learning for Embedded System Design: A Practical Approach*. CRC Press.

Reference Books

1. Xiao, P. (2018). *Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed*. Wiley.
2. Sze, V., Chen, Y.-H., Yang, T.-J., & Emer, J. S. (2020). *Efficient Processing of Deep Neural Networks: A Tutorial and Survey*. Morgan & Claypool.
3. Chien, A. A. (2022). *Computer Architecture for Scientists: Principles and Examples*. MIT Press.
4. Kumar, A., Tripathi, S. L., & Rao, K. S. (Eds.). (2023). *Machine Learning Techniques for VLSI Chip Design*. Wiley.

Course Outcomes:

On successful completion, students will be able to:

- Apply machine learning models for chip design and optimization tasks.
- Analyze and design ML-based hardware accelerators.
- Use EDA tools that incorporate ML-based optimization.
- Develop low-power and high-performance hardware for ML inference.
- Implement ML algorithms on FPGA or embedded systems.

III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
BLOCK CHAIN TECHNOLOGIES					

Course Objectives

- Understand the origin, architecture, and functionality of blockchain and how it transforms traditional business networks.
- Comprehend the fundamentals of cryptography including hash functions and Merkle trees used in blockchain.
- Analyze the principles of digital signatures and how they enable secure cryptocurrency transactions.
- Compare centralized and decentralized systems, and understand the consensus mechanisms like proof-of-work.
- Evaluate Bitcoin's architecture, transaction mechanisms, storage options, mining process, and privacy features.

UNIT I:

Block chain Fundamentals: Tracing Block chain's Origin, Revolutionizing the Traditional Business Network, How Blockchain Works, What Makes a Blockchain Suitable for Business?

Introduction to Cryptography: Cryptographic Hash Functions, SHA256, Hash Pointers and Data Structures, Merkle tree.

UNIT II:

Digital Signatures: Elliptic Curve Digital Signature Algorithm (ECDSA), Public Keys as Identities, A Simple Crypto currency.

UNIT III:

Centralization vs. Decentralization, Distributed Consensus, Consensus without identity using a block chain, Incentives and proof of work.

Mechanics of Bit coin: Bit coin transactions, Bit coin Scripts, Applications of Bit coin scripts, Bit coin blocks, The Bit coin network.

UNIT IV:

Storage of and Usage of Bit coins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

UNIT V:

Bit coin Mining: The Task of Bit coin miners, Mining Hardware, Mining pools, Mining incentives and strategies. Bit coin and Anonymity: Anonymity Basics, Mixing, Zero coin and Zero cash

Textbooks

1. Blockchain for dummies, Manav Gupta, Second IBM Limited Edition, 2018, John Wiley & Sons.

2. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, 2016.

References

1. Blockchain: Blueprint for a New Economy, Melanie Swan, First edition, 2015, O'Reilly Media.

2. Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, Mastering, Second edition, 2017, O'Reilly Media.

e-Resources

1.https://nptel.ac.in/courses/106/104/106104220/

2. https://nptel.ac.in/courses/106/105/106105184/

Course Outcomes:

After completion of the course, the student will be able to

- Describe the core concepts of blockchain technology, including its structure, business utility, and role in decentralized systems.
- Explain the application of cryptographic techniques such as hash functions and Merkle trees in securing blockchain data.
- Apply digital signature techniques (e.g., ECDSA) to verify transactions and identities in cryptocurrencies.
- Analyze decentralized consensus mechanisms including proof-of-work and explore how Bitcoin ensures trust without a central authority.
- Evaluate methods of Bitcoin storage, usage, mining strategies, and privacy techniques for real-world blockchain applications.

***

III Year – II SEMESTER	Open Elective-II	L	T	P	C
		3	0	0	3
DRONE TECHNOLOGY					

Course Objectives:

To understand the basics of drone concepts

- To learn and understand the fundaments of design, fabrication and programming of drone.
- To impart the knowledge of a flying and operation of drone.
- To know about the various applications of drone.
- To understand the safety risks and guidelines of fly safely.

UNIT I:

Introduction To Drone Technology: Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II:

Drone Design, Fabrication and Programming: Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III:

Drone Flying and Operation: Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.

UNIT IV:

Drone Commercial Applications: Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V:

Future Drones and Safety: The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.

Course Outcomes:

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

- Know about a various type of drone technology, drone fabrication and programming.
- Execute the suitable operating procedures for functioning a drone.
- Select appropriate sensors and actuators for Drones.
- Develop a drone mechanism for specific applications.
- Create the programs for various drones.

Text Books

1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.

2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016

References

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016

2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

III Year – II SEMESTER	Professional Core Lab	L	T	P	C
		0	0	3	1.5
VLSI Design Lab					

Course objectives:

- Introduction of mentor graphics tool and technology mapping
- Design of basic cell blocks
- Introduction of layout tools
- Introduction of simulation of combinational circuits
- Introduction of simulation of Sequential circuits

Note: The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the following experiments using 130nm technology with the industry standard EDA Tools.

List of Experiments:

1. Design and Implementation of a Universal Gates
2. Design and Implementation of an Inverter
3. Design and Implementation of Full Adder
4. Design and Implementation of Full Subtract or
5. Design and Implementation of Decoder
6. Design and Implementation of RS-Latch
7. Design and Implementation of D-Latch
8. Design and Implementation asynchronous counter
9. Design and Implementation of static RAM cell
10. Design and Implementation of 8-bit DAC using R-2R latter network

Software Required:

1. Mentor Graphics Software / Equivalent Industry Standard Software.
2. Personal computer system with necessary software to run the programs and to implement.

Course Outcomes:

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

- Able to design a schematic and simple layout for CMOS Inverter
- Able to design Entry & simulation of multiplexer circuit with test bench & functional verification.
- Able to design Entry & simulation of D flip-flop circuit with test bench & functional verification.
- Able to synthesize digital VLSI systems from register-transfer or higher-level descriptions Able to apply the Concept of design rules during the layout of a circuit and to understand current trends in semiconductor technology, and how it impacts scaling and Performance.

III Year – II SEMESTER	Professional Core Lab	L	T	P	C
		0	0	3	1.5
Advanced Digital Communications Lab					

1. Study The Various Data Format.
   (NRZ-L, NRZ-M, NRZ-S, RZ, Bi Phase-L, Bi Phase-M, Bi Phase-Differential Manchester, RZ-AMI)
2. Pseudo Noise sequence and recovery of the clock.
3. ASK generation and Detection.
4. FSK and Minimum Shift Keying generation and Detection.
5. Phase shift keying methods (BPSK, QPSK) generation and Detection.
6. Linear & Adaptive Delta Modulation and Demodulation
7. Differential Phase Shift Keying (DPSK)
8. BER of QPSK in AWGN channel
9. Designing an equalizer in the context of baseband binary data transmission
10. 8-QAM generation & detection
11. Direct Sequence Spread Spectrum
12. Frequency Hopping Spread Spectrum
13. Huffman Coding
14. Shannon Fano Coding
15. Linear Block Codes
16. Cyclic Code Encoder
17. Convolutional Codes

Note: Any of the 5 `Hardware related experiments' and 5 more `Simulation based experiments are performed by all the students of B.Tech- R23 Regulation Students.

III Year – II SEMESTER	Skill Enhancement Course	L	T	P	C
		0	1	3	1.5
Hardware Modeling with HDLs					

Course Description:

This course introduces to design digital logic circuits using Verilog HDL. The various modeling styles in Verilog is explained for logic circuits. The use of Testbench and HDL synthesis in VLSI using System Verilog is provided

Course Educational Objectives:

1. To design combinational, sequential circuits using Verilog HDL
2. To understand behavioral and RTL modeling of digital circuits
3. To verify whether the design meets its timing constraint specifications
4. To analyze the program and their designs on a development board
5. To simulate, synthesize, and program their designs on a development board

UNIT 1:

Hardware Modeling basics

Lexical conventions, data types, system tasks and compiler directives, Modules, ports, hierarchical names encapsulation, modeling primitives, Models of propagation delay and net delay path delays and simulation

UNIT 2

Types of Modeling: Gate-Level Modeling: Gate types, gate delays, Dataflow Modeling: Continuous assignments, delays, expressions, operators, and operands, operator types, examples, Behavioral Modeling: Structured procedures, procedural assignments, timing controls, conditional statements, multiway branching, loops, sequential and parallel blocks, generate blocks

UNIT 3

Timing and Delays: Types of delay models, path delay modeling, timing checks, delay back annotation, BCD to 7-Segment Display Decoder, BCD Adder,32-Bit Adders, Traffic Light Controller, Shift-andAdd Multiplier, Array Multiplier

UNIT 4

Verilog Test benches: What is Verification, what is a Test bench, The Importance of Verification, Convergence Model, What Is Being Verified, Functional Verification Approaches, Testing Versus Verification, Design and Verification Reuse, The Cost of Verification

UNIT 5

HDL-based synthesis: Technology-independent design, styles for synthesis of combinational and sequential logic, synthesis of finite state machines, synthesis of gated clocks, design partitions and hierarchical structures

Simulation Assignments

This course shall involve Verilog Modelling and Simulation Assignments using Xilinx Vivado / Cadence INCISIV tools on the below topics (but not limited to)

1. Modeling and Simulation of Combinational Logic Circuits at Gate Level

2. Modeling Combinational Logic Circuits at Dataflow level

3. Modelling Combinational Logic Circuits at Behavioural Level

4. Modelling Combinational Logic Circuits at Structural Level

5. Verilog Modelling of Delays in Digital Circuits

6. Verilog Modelling of Sequential Logic Circuits

7. Verilog Modelling of Finite State Machines

8. Verilog Modelling using RTL Design methodology – GCD Processor Design

9. Case Study of RTL Modelling of Data Sorter, Min-Max Computation, Serial Communication Controller

10. Modeling Testbenches for Combinational and Sequential Logic Circuits

11. Using Assertions in Verilog

Textbooks:

1. Samir Palnitkar, Verilog HDL, 2/e, Pearson Education, 2013

2. Charles Roth, Digital Systems Design using Verilog, Cengage Learning, 2014

3. M. G. Arnold, “Verilog Digital – Computer Design”, Prentice Hall (PTR), 1999

References:

1. Janick Bergeron, "Writing Test benches using System Verilog", Springer,2014

2. J. Bhasker, System Verilog HDL Primer, B.S. Publications, 2012

3. J. Bhasker, Verilog Synthesis Primer, B. S. Publications, 2011

4. M. Ciletti, Advanced Digital Design with Verilog HDL, 2/e. Pearson Education, 2012

Course Outcomes:

1. To understand the basic concepts of verilog HDL

2. To model digital systems in verilog HDL at different levels of abstraction

3. To understand the concept of timing and delay

4. To know the simulation techniques and test bench creation

5. To analyze the process of HDL synthesis.

III Year – II SEMESTER	Audit Course	L	T	P	C
		2	0	0	0
TECHNICAL PAPER WRITING AND INTELLECTUAL PROPERTY RIGHTS					

COURSE OBJECTIVES

- Introduce students to research fundamentals, including topic selection, literature review, and the structured components of a technical paper.
- Familiarize students with research design, data collection methods, and statistical analysis, alongside proper citation and referencing styles.
- Develop students' skills in writing clear and concise technical papers and delivering professional presentations of research findings.
- Provide a comprehensive overview of intellectual property rights, covering patents, copyrights, trademarks, and trade secrets.
- Raise awareness of ethical considerations in research, emerging issues in IPR (such as digital rights and open access), and the importance of protecting intellectual property in collaborative settings.

UNIT-I

Introduction to Research and Technical Writing: Fundamentals of Research: Definition, objectives, types (basic and applied), and research methodology. Types of Technical Documents: Research papers, theses, and technical reports. Literature Review: Importance, methods for conducting surveys, and reviewing scholarly articles. Research Topic Selection: Identifying research gaps and formulating research questions.

UNIT-II

Research Design and Data Collection: Research Design: Types (exploratory and descriptive) and planning research. Data Collection: Primary vs. secondary data, qualitative and quantitative methods. Visual Data Representation: Graphs, tables, and charts. Citation Styles: Overview of APA and IEEE formats.

UNIT-III

Writing and Presenting Technical Papers: Writing Skills: Clarity, conciseness, and coherence in technical writing. Abstract and Conclusion: Techniques for writing effectively. Presentation Skills: Preparing presentations and using visual aids.

UNIT-IV

Intellectual Property Rights (IPR): Fundamentals of IPR: Introduction to patents, copyrights, and trademarks. Patents: Basic criteria for patentability. Case Studies: Real-world applications of IPR in engineering.

UNIT-V

Ethical Considerations in Research: Ethical Issues: Plagiarism avoidance, responsible authorship, and ethical use of data.

Open Access: Introduction to Creative Commons and open-source research.

Reference Books:

1. Alred, G. J., Brusaw, C. T., &Oliu, W. E. (2020). The Handbook of Technical Writing (12th ed.). Bedford/St. Martin's.

2. Day, R. A., &Gastel, B. (2016). How to write and publish a scientific paper (8th ed.). Cambridge University Press.

3. Kothari, C. R., & Garg, G. (2019). Research methodology: Methods and techniques (4th ed.). New Age International Publishers.

4. Menell, P. S., Lemley, M. A., Merges, R. P., &Balganesh, S. (2020). Intellectual Property in the New Technological Age 2020: Vol. II Copyrights, Trademarks, and State IP Protections.

5. Singh, A. K. (2018). Intellectual property rights: Unleashing the knowledge economy. Springer.

Textbooks:

1) Kumar, R. (2018). Research methodology: A step-by-step guide for beginners (5th ed.). SAGE Publications.

2) Goold, P. R. (2022). A Critical Introduction to Intellectual Property Law. Cambridge University Press.

3) Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approach (5th ed.). SAGE Publications.

4) Glasman-Deal, H. (2020). Science Research Writing: For Native and Non-Native Speakers of English (2nd ed.). World Scientific Publishing Company.

***

B.Tech. – IV Year I Semester

S.No	Category	Course Code	Title	L	T	P	C
1	PC	R2341041	Microwave Engineering & Optical Communications	3	0	0	3
2	PC	R2341042	Digital Image and Video Processing	3	0	0	3
3	Management Course-II	R2341043	E–Waste Management	2	0	0	2
4	PE – IV	R2341044A	RADAR Engineering	3	0	0	3
		R2341044B	Low Power VLSI				
		R2341044C	Spectrum Sensing				
5	PE - V	R2341045A	Speech Signal Processing	3	0	0	3
		R2341045B	Wireless Sensor Networks & IoT Applications				
		R2341045V	Embedded System Design				
6	OE - III	R2341046A	Data Networks & Protocols	3	0	0	3
		R2341046B	Cryptography and Network Security				
		R2341046C	Soft Computing Techniques				
7	PC Lab-1	R2341047	Microwave Engineering & Optical Communications Lab	0	0	3	1.5
8	PC Lab-2	R2341048	Digital Image and Video Processing Lab	0	0	3	1.5
9	SEC	R234104SC	Machine Learning Lab	0	1	2	2
10	AC	R234104AC	Value Education	2	0	0	0
Total				**19**	**1**	**8**	**22**

IV B. TECH I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
MICROWAVE ENGINEERING & OPTICAL COMMUNICATIONS					

Course objectives

1. To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
2. To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
3. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
4. Understand the utility of Optical Fibers in Communications.

UNIT - I

Microwave Tubes:

Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory Expressions for O/P Power and Efficiency. Reflex Klystrons Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

UNIT - II

M-Type Tubes:

Introduction, Cross-field Effects, Magnetrons Different Types, Cylindrical Traveling Wave Magnetron Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PIMode, o/p characteristics, Microwave Solid State Devices: Introduction, Classification, Applications. TEDs Introduction, Gunn Diodes Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

UNIT - III

Waveguide Components:

Coupling Mechanisms Probe, Loop, Aperture types. Waveguide Discontinuities Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees.

Ferrites Composition and Characteristics, Faraday Rotation, Ferrite Components Gyrator, Isolator.

UNIT - IV

Scattering matrix:

Scattering Matrix Properties, Directional Couplers 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator. Microwave Measurements: Description of Microwave Bench Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

UNIT - V

Optical Fiber Transmission Media:

Optical Fiber types, Light Propagation, Optical fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

Textbooks:

1. Microwave Devices and Circuits Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition

References:

1. Optical Fiber Communication Gerd Keiser, TMH, 4thEd., 2008.
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System George Kennedy, 6th Ed., McGraw Hill.

Course outcomes:

After completion of the course, the student will be able to

1 Able to Know the power generation at microwave frequencies and derive the performance characteristics.
2 Realize the need for solid state microwave sources and understand the principles of solid-state devices.
3 Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications

4 Understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
5 Understand the mechanism of light propagation through Optical Fibers.

IV B.TECH I SEMESTER	Professional Core	L	T	P	C
		3	0	0	3
DIGITAL IMAGE AND VIDEO PROCESSING					

Course objectives:

- Understand the fundamentals of image processing including pixel relationships, sampling, quantization, and key image transforms.
- Explore image enhancement and segmentation techniques in spatial and frequency domains.
- Study various image compression techniques and standards including both lossy and lossless methods.
- Learn the basics of digital video processing, including video signal models and filtering.
- Understand motion estimation methods and their applications in video coding and compression.

UNIT I:

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT II:

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy.

UNIT III:

Compression models: Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding, wavelet coding, JPEG standards

UNIT IV:

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations

UNIT V:

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Textbooks

1. Gonzaleze and Woods," Digital Image Processing ", 3rd edition, Pearson

2. Yao wang, Joem Ostarmann and Ya – quin Zhang," Video processing and communication ",1st edition, PHI

References

1. M. Tekalp," Digital video Processing", Prentice Hall International
2. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
3. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", JohnWiley & Sons
4. Chris Solomon, Toby Breckon,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons,

Course Outcomes:

After completion of the course, the student will be able to

- Explain the fundamental concepts of digital image processing, including image representation, sampling, quantization, and key image transforms like DFT, DCT, and DWT.
- Apply spatial and frequency domain enhancement techniques and perform image segmentation using edge detection, thresholding, and region-based methods.
- Compare and implement image compression algorithms, including Huffman, arithmetic, LZW, and JPEG compression standards.
- Describe the structure of analog and digital video systems and apply models for time-varying image formation and basic video sampling and filtering.
- Implement 2D motion estimation techniques such as block matching and optical flow, and apply them in video compression and motion analysis tasks.

IV B.TECH I SEMESTER	Management Course-II	L	T	P	C
		2	0	0	2
E-WASTE MANAGEMENT					

UNIT-1:

Introduction. E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.

UNIT-2:

E-waste hazardous on Global trade Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.

UNIT-3:

E-waste control measures Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source

UNIT-4:

E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs.

UNIT-5:

The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive

Text Books:

1.E-waste: implications, regulations, and management in India and current global best practices",Johri R., TERI Press, New Delhi

Reference Books:

1. Electronic Waste – 1st Edition (Toxicology and Public Health Issues), Fowler B. 2017Elsevier
2. Electronic Waste Management. Science, Hester R.E., and Harrison R.M. 2009.

IV B. TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
RADAR ENGINEERING					

Course Objectives:

- Understand the basic principles, types, and performance metrics of radar systems.
- Explore the concepts of Continuous Wave (CW) radar and Frequency Modulated Continuous Wave (FM-CW) radar systems for range and velocity measurements.
- Analyze Moving Target Indicator (MTI) and Pulse Doppler radar systems for target detection in the presence of clutter.
- Understand the principles of tracking radars and compare various tracking techniques.
- Learn the methods for detecting radar signals in noise using matched filters and evaluate detection performance.

Unit I: Introduction

Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar Block Diagram and Operation, Simple form of Radar Equation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Transmitter Power, Radar Cross Section of simple Targets, PRF and Range Ambiguities.

Radar Cross Section of complex Targets

Unit II: CW and MTI Radars

CW and Frequency Modulated Radar: Doppler Effect, CW Radar-Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Applications of CW radar, FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics for approaching and receding Targets, FM-CW altimeter, Multiple Frequency CW Radar.

Unit III: MTI and Pulse Doppler Radar:

Introduction, Principle, MTI Radar with Power Amplifier Transmitter, Delay Line Cancellers, Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, Non-coherent MTI, MTI versus Pulse Doppler Radar. *MTI Radar with Power Oscillator Transmitter*

Unit IV: Tracking Radar

Sequential Lobing, Conical Scan, Amplitude Comparison monopulse radar using one coordinate system and Phase Comparison methods, Target Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of

Trackers, Radomes, Frequency scan Arrays, Radar Display types, Branch type and Balanced type duplexers, Circulators as Duplexers.*Amplitude Comparison using two coordinate system*

Unit V: Detection of Radar Signals in Noise

Matched Filter Receiver: Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver. *Matched filter with non-white noise*

Textbook (s)

1. Merrill I. Skolnik Introduction to Radar Systems, McGraw-Hill, Second Edition, 1981
2. Merrill I. Skolnik Introduction to Radar Systems, Tata McGraw-Hill, Third Edition, 2001

Reference Books)

1. Gottapu Sasibhushana rao, Microwave & Radar Engineering, Pearson Education, 2013

Course Outcomes:

After completion of the course, the student will be able to

- Explain the operational principles of radar systems, including radar waveforms, radar equation, performance parameters, and target radar cross section.
- Demonstrate the working of CW and FM-CW radar systems, and evaluate their use in speed and altitude measurements.
- Analyze MTI and Pulse Doppler radar systems, including blind speed mitigation, Doppler filtering, and their limitations in real-world scenarios.
- Compare different tracking radar techniques, including monopulse and conical scanning methods, and understand angular tracking accuracy and radar display systems.
- Apply matched filter and correlation detection techniques for radar signal detection in noisy environments, and evaluate system performance using detection theory.

<table>
<tr><td rowspan="2">IV B.TECH I SEMESTER</td><td rowspan="2">Professional Core Elective - IV</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">LOW POWER VLSI</td></tr>
</table>

Course Objectives:

1. Known the low power low voltage VLSI design
2. Understand the impact of power on system performances.
3. Known about different Design approaches.
4. Identify suitable techniques to reduce power dissipation in combinational and sequential circuits.
5. To gain Knowledge on low power design and power estimation techniques in CMOS circuits.
6. To understand the synthesis and software design for low power.

UNIT – I

Fundamentals: Need for Low Power Circuit Design, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit II

Power Dissipation in CMOS Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET, gate induced drain leakage– Power dissipation in CMOS: short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design, hierarchy of limits, fundamental limit, material limit.

Unit III

Power Optimization Using Special Techniques Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques - CMOS Floating Node: Tristate Keeper Circuit, Blocking Gate, Low Power Bus: Low Swing Bus, Charge Recycling Bus, Delay Balancing - Low Power Techniques for SRAM: SRAM Cell, Memory Bank Partitioning.

Unit IV

Design Of Low Power Circuits Transistor and Gate Sizing: Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction - Network Restructuring and Reorganization: Transistor Network Restructuring, Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops : Self-gating Flip-flop, Combinational Flip-flop, Double Edge Triggered Flip-flop - Low Power Digital Cell Library : Cell Sizes and Spacing.

Unit V

Power Estimation Modelling of signals - signal probability calculation - Statistical techniques - estimation of glitching power Sensitivity analysis-Power estimation using input vector compaction, power dissipation in Domino logic, circuit reliability, power estimation at the circuit level, Estimation of maximum power: test generation-based approach.

Textbooks:

1. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering.
2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995
3. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998
4. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic, 1997
5. Neil H. E. Weste, David Money Harris "CMOS VLSI Design 4e: A circuits and systems",Pearson, 2015

Reference Books:

1. DimitriosSoudris, Christians Pignet, Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2002
2. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999
3. AbdelatifBelaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995
4. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", John Wiley and sons, inc. 2001
5. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing

Course Outcomes:

After completion of the course, the student will be able to

- Explain the sources of power dissipation in CMOS
- Classify the special techniques to mitigate the power consumption in VLSI circuits

- Demonstrate the power optimization techniques and power dissipation in CMOS circuits
- Outline the low power circuits
- Summarize the power optimization and trade-off techniques in digital circuits.
- Illustrate the power estimation at circuit level

IV B.TECH I SEMESTER	Professional Core Elective - IV	L	T	P	C
		3	0	0	3
SPECTRUM SENSING					

Course Objectives:

- Introduce the fundamentals of spectrum scarcity and the need for dynamic spectrum access.
- Explain the principles and classification of spectrum sensing techniques.
- Develop understanding detection theory and its applications in signal detection.
- Explore cooperative and non-cooperative spectrum sensing strategies.
- Evaluate sensing performance under various channel impairments and practical constraints.

Unit I:

Introduction to Spectrum Sensing and Cognitive Radio: Spectrum scarcity and underutilization, Introduction to cognitive radio networks, Cognitive radio architecture, Spectrum management functions: sensing, decision, sharing, mobility, Role of spectrum sensing in dynamic spectrum access

Unit II:

Basics of Signal Detection and Detection Theory: Introduction to detection theory, Hypothesis testing: binary hypothesis testing, Probability of detection, probability of false alarm, probability of missed detection, Receiver Operating Characteristic (ROC) curves, Types of spectrum holes: temporal, spatial, frequency.

Unit III:

Spectrum Sensing Techniques: Energy detection: advantages, limitations, Matched filter detection, Cyclostationary feature detection, Wavelet-based detection, Eigenvalue-based detection,

Unit IV:

Cooperative and Non-Cooperative Sensing: Centralized vs. distributed sensing, Hard and soft combining techniques, Fusion rules: OR, AND, k-out-of-N, Challenges in cooperative sensing: reporting delays, errors, and malicious users, Sensing in MIMO and massive MIMO environments

Unit V:

Practical Issues and Advanced Topics: Sensing under fading and shadowing, Noise uncertainty, Compressive sensing for spectrum sensing, Wideband sensing, Spectrum sensing in 5G and IoT networks, Regulatory perspectives and standards (IEEE 802.22, 802.11af)

Course Outcomes:

After completion of the course, the student will be able to

- Describe the fundamentals of spectrum sensing and cognitive radio systems and articulate the need for dynamic spectrum access.
- Apply detection theory to formulate and analyze signal detection problems in the context of cognitive radio networks.
- Compare and evaluate various spectrum sensing techniques such as energy, matched filter, and cyclostationary detection.
- Design and simulate cooperative spectrum sensing schemes using different fusion techniques and understand their trade-offs.
- Identify and solve practical challenges in implementing spectrum sensing, including noise uncertainty and fading, and explore advanced topics like compressive and wideband sensing.

<table>
<tr><td rowspan="2">IV B.TECH I SEMESTER</td><td rowspan="2">Professional Core Elective - V</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">SPEECH SIGNAL PROCESSING</td></tr>
</table>

Course Objectives:

- Understand the fundamentals of human speech production and its relevance to automatic speech recognition (ASR).
- Apply signal processing techniques to analyze and extract features from speech.
- Explore various pattern comparison and matching techniques in speech signal analysis.
- Understand and implement Hidden Markov Models (HMMs) for speech recognition.
- Design components of large vocabulary continuous speech recognition systems using statistical language models and subword units.

Unit I: The Speech Signal:

Fundamentals of Speech recognition, the process of speech production and perception in human beings, the speech production process, representing speech in time and frequency domains, speech sounds and features.

Unit II: Signal Processing and Analysis methods for Speech Recognition:

Spectral analysis models, The Bank-of-filters front-end processor, Linear predictive coding model for Speech recognition, Vector quantization.

Unit III: Pattern Comparison Techniques:

Introduction, Speech detection, Distortion measures- Mathematical considerations, Distortion measures- Perceptual considerations, Spectral distortion measures.

Unit IV: Theory and Implementation of Hidden Markov Models:

Introduction, Discrete time Markov processes, Extensions to Hidden Markov models, Three basic problems for HMMs, Types of HMMs, Continuous observation densities in HMMs, comparison of HMMs, Implementation issues for HMMs, HMM system for isolated word recognition.

Unit V: Large Vocabulary continuous speech recognition:

Introduction, Sub word speech units, sub word unit models based on HMMs, Training of sub word units, Language models for Large vocabulary speech recognition, Statistical language modelling, Perplexity of the language model, Overall recognition system based on sub word units.

Textbooks:

1. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2007.

Reference Books:

1. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson Education, 2009.
2. Claudio Becchetti and Lucio Prina Ricotti, Speech Recognition, John Wiley and Sons, 1999.
3. Frederick Jelinek, Statistical Methods of Speech Recognition, MIT Press, Cambridge, MA; London, England, 1997.
4. Daniel Jurafsky and James H Martin, Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 1 st Ed., 2000.

e- Resources:

1. https://nptel.ac.in/courses/117105145
2.https://ocw.mit.edu/courses/6-345-automatic-speech-recognition-spring-2003/
3. https://www.classcentral.com/course/youtube-digital-speech-processing-47859

Course Outcomes:

After completion of the course, the student will be able to

- Explain the process of speech production and describe the time and frequency domain representations of speech signals.
- Apply and evaluate signal processing methods such as spectral analysis, linear predictive coding, and vector quantization in speech recognition systems.
- Compare various pattern comparison techniques and distortion measures used in speech detection and recognition.
- Implement and optimize Hidden Markov Models (HMMs) for isolated word speech recognition systems.
- Design and evaluate large vocabulary continuous speech recognition (LVCSR) systems using subword units and statistical language models.

IV B.TECH I SEMESTER	Professional Core Elective - V	L	T	P	C
		3	0	0	3
WIRELESS SENSOR NETWORKS & IOT APPLICATIONS					

Course Objectives:

- To introduce the concepts, architecture, and protocols of Wireless Sensor Networks and their challenges.
- To understand the fundamentals of Internet of Things (IoT) and the role of WSN in enabling IoT applications.
- To learn various communication protocols and data aggregation strategies in WSN and IoT.
- To integrate sensor networks with IoT systems using hardware platforms.
- To explore real-world applications of IoT and address associated security challenges

Unit I:

Introduction to Wireless Sensor Networks (WSNs)

Overview of WSNs, Application areas: health, environment, smart cities, defence, griculture,WSN architecture: sensor nodes, sink, gateway, Challenges in WSNs: energy constraints, scalability, node failure, Types of sensor networks: single-hop, multi-hop, static vs. mobile nodes

Unit II:

Sensor Network Protocols and Architecture

Communication architecture: layered design, Medium Access Control (MAC) protocols: S-MAC, T-MAC, Routing protocols: LEACH, PEGASIS, Directed Diffusion, Localization techniques: GPS-based and non-GPS-based methods,Time synchronization and sensor data aggregation

Unit III:

IOT Fundamentals

Introduction to Internet of Things (IoT), IoT architecture: sensing, network, data processing, application layer,Communication protocols for IoT: MQTT, CoAP, HTTP, IoT enabling technologies: RFID, Bluetooth, Zigbee, NB-IoT, LoRa, Role of cloud computing and edge computing in IoT

Unit IV:

Integration of WSN with IoT

Interfacing sensors with microcontrollers (Arduino, Raspberry Pi), Sensor data transmission over IoT platforms, Case Study: Environmental monitoring using WSN-IoT integration, Power management strategies for IoT devices, IoT data analytics basics: preprocessing and visualization

Unit V:

IoT Applications and Security

Smart agriculture, smart health, smart homes, smart grid, Industrial IoT (IIoT) and predictive maintenance, IoT security issues: device-level, network-level, cloud-level, Security protocols and best practices, Future trends in WSN and IoT: AIoT, 6G integration, digital twins

Textbooks:

1 Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley.

2 Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-on Approach, VPT.

3 C. Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, PHI, 2004.

4 Jagannathan Sarangapani, Wireless Ad- hoc and Sensor Networks: Protocols. Performance and Control , CRC Press,2007

5 Holger Karl &Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.

Reference books:

- Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
- Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Elsevier.
- KazernSohraby, Daniel Minoli, &TaiebZnati, Wireless Sensor Networks- Technology, Protocols and Applications John Wiley, 2007.

- Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.
- C.K. Toh , Ad- Hoc Mobile Wireless Networks: Protocols & Systems, Prentice Hall, 2002
- C. S. Raghavendra, Krishna M. Sivalingam, Wireless Sensor Networks, Springer, Ist Edition,2006
- S Anandamurugan ,Wireless Sensor Networks, Lakshmi Publications, 2010

Course Outcomes:

After completion of the course, the student will be able to

- Describe the architecture and operation of Wireless Sensor Networks and identify challenges in deployment.
- Analyze communication protocols and network designs for efficient WSN operation.
- Explain IoT concepts, architectures, and technologies for sensor-based systems.
- Develop and implement basic WSN-IoT integration systems using real-time platforms.
- Evaluate security challenges in IoT systems and propose suitable mitigation techniques.

IV B.TECH I SEMESTER	Professional Core Elective - V	L	T	P	C
		3	0	0	3
EMBEDDED SYSTEM DESIGN					

Course Objectives:

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware.
- To understand the necessity of operating systems in correlation with hardware systems.
- To learn the methods of interfacing and synchronization for tasking.

Unit -I Introduction to Embedded Systems:

Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit -II: Typical Embedded System:

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit -III: Embedded Firmware:

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT -IV: RTOS Based Embedded System Design:

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multi processing and Multi tasking, Task Scheduling.

Unit -V: TASK COMMUNICATION:

Task communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets,

Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Textbooks:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH. systems.

2.Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

3.Embedded Systems – Lyla, Pearson, 2013.

4.An Embedded Software Primer - David E. Simon, Pearson Education.

e-Resources:

1. http://nptel.ac.in/courses/108102045/ NPTEL

2. Embedded Systems 1. http://nptel.ac.in/courses/108102045/ GATE SYLLABUS

Course Outcomes:

After completion of the course, the student will be able to

1. Understand basic concept of embedded systems. Knowledge
2. Apply and analyze the applications in various processors and domains of embedded system.
3. Analyze and develop embedded hardware and software development cycles and tools.
4. Analyze to understand what a microcomputer, core of the embedded system.
5. Remember the definitions of ASICs, PLDs, memory, memory interface. Knowledge
6. Analyze to understand different concepts of a RTOS, sensors, memory interface, communication interface.

IV B. TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
DATA NETWORKS & PROTOCOLS					

Course Objectives

- Introduce the fundamental principles and components of data communication and networking.
- Explain network models, protocols, transmission media, and error control techniques.
- Provide insight into the working of different layers of the OSI and TCP/IP models.
- Analyze routing algorithms and addressing techniques used in networking.
- Familiarize students with transport and application layer protocols and services.

Unit - I Introduction to Data Communications:

Components, Data Representation, Data Flow, Network, Uses of Networks, Network Topologies, Categories of Networks, Multiplexing: FDM, TDM. Reference Models: TCP/IP Model, The OSI Model, Comparison of the OSI and TCP/IP reference model. Physical Layer: Guided Media, Unguided Media (wireless).

Unit- II Data Link Layer:

Design issues, Error Detection & Correction, Elementary Data Link Layer Protocols, Sliding window protocols Multiple Access Protocols - ALOHA, CSMA, CSMA/CD, CSMA/CA, Collision free protocols, Ethernet Physical Layer, Ethernet Mac Sub layer.

Unit- III The Network Layer:

Network Layer Design issues, Routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Hierarchical Routing; Congestion control algorithms, IP addresses, CIDR, Sub netting, Super Netting, IPv4, Packet Fragmentation, IPv6 Protocol, Transition from IPv4 to IPv6.

Unit-IV Transport Layer:

Services provided to the upper layer's elements of transport protocol, addressing, connection establishment, Connection release, Error Control & Flow Control. UDP, Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Sliding Window, The TCP Congestion Control Algorithm.

Unit-V Application Layer:

Introduction, services, Applications layer paradigms: Client-server model, HTTP, E-mail, WWW, TELNET, DNS.

Textbooks:

1. Kurose James F, Keith W- Computer Networking A Top-Down Approach, 6th Edition, Pearson.

2. Behrouz A. Forouzan - Data Communications and Networking, 4th Edition, McGraw-Hill Education

Reference Books:

1. Bhusan Trivedi - Data communication and Networks, Oxford university press, 2016

2. Andrew S Tanenbaum - Computer Networks, 4th Edition, Pearson Education

3. W. A. Shay - Understanding Communications and Networks, 3rd Edition, Cengage Learning.

Course Outcomes:

After completion of the course, the student will be able to

- Describe the components, data flow, and classification of networks, and compare OSI and TCP/IP models.
- Implement error detection and correction methods and evaluate various MAC layer protocols including Ethernet.
- Apply routing algorithms and IP addressing schemes for efficient network layer design and analyze IPv4/IPv6 functionalities.
- Illustrate how transport layer protocols like TCP and UDP manage connections, flow, and congestion control.
- Explain the functionality and protocols at the application layer including HTTP, DNS, and email protocols.

IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
CRYPTOGRAPHY AND NETWORK SECURITY					

Course Objectives

- Introduce the basic concepts and principles of cryptography and network security.
- Provide understanding of various symmetric and asymmetric cryptographic algorithms.
- Explain cryptographic hash functions, message authentication, and digital signature schemes.
- Explore key management techniques and security at transport and wireless levels.
- Introduce secure communication protocols and case studies in practical applications of cryptography.

Unit-I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

Unit-II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

Unit-III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

Unit-IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH).

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.

Unit-V

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange.

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions.

Textbooks:

1. Cryptography and Network Security-Principles and Practice: William Stallings, Pearson Education, 6th Edition.

2. Cryptography and Network Security: Atul Kahate, Mc GrawHill, 3rd Edition.

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, WileyIndia, 1st Edition.

2. Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill,3rd Edition.

3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.

4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.

5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.

6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

Course Objectives:

After completion of the course, the student will be able to

- Describe the fundamentals of network security, various types of attacks, and cryptographic techniques.
- Implement and compare symmetric and asymmetric encryption algorithms like DES, AES, RSA, and Elgamal.
- Analyze hash functions, digital signature schemes, and secure authentication protocols such as Kerberos and X.509.
- Evaluate transport-level and wireless network security protocols including SSL/TLS, HTTPS, SSH, and IEEE 802.11i.
- Apply security mechanisms in real-time scenarios like email security (PGP, S/MIME), IP security, and secure financial transactions.

IV B.TECH I SEMESTER	Open Elective - III	L	T	P	C
		3	0	0	3
SOFT COMPUTING TECHNIQUES					

Course Objectives:

- To introduce the fundamentals and need of Soft Computing and differentiating it from conventional (hard) computing techniques.
- To understand neural network architectures, learning paradigms, and their applications.
- To explore fuzzy logic systems and their role in approximate reasoning and control.
- To comprehend genetic algorithms and the concept of evolutionary optimization.
- To study hybrid systems that integrate neural networks, fuzzy logic, and genetic algorithms for solving real-world complex problems.

Unit I:

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit II:

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit III:

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

Unit IV:

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

Unit: V

GA based Backpropagation Networks: GA based Weight Determination, K - factor determination in Columns.

Fuzzy Backpropagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Reference Books:

1 Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
2 Genetic Algorithms: Search and Optimization, E. Goldberg. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
3 Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Course Outcomes

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

- Explain the concept of soft computing and differentiate it from hard computing paradigms.
- Design and implement neural networks for classification, pattern recognition, and regression problems.
- Apply fuzzy set theory and fuzzy logic in decision-making, control, and classification tasks.
- Solve optimization problems using genetic algorithms and understand their convergence properties.
- Develop and analyze hybrid systems like neuro-fuzzy and fuzzy-genetic models for advanced applications.

<table>
<tr><td rowspan="2">IV B.TECH I SEMESTER</td><td rowspan="2">Professional Core Lab - 1</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td colspan="6">MICROWAVE ENGINEERING & OPTICAL COMMUNICATIONS LAB</td></tr>
</table>

Course Objectives:

- Defining the range of frequencies for operation in microwave engineering.
- Understand the functioning of microwave components
- Verify the various Characteristics of Active and Passive Microwave Devices Practically.
- Measure the characteristics optical devices.
- Measure the various parameters of the optical sources.

LIST OF EXPERIMENTS:

1. To verify Reflex Klystron Characteristics and to determine the frequency and tuning range of reflex klystron.
2. To verify Gunn Diode Characteristics.
3. To analyze the fixed and variable attenuator and plot the micrometer reading Vs attenuation.
4. To determine the coupling factors and directivity of directional coupler.
5. To measure the power distribution of various wave guide Tee i.e. E plane, H plane.
6. To measure the power distribution in Magic Tee.
7. VSWR Measurement and load impedance calculations using Smith chart.
8. Scattering parameters of Circulator.
9. Characterization of LED.
10. Characterization of Laser Diode.
11. Intensity modulation of Laser output through an optical fiber.
12. Measurement of Data rate for Digital Optical link.
13. Measurement of Numerical Aperture of fiber cable.
14. Measurement of losses for Analog Optical link.

Course Outcomes:

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

1. Verify characteristics of Reflex Klystron.
2. Analyze various parameters of Waveguide Components.
3. Estimate the power measurements of RF Components such as directional Couplers.
4. Demonstrate characteristics of various optical sources.
5. Measure data Rate, Numerical Aperture and Losses in Optical Link.

<table>
<tr><td rowspan="2">IV B.TECH I SEMESTER</td><td rowspan="2">Professional Core Lab – 2</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td colspan="6">DIGITAL IMAGE AND VIDEO PROCESSING LAB</td></tr>
</table>

Course Objectives:

- Provide hands-on experience in implementing fundamental image processing techniques.
- Familiarize students with pixel-based operations, image transformations, and enhancement techniques.
- Enable understanding and practical application of frequency domain processing (e.g., FFT, DCT).
- Explore compression techniques for image and video data.
- Develop skills in basic video acquisition, processing, and restoration methods.

List of Experiments:

1.Simulation and Display of an Image, Negative of an Image(Binary & Gray Scale)

2. Implementation of Relationships between Pixels

3. Implementation of Transformations of an Image

4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization

5. Display of bit planes of an Image

6. Display of FFT(1-D & 2-D) of an image

7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image

8. Implementation of Image Smoothening Filters(Mean and Median filtering of an Image)

9. Implementation of image sharpening filters and Edge Detection using Gradient Filters

10. Image Compression by DCT,DPCM, HUFFMAN coding

11. Implementation of image restoring techniques

12. Implementation of Image Intensity slicing technique for image enhancement

13. Canny edge detection Algorithm

14.Video Acquisition

15.Video Manipulation

16.Video dejittering

17.video inpainting

Course Outcomes

After completion of the course, the student will be able to

- Implement basic image operations such as negative, bit-plane slicing, and pixel relationships.
- Perform spatial and frequency domain transformations including FFT and DCT on image data.
- Apply contrast enhancement, histogram equalization, and filtering techniques for image smoothing and sharpening.
- CO4: Implement edge detection methods (e.g., gradient filters, Canny) and image compression techniques such as Huffman and DPCM.
- CO5: Acquire and manipulate video sequences, perform dejittering, inpainting, and evaluate video quality improvements using restoration techniques.

IV B.TECH I SEMESTER	Skill Enhancement Course	L	T	P	C
		0	1	2	2
MACHINE LEARNING LAB					

Course objectives:

This course will enable students to

1. Make use of Data sets in implementing the machine learning algorithms

2. Implement the machine learning concepts and algorithms in any suitable language of choice.

List of Experiments:

1 The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)

2 Extract the data from database using python

3 Implement k-nearest neighbours classification using python

4 Given the following data, which specify classifications for nine ombinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5 The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium skiing design single twenties no ->highRisk
high golf trading married forties yes ->lowRisk

ow speedway transport married thirties yes ->medRisk
medium football banking single thirties yes ->lowRisk
high flying media married fifties yes ->highRisk
ow football security single twenties no ->medRisk
medium golf media single thirties yes ->medRisk
medium golf transport married forties yes ->lowRisk
high skiing banking single thirties yes ->highRisk
ow golf unemployed married forties yes ->highRisk
Input attributes are (from left to right) income, recreation, job, status, agegroup, home-owner. Find the unconditional probability of `golf' and the conditional probability of `single' given `medRisk' in the dataset?

6 Implement linear regression using python.

7 Implement Naïve Bayes theorem to classify the English text

8 Implement an algorithm to demonstrate the significance of genetic algorithm

9 Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a.CSV file.

10 For a given set of training data examples stored in a .CSV file, implement and demonstrate the candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.

11 Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

12 Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

13 Write a program to implement the naïve Bayesian classifier for a sample training dataset stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

14 Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

15 Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

16 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

17 Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

18 Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course outcomes:

After completion of the course, the student will be able to

1. Understand the implementation procedures for the machine learning algorithms.
2. Design Java/Python programs for various Learning algorithms.
3. Apply appropriate data sets to the Machine Learning algorithms.
4. Identify and apply Machine Learning algorithms to solve real world problems.

IV B.TECH I SEMESTER	Skill Enhancement Course	L	T	P	C
		2	0	0	0
Value Education					

UNIT 1:

Introduction of Value Education

Introduction, Definition, Need for Value Education, Other reasons, Objectives of Value Education, Types of Values, Categorization of Values, Factors Influencing the Learning of Values, Value Education in India, Implementing the above in the school systems under the Central control, Initiatives from the Planning Commission, Approaches to teaching VE, The role of Teachers.

Assignment- 1

Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life?

UNIT 2:

Salient values for life

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work, Positive and creative thinking.

Assignment- 2: Give an example of scenario which explains you are a team player.

UNIT 3:

Human Rights

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

Assignment- 3

Visit Report: Visit to Non-Governmental Organizations (NGO)

UNIT 4: Environment and Ecology

Ecological balance, A Balanced Ecosystem - An Aquarium, Advantages, how to create a balanced ecosystem model, interdependence of all beings – living and non-living. Man, and nature, Environment conservation and enrichment.

Assignment 4: Make a report on following activity

Group Discussion Topics: -

1. Energy and natural resource depletion,
2. Environmental pollution,
3. Global warming,
4. Ozone depletion,
5. Deforestation,
6. Soil degradation.

UNIT 5:

Social values & Ethical values

Social values - Social consciousness and responsibility, Consumer rights and responsibilities

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Assignment- 5

Write Code of ethics for engineers.

Assignment- 6

Report on guest Lecture: Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.

Reference Books:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.

2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.

3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.

4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.

5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.
6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.

7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.

8. NCERT, Education in Values, New Delhi, 1992.

9. Swami Budhananda (1983) How to Build Character A Primer: Rmakrishna Mission, New Delhi.

10. A Culture Heritage of India (4 Vols.), Bharatiya Vidya Bhuvan, Bombay, (Selected Chapters only)

11. For Life, For the future: Reserves and Remains – UNESCO Publication.

12. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996.

13. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai.

14. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
15. Awakening Indians to India, Chinmayananda Mission, 2003.

******

List of Domains for Honors:

Honor Degree in Electronics and Communication Engineering

Note: A student must acquire additional 18 credits and out of which at least 6 credits (i.e., 2 Courses of 3 Credits each) must be earned from NPTEL/SWAYAM MOOC Courses

(As per Proc.NoE1/JNTUGV/DAP/Guidelines for B.Tech Honors/2025 Dt: 20-02-2025)

(I) VLSI Circuit Design and Verification

S.No	Course Code	Subject Title	L	T	P	C
1	R234HO01	CMOS Logic Circuit Design	3	0	0	3
2	R234HO02	System on Chip Design	3	0	0	3
3	R234HO03	VLSI Fabrication Technology	3	0	0	3
4	R234HO04	Advanced VLSI Design	3	0	0	3
5	R234HO05	Introduction to CAD for VLSI	3	0	0	3
					Total	**15**

(II) Robotics and Automation

S.No	Course Code	Subject Title	L	T	P	C
1	R234HO06	Industrial Automation	3	0	0	3
2	R234HO07	Robots and Control	3	0	0	3
3	R234HO08	Distributed Embedded systems	3	0	0	3
4	R234HO09	Advanced Controllers	3	0	0	3
5	R234HO10	Industrial Automation	3	0	0	3
					Total	**15**

(III) Cognitive Radio Networks

S.No	Course Code	Subject Title	L	T	P	C
1	R234HO11	Optical Communications	3	0	0	3
2	R234HO12	Wireless and Mobile Networks	3	0	0	3
3	R234HO13	Software Defined Radio	3	0	0	3
4	R234HO14	MIMO Wireless Communications	3	0	0	3
5	R234HO15	Wireless broad band communications	3	0	0	3
					Total	**15**

(IV) Multimedia Signal Processing

S.No	Course Code	Subject Title	L	T	P	C
1	R234HO16	Detection & Estimation of Signals (DES)	3	0	0	3
2	R234HO17	Statistical Signal Processing	3	0	0	3
3	R234HO18	Computer Vision	3	0	0	3
4	R234HO19	Audio Signal Processing	3	0	0	3
5	R234HO20	Detection & Estimation of Signals (DES)	3	0	0	3
					Total	**15**

Suggested NPTEL Courses:

1. Microelectronics: Devices to Circuits (Source: IIT Kanpur & NPTEL via SWAYAM)
2. Integrated Photonics Devices and Circuits (Source: IIT Madras & NPTEL via SWAYAM)
3. Mathematical Aspects of Biomedical Electronic System Design (Source: IISc Bangalore & NPTEL via SWAYAM)
4. Signal Processing for mm Wave communication for 5G and beyond (Source: IIT Kharagpur & NPTEL via SWAYAM) MOOCS - 2
5. Deep Learning for Computer Vision (Source: NPTEL)
6. Big Data Computing (Source: IIT Patna & NPTEL via SWAYAM)
7. Fabrication Techniques for MEMS-based sensors: clinical perspective (Source: IISc Bangalore & NPTEL via SWAYAM)
8. Introduction to Industry 4.0 and Industrial Internet of Things (Source: IIT Kharagpur & NPTEL via SWAYAM)

VLSI Circuit Design and Verification	L	T	P	C
	3	0	0	3
CMOS Logic Circuit Design				

Course Description

The Purpose of the Course is to introduce the Design of CMOS Logic Circuits. The Course aims to provide the technological advances in the Logic Circuit using Digital Systems. The Target audience are Third-Year engineering students. The Combinational and Sequential Circuits working mechanisms are discussed. The types of Semiconductor memories are discussed with applications. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. To discuss basic CMOS logic gates, implementation of AOI and OAI gates
2. Design MOS logic circuits using Transmission gates
3. To analyze different delays and power dissipation in number of stages
4. To understand the design of combinational circuits using cascade and dynamic logic
5. To design different types of Semiconductor Memories

Course Outcomes

1. Able to apply mathematical methods and transistor physics in the analysis of CMOS circuits
2. Able to Design CMOS inverter with different loads for given levels noise margins and propagation delay's.
3. Can execute moderately sized digital logic designs with OAI, AOI, and transmission gates
4. Able to design static and dynamic CMOS circuits (both Combinational and sequential) at transistor level and layout level.
5. Able to design memory architectures that aids the growth of VLSI designs with reduced access time and reduced power consumption

Unit 1: MOS DESIGN

This unit focus on introduction of basic parameters of Pseudo NMOS Logic. The System Time constrains and power parameters will be covered.

Syllabus Topics

Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

Examples/Applications/Case Studies

- Implementing Basic Logic using VHDL Programming
- Understanding System Parameters
- To Learn the Implementation of NMOS,PMOS,CMOS Logic with Layouts

Exercise/Project Problems

1. Use XILINX tool to design CMOS Inverter
2. To analyze the System parameters using Xilinx Tool
3. Dump and Verify the CMOS Inverter Program on a FPGA Board

Tools Study

- XILINX tool *for understanding basic Logic Circuits*
- *FPGA Kits in VLSI Lab*

Learning Outcomes

1. Able to apply mathematical methods and transistor physics in the analysis of CMOS circuits
2. Memorize various system parameters of Digital Logic Circuit

References/e-Resources

- CMOS Digital VLSI Design (Source:IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source:IIT Kharagpur & NPTEL via Swayam)

Unit 2: COMBINATIONAL MOS LOGIC CIRCUITS

This unit focus on design of Combinational Circuits. The Complex Logic Circuit design are studied. This unit will focus logical design of Digital Systems.

Syllabus Topics

MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

Examples/Applications/Case Studies

- Implementing NAND & NOR gates using VHDL Programming
- Implementing Logic using VHDL Programming Styles
- To Learn the Transmission gates

Exercise/Project Problems

1. Use XILINX tool to design CMOS Full adders
2. To implement Boolean expressions using Xilinx Tool
3. To study CMOS transmission gates

Tools Study

- XILINX tool *for understanding Combinational Logic Circuits*

- Cadence tool *for understanding Combinational Logic Circuits*

Learning Outcomes

1. Can execute moderately sized digital logic designs with OAI, AOI, and transmission gates
2. Design and implementation of Combinational Circuits

References/e-Resources

- CMOS Digital VLSI Design (Source:IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source:IIT Kharagpur & NPTEL via Swayam)

Unit 3: SEQUENTIAL MOS LOGIC CIRCUITS

This unit focus on design of Sequential Circuits. The Storage Circuits designs are studied. This unit will focus logical design of Memory Elements.

Syllabus Topics

Behaviour of Bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered Flip-flop.

Examples/Applications/Case Studies

- Implementation of Flip flops using VHDL Programming
- Compare the merits and demerits of Flip flops and Latch
- Design of Memory elements with time constrains

Exercise/Project Problems

1. Use XILINX tool to design Flip flop
2. To implement Flip flop using Verilog Programming
3. To study Time constrains of Latch and Flip flop

Tools Study

- XILINX tool *for understanding Sequential Logic Circuits*
- Cadence tool *for understanding Sequential Logic Circuits*

Learning Outcomes

1. To understand the design of Sequential circuits
2. To understand the Timing Constrains

References/e-Resources

- CMOS Digital VLSI Design (Source:IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source:IIT Kharagpur & NPTEL via Swayam)

Unit 4: DYNAMIC LOGIC CIRCUITS

This unit focus on application of Dynamic Logic Circuits with various design strategies .

Syllabus Topics

Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS Transmission gate logic, High performance Dynamic CMOS circuits.

Examples/Applications/Case Studies
- To study CMOS Transmission gate Logic
- To know the prominence of Dynamic Logic Circuits
- Design of CMOS circuits at transistor level and layout level

Exercise/Project Problems
1. To implement Dynamic Circuits using Cadence Tool
2. To understand the merits and demerits of Transmission gates

Tools Study
- XILINX tool *for understanding Dynamic Circuits*
- Cadence tool *for understanding Dynamic Circuits*

Learning Outcomes
1. Able to design static and dynamic CMOS circuits (both Combinational and sequential) at transistor level and layout level
2. Able to understand Transmission gates

References/e-Resources
- CMOS Digital VLSI Design (Source: IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source: IIT Kharagpur & NPTEL via Swayam)

Unit 5: SEMICONDUCTOR MEMORIES

This unit focus on types of Memories. This unit will discuss about parameters affecting storage.

Syllabus Topics

Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

Examples/Applications/Case Studies
- Types of RAM
- Comparing DRAM & SRAM
- Applications of Flash memories

Exercise/Project Problems
1. Use XILINX tool to design Memories
2. To study Types of memories

Tools Study

- XILINX tool *for design of memories*
- Cadence tool *for study of System constrains of memory implementation*

Learning Outcomes

1. Able to design memory architectures that aids the growth of VLSI designs with reduced access time and reduced power consumption
2. Understand the Memory Implementation

References/e-Resources

- CMOS Digital VLSI Design (Source: IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source: IIT Kharagpur & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Logic gates

- **Lab 1**: To implement Logic gates using VHDL (understanding the concept)
- **Lab 2**: To implement Universal gates using Verilog (understanding the concept)

Week 3-4: Full Adder

- **Lab 3**: To implement Half Adder using VHDL (understanding the concept)
- **Lab 4**: To implement Full Adder using VHDL (understanding the concept)

Week 5-6: Flip Flops

- **Lab 5**: To implement D-Flip Flop & T-Flip Flop using VHDL (understanding the concept)
- **Lab 6**: : To implement SR-Flip Flop & JK-Flip Flop using VHDL (understanding the concept)

Week 7-8: Cadence Tool for design of CMOS Inverter

- **Lab 7**: Schematic design of a CMOS Inverter in Cadence Virtuoso Schematic Editor (understanding the concept)
- **Lab 8**:Layout design of a CMOS Inverter in Cadence Virtuoso Layout Editor (understanding the concept)

Week 9-10: Cadence Tool for Timing Constrains measurement

- **Lab 9**: Extraction of Logical effort and parasitic delay of a CMOS inverter (understanding the concept)
- **Lab 10**: Design and characterization of D-Latch and D-Flip Flop in CMOS Technology

Textbooks and References

Textbooks

1. Ken Martin, *(2011). Digital Integrated Circuit Design.* Oxford University Press.

2. Sung-Mo Kang, *(2011). CMOS Digital Integrated Circuits Analysis and Design.* TMH

References

1. Ming-BO Lin, (2011). *Introduction to VLSI Systems: A Logic, Circuit and System Perspective*, CRC Press
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, *(2017). Digital Integrated Circuits – A Design Perspective,* PHI.

Online Resources

- CMOS Digital VLSI Design (Source:IIT Roorkee & NPTEL via Swayam)
- Digital Electronic Circuits (Source:IIT Kharagpur & NPTEL via Swayam)
- Design and Analysis of VLSI Subsytems(Source:IIT Madras & NPTEL via Swayam)

VLSI Circuit Design and Verification	L	T	P	C
	3	0	0	3
SYSTEM ON CHIP DESIGN				

Course Description

The Purpose of the Course is to introduce the basics of System on Chip Design. The Course aims to provide the techniques Processor selection and Memory Design for SoC. The Target audiences are Third-Year engineering students. The SoC optimization techniques will be discussed. This will help us to understand the SoC Applications. The Stake holders will develop Creative Skills.

Teaching Objectives

1. To understand the concepts of SOC Testing.
2. To understand the concepts of System on Chip Design Validation.
3. To understand the concepts of System on Chip Design methodology for Logic and Analog Cores

Course Outcomes

1. Understand about SoC Design Methodology.
2. Ability to understand the design of different embedded memories.
3. Validation and Testing Concepts can be understood.
4. Investigate new techniques for future systems

Unit 1: SYSTEM ARCHITECTURE: OVERVIEW

This unit focus on SoC design requirements and specifications. The Product Economics for SOC will be covered.

Syllabus Topics

Components of the system, Processor architectures, Memory and addressing, system level interconnection, SoC design requirements and specifications, design iteration, System Architecture & complexity, Product Economics for SOC, Dealing with Design Complexity

Examples/Applications/Case Studies

- Processor architectures
- Speech production models
- Product Economics for SOC

Exercise/Project Problems

4. System level interconnection
5. System Architecture & complexity

Tools Study

- *Synopsys tool*
- *Cadence tool*

Learning Outcomes

3. Understand design requirements and specifications

References/e-Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source: IISc Bangalore & NPTEL via Swayam)

Unit 2: PROCESSOR SELECTION FOR SOC

This unit focus on Professors used for SoC. The basic requirements of Processors will be covered.

Syllabus Topics

Overview - soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors

Examples/Applications/Case Studies

- Interrupts and exceptions
- Superscalar processors

Exercise/Project Problems

1. Robust processors
2. **VLIW processors**

Tools Study

- *Synopsys tool*
- *Cadence tool*

Learning Outcomes

- **Understand Processor types and basic handling mechanisms**

References/e-Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source: IISc Bangalore & NPTEL via Swayam)

Unit 3: MEMORY DESIGN

This unit focus on SoC memory specifications. The SoC memory systems will be covered.

Syllabus Topics

SoC external memory, SoC internal memory, Scratch pads and cache memory – Cache organization and write policies – strategies for line replacement at miss time – Split I- and D caches – multilevel caches – SoC memory systems – board based memory systems – simple processor/memory interaction.

Examples/Applications/Case Studies

- SoC internal memory
- Multilevel caches

Exercise/Project Problems

1. Cache organization
2. Board based memory systems

Tools Study

- *Synopsys tool*
- *Cadence tool*

Learning Outcomes

- **Ability to understand the design of different embedded memories**

References/e-Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source: IISc Bangalore & NPTEL via Swayam)

Unit 4: INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION

This unit focus on interconnect architectures. The SoC customization will be covered.

Syllabus Topics

Bus architectures – SoC standard buses – AMBA, Core Connect – Bus Interface Units: Bus Sockets and Bus Wrappers– Contention and Shared Bus-SOC Customization: An Overview-Processor Customization Approaches -Reconfigurable Technologies

Examples/Applications/Case Studies

- SoC standard buses
- Processor Customization

Exercise/Project Problems

1. Core Connect
2. Reconfigurable Technologies

Tools Study

- *Synopsys tool*
- *Cadence tool*

Learning Outcomes

1. Understand types of Bus architectures and Customization Methods

References/e-Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source: IISc Bangalore & NPTEL via Swayam)

Unit 5: APPLICATION STUDIES

This unit focus on SoC applications. The Examples are discussed.

Syllabus Topics

SOC Design Approach, AES: Algorithm and Requirements, AES: Design and Evaluation, 3-D Graphics Processors-Analysis: Processing-Analysis: Interconnection-Prototyping, JPEG Compression, Example JPEG System for Digital Still Camera.

Examples/Applications/Case Studies

- AES: Algorithm and Requirements
- Processors-Analysis

Exercise/Project Problems

1. 3-D Graphics Processors
2. JPEG System for Digital Still Camera

Tools Study

- *Synopsys tool*
- *Cadence tool*

Learning Outcomes

1. Investigate new techniques for future systems

References/e-Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source: IISc Bangalore & NPTEL via Swayam

Laboratory Exercises

Week 1-2: System Architecture

- **Lab 1**: To study Processor architectures (understanding the concept)
- **Lab 2**: To study Product Economics for SoC (understanding the concept)

Week 3-4: Processor Selection for SoC

- **Lab 3**: To study VLIW processors (understanding the concept)
- **Lab 4**: To study Superscalar processors (understanding the concept)

Week 5-6: Memory Design

- **Lab 5**: To Study cache organization (understanding the concept)
- **Lab 6**: To Study board based memory systems (understanding the concept)

Week 7-8: Interconnect Architectures

- **Lab 7**: To Study SoC standard buses (understanding the concept)

- **Lab 8**: To Study Bus Interface Units (understanding the concept)

Textbooks and References

Textbooks

3. Flynn, Michael J., and Wayne Luk. ,(2011) *Computer system design: system-on-chip*. John Wiley & Sons
4. Wayne Wolf ,(2008) "*Modern VLSI Design – System – on – Chip Design*", Prentice Hall

References

3. Wayne Wolf ,(2008) "*Modern VLSI Design – IP based Design*", Prentice Hall
.

Online Resources

- Workshop on ARM based SoC Design (Source: NIELIT Calicut & NPTEL Plus)
- Electronics - ARM Based Development (Source:IISc Bangalore & NPTEL via Swayam)

VLSI Circuit Design and Verification	L	T	P	C
	3	0	0	3
VLSI Fabrication Technology				

Course Objectives

This course aims to:

1. Introduce the basic principles and steps involved in VLSI fabrication.
2. Explain various semiconductor processing techniques used in IC manufacturing.
3. Provide an understanding of IC process integration and layout design considerations.
4. Familiarize students with contamination control and yield enhancement techniques.
5. Offer insights into advanced fabrication technologies and trends in the semiconductor industry.

Course Outcomes (COs)

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

- Explain the sequence of steps involved in CMOS VLSI fabrication.
- Apply various semiconductor processing techniques such as oxidation, diffusion, ion implantation, and lithography.
- Analyze the influence of process parameters on device performance and yield.
- Identify contamination control and cleanroom protocols essential for IC fabrication.
- Understand modern trends in fabrication like FinFETs, SOI, and 3D integration.

Syllabus

Unit 1: Introduction to VLSI Fabrication

Overview of IC fabrication technologies, Cleanroom classifications and contamination control, Wafer types and crystal growth techniques (Czochralski and Float-zone), Wafer preparation and polishing, Moore's Law and technology scaling trends

Unit 2: Oxidation, Diffusion, and Ion Implantation

Thermal oxidation: dry and wet processes, Oxide thickness control and measurement, Diffusion process: Fick's laws, drive-in and pre-deposition, Ion implantation: doping profiles, annealing, channeling, Comparison between diffusion and implantation

Unit 3: Photolithography and Etching

Photoresist types and characteristics, Exposure systems: contact, proximity, projection, Resolution and alignment issues, Etching techniques: wet and dry (plasma, RIE), Lithography for sub-micron technologies (EUV, DUV)

Unit 4: Thin Film Deposition and Metallization

Deposition techniques: CVD, LPCVD, PECVD, PVD, Step coverage and film stress issues, Epitaxial growth: homoepitaxy and heteroepitaxy, Metallization: materials (Al, Cu), silicides, barrier layers, Chemical Mechanical Planarization (CMP)

Unit 5: Process Integration and Advanced Technologies

NMOS, PMOS and CMOS process flows, Isolation techniques: LOCOS, STI, Yield analysis, reliability, and failure mechanisms, Advanced fabrication techniques: SOI, FinFETs, 3D ICs, Process simulation tools and current trends in semiconductor manufacturing

Textbooks

1. **S.M. Sze, Kwok K. Ng**, *Physics of Semiconductor Devices*, 3rd Edition, Wiley, 2006.
2. **S.K. Ghandhi**, *VLSI Fabrication Principles: Silicon and Gallium Arsenide*, 2nd Edition, Wiley, 1994.

Reference Books

1. **James D. Plummer, Michael D. Deal, Peter B. Griffin**, *Silicon VLSI Technology: Fundamentals, Practice, and Modeling*, Pearson Education, 2000.
2. **Stephen A. Campbell**, *The Science and Engineering of Microelectronic Fabrication*, 2nd Edition, Oxford University Press, 2001.
3. **Gary S. May, Simon M. Sze**, *Fundamentals of Semiconductor Fabrication*, Wiley, 2003.
4. **Harry J. Levinson**, *Principles of Lithography*, 4th Edition, SPIE Press, 2019.

VLSI Circuit Design and Verification	L	T	P	C
	3	0	0	3
Advanced VLSI Design				

Course Objectives

This course aims to:

1. Deepen understanding of VLSI design beyond the basics, focusing on advanced digital and analog circuits.
2. Introduce design methodologies for high-performance and low-power integrated circuits.
3. Explore advanced circuit topologies, layout optimization, and device scaling effects.
4. Provide insight into clocking, timing analysis, and signal integrity challenges in VLSI.
5. Familiarize students with modern CAD tools and industry-standard design flows.

Course Outcomes (COs)

After completing this course, students will be able to:

- Analyze and design complex digital and analog VLSI circuits with performance constraints.
- Apply advanced low-power design techniques to reduce power consumption.
- Perform timing analysis and implement clock distribution strategies.
- Optimize layouts considering parasitic effects and process variations.
- Utilize CAD tools for simulation, synthesis, and verification of VLSI designs.

Syllabus

Unit 1: Advanced CMOS Digital Circuits

Review of CMOS logic styles and scaling trends, Complex logic gates and compound gates, Pass transistor logic, transmission gates, and complementary pass logic, Static and dynamic logic design, Design of arithmetic circuits (adders, multipliers)

Unit 2: Low-Power VLSI Design Techniques

Power dissipation sources in CMOS circuits, Dynamic and static power reduction techniques, Multi-threshold CMOS, power gating, and clock gating, Voltage scaling and adaptive body biasing, Power estimation and modeling

Unit 3: High-Speed and High-Performance Design

Critical path analysis and pipeline design, Clock distribution networks and skew management, Signal integrity issues: crosstalk, ground bounce, Interconnect modeling and optimization, Timing analysis and closure techniques

Unit 4: Layout Design and Parasitics

Layout principles and design rules for advanced nodes, Parasitic capacitances and resistances, Extraction and modeling of parasitic effects, Layout optimization techniques for speed and power, Design for manufacturability (DFM) and variability considerations

Unit 5: VLSI Design Methodologies and Tools

Design flow overview: RTL to GDSII, Hardware description languages (Verilog, VHDL), Logic synthesis and optimization, Static timing analysis (STA), Verification methodologies: simulation, formal verification, Overview of popular CAD tools (Cadence, Synopsys, Mentor Graphics)

Textbooks

1. **David A. Hodges, Horace G. Jackson**, *Analysis and Design of Digital Integrated Circuits*, 3rd Edition, McGraw-Hill, 2014.
2. **Neil H.E. Weste, Kamran Eshraghian**, *Principles of CMOS VLSI Design*, 4th Edition, Pearson, 2015.

Reference Books

1. **Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic**, *Digital Integrated Circuits: A Design Perspective*, 2nd Edition, Pearson, 2003.
2. **Sung-Mo Kang, Yusuf Leblebici**, *CMOS Digital Integrated Circuits: Analysis and Design*, 4th Edition, McGraw Hill, 2014.
3. **Bhaskar Ghose**, *Advanced VLSI Design: Circuits and Systems*, PHI Learning, 2010.
4. **Kang and Leblebici**, *CMOS Digital Integrated Circuits*, 3rd Edition, McGraw Hill, 2003.

VLSI Circuit Design and Verification	L	T	P	C
	3	0	0	3
Introduction to CAD for VLSI				

Course Objectives

This course aims to:

1. Introduce the principles and methodologies of computer-aided design (CAD) tools used in VLSI.
2. Provide understanding of the various stages in VLSI design automation.
3. Familiarize students with hardware description languages and synthesis tools.
4. Explain algorithms for layout, verification, and optimization of VLSI circuits.
5. Develop skills to use CAD tools for design, simulation, and testing of integrated circuits.

Course Outcomes (COs)

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

- Describe the role and flow of CAD tools in VLSI design automation.
- Apply HDL coding and simulation for digital circuit design.
- Use synthesis tools to convert RTL to gate-level netlists.
- Understand and apply algorithms for placement, routing, and floorplanning.
- Perform verification and testing using CAD methodologies.

Syllabus

Unit 1: Overview of VLSI CAD Tools and Design Flow

Introduction to VLSI design automation, Design flow: Specification to fabrication, Types of CAD tools: front-end and back-end, Design representation: netlists, layouts, and formats, Design challenges and automation benefits

Unit 2: Hardware Description Languages (HDL)

Introduction to Verilog and VHDL, Design units and simulation models, Behavioral, dataflow, and structural modeling, Testbench creation and simulation, Case study: Simple digital design using HDL

Unit 3: Logic Synthesis and Optimization

RTL to gate-level synthesis, Technology libraries and mapping, Logic optimization techniques, Boolean algebra and DAG representation, Power, area, and timing trade-offs

Unit 4: Physical Design Automation

Floor planning and partitioning, Placement algorithms: combinatorial and analytical, Routing algorithms: maze routing, channel routing, Clock tree synthesis and timing closure, Design rule checking (DRC) and layout versus schematic (LVS)

Unit 5: Verification and Testing in CAD

Simulation vs formal verification, Static timing analysis (STA), Design for Testability (DFT) concepts, Built-in self-test (BIST), CAD tools for verification and test automation

Textbooks

1. **Sabih H. Gerez**, *Algorithms for VLSI Design Automation*, 3rd Edition, Wiley, 2009.
2. **Neil Weste, Kamran Eshraghian**, *Principles of CMOS VLSI Design*, 4th Edition, Pearson, 2015.

Reference Books

1. **Sanjay Churiwala**, *VLSI Design and EDA Tools*, Wiley, 2020.
2. **Stephen Brown, Zvonko Vranesic**, *Fundamentals of Digital Logic with VHDL Design*, 3rd Edition, McGraw-Hill, 2008.
3. **Wayne Wolf**, *Modern VLSI Design: IP-Based Design*, 4th Edition, Pearson, 2008.
4. **Rajesh K. Gupta**, *VLSI CAD: Algorithms and Tools*, 1st Edition, Springer, 2012.

Robotics and Automation	L	T	P	C
	3	0	0	3
Industrial Automation				

Course Objectives

This course aims to:

1. Introduce the fundamental concepts and components of industrial automation systems.
2. Provide knowledge of sensors, actuators, and control devices used in automation.
3. Explain programmable logic controllers (PLCs) and their programming.
4. Explore industrial communication protocols and supervisory control systems.
5. Familiarize students with modern automation trends including robotics and SCADA.

Course Outcomes (COs)

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

- Explain the components and architecture of industrial automation systems.
- Select and apply appropriate sensors and actuators in industrial environments.
- Program and troubleshoot PLCs for automated industrial processes.
- Understand industrial communication standards and supervisory control.
- Describe the role of robotics and SCADA in modern industrial automation.

Syllabus

Unit 1: Introduction to Industrial Automation

Evolution and benefits of automation, Types of automation: fixed, programmable, flexible, Components of automation systems: sensors, actuators, controllers, Industrial control systems overview, Safety and standards in automation

Unit 2: Sensors and Actuators

Classification and working principles of sensors (proximity, temperature, pressure, flow, level), Signal conditioning and data acquisition, Actuators: hydraulic, pneumatic, electric, Motor types and control (DC, AC, stepper, servo motors), Drives and converters

Unit 3: Programmable Logic Controllers (PLCs)

PLC architecture and operation, PLC input/output modules, Ladder logic programming and instruction set, Timers, counters, and sequencers, PLC applications and troubleshooting

Unit 4: Industrial Communication and SCADA

Industrial communication protocols: Modbus, Profibus, Ethernet/IP, CAN, Fieldbus and networked control systems, Supervisory Control and Data Acquisition (SCADA) systems, Human Machine Interface (HMI) basics, Data acquisition and process monitoring

Unit 5: Robotics and Advanced Automation

Industrial robots: types, configurations, and applications, Robot kinematics and control basics, Automation trends: IIoT (Industrial Internet of Things), smart manufacturing, Introduction to MES (Manufacturing Execution Systems), Case studies on automation in various industries

Textbooks

1. **Groover, M.P.**, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 4th Edition, Pearson, 2015.
2. **Frank D. Petruzella**, *Programmable Logic Controllers*, 5th Edition, McGraw Hill, 2016.

Reference Books

1. **Katsundo Hitomi**, *Industrial Robots*, 2nd Edition, Taylor & Francis, 2017.
2. **J. David Irwin**, *Industrial Automation and Process Control*, 1st Edition, Cengage, 2013.
3. **L.A. Bryan, E.A. Bryan**, *Programmable Controllers: Theory and Implementation*, 3rd Edition, Momentum Press, 2014.
4. **Thomas A. Hughes**, *Measurement and Control Basics*, 4th Edition, ISA, 2016.

Robotics and Automation	L	T	P	C
	3	0	0	3
Robots and Control				

Course Objectives

This course aims to:

1. Introduce fundamental concepts of robotics and control theory.
2. Explain robot kinematics, dynamics, and motion control.
3. Provide knowledge of robot manipulators, sensors, and actuators.
4. Explore control strategies for robotic systems.
5. Discuss recent advancements and applications of robotics in industry.

Course Outcomes (COs)

After completing this course, students will be able to:

- Describe the components and classifications of robots.
- Analyze forward and inverse kinematics of robotic manipulators.
- Model robot dynamics and apply motion control techniques.
- Design control algorithms for robot movement and interaction.
- Understand sensor integration and applications in robotic systems.

Syllabus

Unit 1: Introduction to Robotics

History and evolution of robots, Classification and types of robots (articulated, SCARA, Cartesian, mobile), Robot components: manipulators, sensors, actuators, controllers, Robot applications in industry and research, Degrees of freedom and workspace analysis

Unit 2: Robot Kinematics

Reference frames and coordinate transformations, Forward kinematics: position and orientation calculation, Inverse kinematics: analytical and numerical methods, Homogeneous transformation matrices, Velocity kinematics and Jacobian matrices

Unit 3: Robot Dynamics

Force and torque in robotic arms, Newton-Euler formulation for manipulator dynamics, Lagrangian formulation, Dynamic equations of motion, Simulation of robot dynamics

Unit 4: Robot Control Systems

Control system fundamentals and feedback principles, Joint space and task space control, PID controllers and advanced control strategies (adaptive, robust, nonlinear), Trajectory planning and motion control, Stability analysis and control performance evaluation

Unit 5: Sensors, Actuators, and Advanced Topics

Types of sensors in robotics: position, velocity, force, tactile, vision, Actuators: electric, hydraulic, pneumatic, Robot programming and interfacing, Introduction to mobile robots and autonomous systems, Recent trends: AI in robotics, collaborative robots, and human-robot interaction

Textbooks

1. **John J. Craig**, *Introduction to Robotics: Mechanics and Control*, 4th Edition, Pearson, 2018.
2. **Saeed B. Niku**, *Introduction to Robotics: Analysis, Control, Applications*, 3rd Edition, Wiley, 2010.

Reference Books

1. **Richard D. Klafter, Thomas A. Chmielewski, Michael Negin**, *Robotics Engineering: An Integrated Approach*, 2nd Edition, Prentice Hall, 2005.
2. **M. Spong, S. Hutchinson, M. Vidyasagar**, *Robot Modeling and Control*, Wiley, 2006.
3. **T. R. Kurfess**, *Robotics and Automation Handbook*, 2nd Edition, CRC Press, 2004.
4. **Mark W. Spong**, *Robot Dynamics and Control*, Wiley, 2006.

Robotics and Automation	L	T	P	C
	3	0	0	3
Distributed Embedded Systems				

Course Objectives

This course aims to:

1. Introduce the principles and architecture of distributed embedded systems.
2. Explain communication mechanisms and protocols for embedded networked devices.
3. Explore real-time operating systems and scheduling for distributed applications.
4. Provide knowledge on fault tolerance, synchronization, and security in distributed embedded systems.
5. Discuss design methodologies, middleware, and case studies of industrial distributed embedded systems.

Course Outcomes (COs)

Upon successful completion, students will be able to:

- Understand the architecture and characteristics of distributed embedded systems.
- Analyze communication protocols and middleware for embedded distributed networks.
- Design real-time scheduling and resource management schemes.
- Apply fault-tolerance and synchronization techniques in embedded distributed systems.
- Evaluate security challenges and solutions in distributed embedded environments.

Syllabus

Unit 1: Introduction and Architecture

Definition and examples of distributed embedded systems, Characteristics and design challenges, Architectural models: client-server, peer-to-peer, publish-subscribe, Hardware and software components, Case studies: automotive, aerospace, industrial automation

Unit 2: Communication in Distributed Embedded Systems

Network topologies and protocols (CAN, LIN, FlexRay, Ethernet, Wireless), Message passing and remote procedure calls (RPC), Middleware for distributed embedded systems, Real-time communication protocols, Quality of Service (QoS) and resource constraints

Unit 3: Real-Time Operating Systems and Scheduling

RTOS basics and features, Task models and process synchronization, Scheduling algorithms: rate monotonic, earliest deadline first, etc., Resource management and deadlock avoidance, Timing analysis and predictability

Unit 4: Fault Tolerance, Synchronization, and Security

Fault types and detection mechanisms, Redundancy and recovery techniques, Clock synchronization methods, Security challenges in distributed embedded systems, Cryptography and secure communication

Unit 5: Design Methodologies and Case Studies

Model-based design and simulation tools, Middleware architectures and frameworks, Design for scalability and maintainability, Case studies: smart grids, autonomous vehicles, industrial IoT, Emerging trends: edge computing, cyber-physical systems

Textbooks

1. **Sanjay E. Sarma, David M. Tilbury**, *Distributed Embedded Control Systems*, Wiley, 2015.
2. **Jane W. S. Liu**, *Real-Time Systems*, 2nd Edition, Pearson, 2000.

Reference Books

1. **J. M. Lee**, *Embedded Software and Systems*, 1st Edition, Wiley, 2007.
2. **Peter Marwedel**, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems*, 2nd Edition, Springer, 2017.
3. **Muhammad Ali Mazidi**, *Distributed Embedded Systems*, Pearson, 2018.
4. **Rajib Mall**, *Real-Time Systems: Theory and Practice*, 2nd Edition, Pearson, 2013.

Robotics and Automation	L	T	P	C
	3	0	0	3
Advanced Controllers				

Course Objectives

This course aims to:

1. Introduce advanced control system concepts beyond classical PID control.
2. Develop analytical skills for modeling and designing advanced controllers.
3. Cover modern control techniques such as state-space, optimal, and robust control.
4. Explore adaptive and nonlinear control strategies.
5. Apply advanced control techniques to real-world engineering problems.

Course Outcomes (COs)

After successful completion, students will be able to:

- Model dynamic systems using state-space representation.
- Design and analyze optimal control systems.
- Understand and implement robust control methods for uncertain systems.
- Develop adaptive and nonlinear control solutions.
- Apply advanced controllers to practical engineering systems.

Syllabus

Unit 1: State-Space Control Design

State-space representation of systems, Controllability and observability, State feedback control and pole placement, Observers and state estimation (Luenberger observer), Design of full-order and reduced-order observers

Unit 2: Optimal Control

Formulation of optimal control problems, Calculus of variations and Pontryagin’s minimum principle, Linear Quadratic Regulator (LQR) design, Riccati equations and solutions, Applications in engineering systems

Unit 3: Robust Control

Introduction to robustness and system uncertainties, H-infinity control theory basics, Sensitivity and complementary sensitivity functions, Loop shaping and robust controller design, Applications to practical uncertain systems

Unit 4: Adaptive Control

Concepts of adaptive control, Model Reference Adaptive Control (MRAC), Self-tuning regulators, Stability analysis of adaptive systems, Applications and challenges

Unit 5: Nonlinear Control

Nonlinear system characteristics, Phase plane analysis, Lyapunov stability theory, Feedback linearization, Sliding mode control and applications

Textbooks

1. **Katsuhiko Ogata**, *Modern Control Engineering*, 5th Edition, Prentice Hall, 2010.
2. **D. E. Kirk**, *Optimal Control Theory: An Introduction*, Dover Publications, 2004.

Reference Books

1. **M. Vidyasagar**, *Nonlinear Systems Analysis*, 2nd Edition, SIAM, 2002.
2. **B. C. Kuo**, *Automatic Control Systems*, 9th Edition, Wiley, 2014.
3. **Zhou, Doyle, and Glover**, *Robust and Optimal Control*, Prentice Hall, 1996.
4. **Ioannou and Sun**, *Robust Adaptive Control*, Dover, 2012.

Cognitive Radio Networks	L	T	P	C
	3	0	0	3
Optical Communications				

Course Objectives

This course aims to:

1. Introduce fundamentals of optical fiber communication systems.
2. Explain the physical principles of light propagation in fibers.
3. Discuss components and devices used in optical communication.
4. Cover optical transmitter, receiver, and system design.
5. Present recent developments and challenges in optical networks.

Course Outcomes (COs)

Upon completion, students will be able to:

- Explain the basic principles of optical fiber and wave propagation.
- Analyze fiber characteristics and losses.
- Understand and design optical transmitters and receivers.
- Evaluate performance parameters of optical communication systems.
- Discuss modern optical network architectures and technologies.

Syllabus

Unit 1: Introduction to Optical Fiber Communications

History and evolution, Basic components of optical communication system, Electromagnetic spectrum and optical windows, Advantages of optical communication

Unit 2: Optical Fiber Fundamentals

Structure and types of optical fibers, Light propagation: total internal reflection, acceptance angle, numerical aperture, Modes of propagation: single-mode and multimode fibers, Fiber fabrication techniques

Unit 3: Fiber Losses and Dispersion

Attenuation mechanisms: absorption, scattering, bending losses, Chromatic dispersion and modal dispersion, Polarization mode dispersion, Dispersion compensation techniques

Unit 4: Optical Sources and Detectors

Light sources: LEDs, LASER diodes, VCSELs, Modulation techniques, Photodetectors: PIN diode, Avalanche photodiode (APD), Receiver sensitivity and noise considerations

Unit 5: Optical System Design and Networks

Optical link design and power budget analysis, Noise and bandwidth considerations, Optical amplifiers: EDFA, Raman amplifiers, Wavelength division multiplexing (WDM) and Dense WDM (DWDM), Optical switching and networking basics

Textbooks

1. **Gerd Keiser**, *Optical Fiber Communications*, 5th Edition, McGraw-Hill, 2017.
2. **John M. Senior**, *Optical Fiber Communications: Principles and Practice*, 3rd Edition, Pearson, 2009.

Reference Books

1. **Govind P. Agrawal**, *Fiber-Optic Communication Systems*, 4th Edition, Wiley, 2010.
2. **Joseph C. Palais**, *Fiber Optic Communications*, 5th Edition, Pearson, 2005.
3. **Stuart E. Miller**, *Optical Networks: A Practical Perspective*, 3rd Edition, Morgan Kaufmann, 2010.
4. **R. Ramaswami, K. N. Sivarajan**, *Optical Networks: A Practical Perspective*, 3rd Edition, Morgan Kaufmann, 2009.

Cognitive Radio Networks	L	T	P	C
	3	0	0	3
Wireless and Mobile Networks				

Course Description

The Purpose of the Course is to introduce the basic principles of Wireless communications. The Course aims to provide information about Spread spectrum. The Target audience are Third-Year engineering students. The multiplexing methods are also introduced. The Stake holders will acquire concepts of Cellular Communication.

Teaching Objectives

1.To understand the Wireless Channel Modeling

2.To study concepts of Spread Spectrum

3.To understand Multiplexing and Multiple Access

4.To understand the Cellular systems

Course Outcomes

1.Identify the limitations of conventional mobile telephone systems; understand the Concepts of cellular systems..

2.Understand the Multiplexing and Multiple Access in cellular systems

3.Understand the architectures of various cellular systems

4.Understand the concepts of Spread Spectrum and Diversity

Unit 1: EVOLUTION OF MOBILE RADIO COMMUNICATION FUNDAMENTALS

This unit focus on introduction of operation of cellular systems. The Wireless Channel Modeling is discussed.

Syllabus Topics

General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space

Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modeling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modeling.

Examples/Applications/Case Studies

●Study of Handoff Strategies

●Study of Multipath Fading

●Wireless Channel Modeling

Exercise/Project Problems

1.Frequency reuse

2.Channel Modeling

Tools Study

●MATLAB

Learning Outcomes

1.Identify the limitations of conventional mobile telephone systems; understand the concepts of cellular systems..

References/e-Resources

●Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)

●Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 2: SPREAD SPECTRUM AND DIVERSITY

This unit focus on Understand the concepts of Spread Spectrum and Diversity. The Diversity Combining Techniques is discussed.

Syllabus Topics

Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation.

Examples/Applications/Case Studies

●Study of Vocoders

●Study of Time Hopping

●Detection Strategies

Exercise/Project Problems

1.Spread Spectrum Modulation

2.Diversity Combining Techniques

Tools Study

●MATLAB

Learning Outcomes

1.Understand the concepts of Spread Spectrum and Diversity

References/e-Resources

●Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)

●Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 3: EQUALIZATION AND MULTIPLE ACCESS

This unit focus on Multiplexing and Multiple Access. The Multiple Access for Radio Packet Systems is discussed.

Syllabus Topics

Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC- FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.

Examples/Applications/Case Studies

●Study of Equalization Techniques

●Study of Multiplexing and Multiple Access

●Hybrid Method of Multiple Access Schemes

Exercise/Project Problems

1.Adaptive Equalizers

2.Pure ALOHA, Slotted ALOHA

Tools Study

● MATLAB

Learning Outcomes

1.Understand the Multiplexing and Multiple Access in cellular systems

References/e-Resources

●Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)

●Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 4: CELLULAR NETWORKS

This unit focus on study on CDMA . The Long Term Evolution is discussed.

Syllabus Topics

GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.

Examples/Applications/Case Studies

- Study of General Packet Radio Service
- Study of Long Term Evolution

Exercise/Project Problems

1. Mobile Satellite Communication
2. CDMA Based Standards

Tools Study

●MATLAB

Learning Outcomes

1.Understand the architectures of various cellular systems

References/e-Resources

●Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)

●Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 5: OTHER WIRELESS NETWORKS

This unit focus on introduction of operation of cellular systems. The Wireless Channel Modeling is discussed.

Syllabus Topics

Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G & 5G and concept of NGN.

Examples/Applications/Case Studies

- Study of Mobile Adhoc Networks
- Study of Ultra-Wideband Communication

Exercise/Project Problems

1.Wi-Fi Standards

2.Mobile data networks

Tools Study

●**MATLAB**

Learning Outcomes

1.Understand the concept of Ultra-Wideband Communication

References/e-Resources

●Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)

●Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Mobile radio communication fundamentals

●Lab 1: Operation of Cellular Systems (understanding the concept)

●Lab 2: Wireless Channel Modeling (understanding the concept)

Week 3-4: Spread Spectrum and Diversity

●Lab 3: Vocoders (understanding the concept)

●Lab 4: Diversity Combining Techniques (understanding the concept)

Week 5-6: Equalization and Multiple Access

- Lab 5: FDMA, TDMA, CDMA (understanding the concept)
- Lab 6: Pure ALOHA, Slotted ALOHA, CSMA (understanding the concept)

Week 7-8: Cellular Networks

- Lab 7: Long Term Evolution (understanding the concept)

- Lab 8: Mobile Satellite Communication (understanding the concept)

Textbooks

1.T.S. Rappaport, (2002). “Wireless Communication-Principles and practice”, Pearson Publications.

2.Upena Dalal, (2015). “Wireless Communication and Networks”, Oxford

3.T L Singal, (2010). “Wireless Communications”, McGraw Hill Publications.

References

1.Andrea Goldsmith, (2005). “Wireless Communications”, Cambridge University Press,

2.S. Haykin & M. Moher, (2005). “Modern wireless communication”, Pearson.

Online Resources

1. Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
2. Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Cognitive Radio Networks	L	T	P	C
	3	0	0	3
Software Defined Radio (SDR)				

Course Objectives

This course aims to:

1. Introduce the principles and architecture of Software Defined Radio.
2. Explain signal processing techniques used in SDR.
3. Explore hardware platforms and software tools for SDR implementation.
4. Discuss design, testing, and deployment of SDR systems.
5. Provide insights into emerging SDR applications and standards.

Course Outcomes (COs)

After completing the course, students will be able to:

- Understand SDR architecture and key components.
- Apply digital signal processing techniques in SDR systems.
- Develop and simulate SDR algorithms using software tools.
- Select appropriate hardware platforms for SDR implementation.
- Analyze and evaluate SDR applications in modern wireless communications.

Syllabus

Unit 1: Introduction to Software Defined Radio

Evolution of radio communication systems, Definition and characteristics of SDR, SDR architecture and components, Benefits and challenges of SDR, Overview of cognitive radio and adaptive radio

Unit 2: Signal Processing for SDR

Analog to digital and digital to analog conversion, Sampling theorem and quantization, Digital modulation and demodulation techniques, Channel coding and decoding, Signal processing algorithms: FFT, filtering, mixing

Unit 3: Hardware Platforms for SDR

Overview of hardware components: RF front-end, ADC/DAC, FPGA, DSP, microcontrollers, Popular SDR platforms: USRP, RTL-SDR, HackRF, LimeSDR, Hardware-software co-design considerations, Performance metrics and constraints

Unit 4: Software Tools and Development

SDR software frameworks: GNU Radio, MATLAB/Simulink, LabVIEW, Real-time signal processing and implementation, Software architecture and API programming, Testing, debugging, and validation techniques

Unit 5: Applications and Case Studies

SDR in cellular communications, Wi-Fi, Bluetooth, Cognitive radio and dynamic spectrum access, SDR in satellite and military communications, Emerging trends: 5G, IoT, and 6G potential with SDR, Case studies of SDR deployment

Textbooks

1. **Joseph Mitola III, Gerald Q. Maguire Jr.**, *Cognitive Radio: Making Software Radios More Personal*, Wiley, 2009.
2. **Ettus Research**, *Software Defined Radio for Engineers*, 1st Edition, Artech House, 2014.

Reference Books

1. **Harald Kayser**, *Software Defined Radio: Enabling Technologies*, Wiley, 2006.
2. **Dr. Jeffrey H. Reed**, *Software Radio: A Modern Approach to Radio Engineering*, Prentice Hall, 2002.
3. **Peter Athanas**, *Software Defined Radio: Architectures, Systems and Functions*, Wiley, 2013.
4. **Mathur, S., Kaur, H.**, *Software Defined Radio Systems and Techniques*, Wiley, 2018.

	L	T	P	C
Cognitive Radio Networks	**3**	**0**	**0**	**3**
MIMO Wireless Communications				

Course Objectives

This course aims to:

1. Introduce the fundamental concepts of Multiple-Input Multiple-Output (MIMO) wireless systems.
2. Explain the theory behind MIMO channel modeling and capacity analysis.
3. Explore various MIMO transmission techniques and signal processing algorithms.
4. Discuss practical implementation challenges and performance evaluation.
5. Present emerging trends and applications of MIMO in modern wireless standards.

Course Outcomes (COs)

After completing this course, students will be able to:

- Understand the principles of MIMO systems and channel characteristics.
- Analyze MIMO channel capacity and diversity gains.
- Apply MIMO transmission schemes such as spatial multiplexing and diversity.
- Design and implement signal detection and channel estimation algorithms for MIMO.
- Evaluate the performance of MIMO systems in real-world wireless scenarios.

Syllabus

Unit 1: Introduction to MIMO Systems

Overview of MIMO technology and historical perspective, MIMO system architecture and components, Benefits of MIMO: capacity increase, diversity, and multiplexing gains, Wireless channel characteristics for MIMO

Unit 2: MIMO Channel Modeling

Statistical channel models: Rayleigh and Rician fading, Correlation and antenna spacing effects, Channel state information (CSI), Channel capacity concepts for MIMO: ergodic and outage capacity

Unit 3: MIMO Transmission Techniques

Spatial multiplexing (e.g., V-BLAST), Diversity techniques: Alamouti scheme, space-time coding, Beamforming and precoding, MIMO-OFDM integration

Unit 4: Signal Processing for MIMO

Channel estimation methods, Detection algorithms: Zero-Forcing, MMSE, ML detection, Linear and nonlinear receivers, Performance analysis and complexity considerations

Unit 5: Practical Aspects and Applications

MIMO in 4G LTE and 5G NR standards, Massive MIMO concepts and challenges, Implementation issues: hardware complexity, synchronization, MIMO for mmWave and IoT applications, Future trends in MIMO wireless communications

Textbooks

1. **Arogyaswami J. Paulraj, Rohit Nabar, Dhananjay Gore**, *Introduction to Space-Time Wireless Communications*, Cambridge University Press, 2003.
2. **David Tse and Pramod Viswanath**, *Fundamentals of Wireless Communication*, Cambridge University Press, 2005.

Reference Books

1. **Lajos Hanzo, Yong Soo Choi, Brian L. Yeap**, *MIMO-OFDM for LTE, WiFi and WiMAX: Coherent versus Non-Coherent and Cooperative Turbo-Transceivers*, Wiley, 2010.
2. **Emil Björnson, Jakob Hoydis, Luca Sanguinetti**, *Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency*, Cambridge University Press, 2017.
3. **Ezio Biglieri, Robert Calderbank, Anthony Constantinides**, *MIMO Wireless Communications*, Cambridge University Press, 2007.
4. **A. Goldsmith**, *Wireless Communications*, Cambridge University Press, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM

VIZIANAGARAM – 535 003 Andhra Pradesh (India)

B. Tech ECE (R23-COURSE STRUCTURE & SYLLABUS)

	L	T	P	C
Cognitive Radio Networks	**3**	**0**	**0**	**3**
Wireless Broadband Communications				

Course Description

The Purpose of the Course is to introduce the next generation networks. The Course aims to provide information about IP Multimedia Sub-System. The Target audience are Third-Year engineering students. The architecture of a next generation network is also introduced. The Stake holders will acquire concepts of Wireless Broad Communications

Teaching Objectives

1. To learn the technical, economic and service advantages of next generation networks.
2. To learn the basic architecture of a next generation network (NGN) with reference
3. To understand NGN services
4. To learn the role of IP Multimedia Sub-System (IMS), network attachment and admission control functions
5. To learn and compare the various methods of providing connection-oriented services over NGN.

Course Outcomes

1. Understand the concepts of Wireless LAN.
2. Understand the concepts of Mobile Network Layer & Transport Layer
3. Understand the concepts of High Speed Packet Data
4. Understand the basic architecture of a next generation network (NGN) with reference.

Unit 1: EVOLUTION OF WIRELESS NETWORKS

This unit focus on introduction of operation of Wireless systems. The Wireless LAN Protocols is discussed.

Syllabus Topics

Review of cellular standards, migration and advancement of GSM architecture and CDMA architecture, WLAN – IEEE 802.11and HIPERLAN, Bluetooth..

Examples/Applications/Case Studies

- GSM Architecture
- Wireless LAN advantages
- Bluetooth applications

Exercise/Project Problems

1. CDMA architecture
2. HIPERLAN advantages

Tools Study

- *MATLAB*

Learning Outcomes

1. Understand the concepts of Wireless LAN.

References/e-Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 2: WIRELESS PROTOCOLS

This unit focus on Understand the concepts of Mobile network layer. The Mobile transport layer Techniques is discussed.

Syllabus Topics

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements Indirect TCP, snooping TCP, Mobile TCP.

Examples/Applications/Case Studies

- Compare IPv4 & IPv6
- Study of Congestion control
- Mobile TCP

Exercise/Project Problems

1. IP mobility management
2. Data forwarding procedures

Tools Study

- *MATLAB*

Learning Outcomes

1. Understand the concepts of Mobile Network Layer & Transport Layer

..

References/e-Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 3: 3G EVOLUTIONS

This unit focus on CDMA concepts. The High Speed Data Packet concepts are discussed.

Syllabus Topics

IMT-2000 - W-CDMA, CDMA 2000 – radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA..

Examples/Applications/Case Studies

- Study of UMTS-services
- Study of Channel Allocation

Exercise/Project Problems

1. CDMA 2000
2. HSDPA

Tools Study

- *MATLAB*

Learning Outcomes

1. Understand the concepts of High Speed Packet Data

..

References/e-Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 4: 4G AND BEYOND

This unit focus on study on network architectures . The Long Term Evolution is discussed.

Syllabus Topics

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure..

Examples/Applications/Case Studies

- Study of network architectures
- Study of Long Term Evolution

Exercise/Project Problems

1. Random access procedure
2. MAC control element

Tools Study

- *MATLAB*

Learning Outcomes

1. Understand the basic architecture of a next generation network (NGN) with reference..

References/e-Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Unit 5: LAYER-LEVEL FUNCTIONS

This unit focus on introduction of MAC scheme. The multimedia broadcast/multicast services are discussed.

Syllabus Topics

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation –CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

.

Examples/Applications/Case Studies

- Study of wireless channels
- Study of location-based services

Exercise/Project Problems

1. SC-FDMA
2. Services - multimedia broadcast/multicast

Tools Study

- *MATLAB*

Learning Outcomes

1. To understand the methods of providing connection-oriented services over NGN

References/e-Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Laboratory Exercises

Week 1-2:Wireless Networks fundamentals

- **Lab 1**: Wireless LAN (understanding the concept)
- **Lab 2**: Bluetooth (understanding the concept)

Week 3-4: Wireless Protocols

- **Lab 3**: IP Adressing (understanding the concept)
- **Lab 4**: TCP (understanding the concept)

Week 5-6: 3G

- **Lab 5**: W-CDMA (understanding the concept)
- **Lab 6**: HSDPA (understanding the concept)

Week 7-8: 4G

- **Lab 7**: Long Term Evolution (understanding the concept)
- **Lab 8**: EPC network architecture (understanding the concept)

Textbooks and References

Textbooks

1. Kaveh Pahlavan, *(2008)*. "*Principles of wireless networks*", Prentice-Hall of India.
2. Vijay K.Garg, *(2013)*. "*Wireless Network Evolution- 2G & 3G*" Pearson.

References

1. Clint Smith,P.E, Dannel Collins, *(2008)*. "*3G Wireless Networks*" , Tata McGraw-Hill.
2. Jochen H.Schiller, *(2014)*. "*Mobile Communications*", Pearson.

Online Resources

- Introduction to Wireless and Cellular Communications (Source:IIT Madras & NPTEL via Swayam)
- Advanced 3G and 4G Wireless Mobile Communications (Source:IIT Kanpur & NPTEL via Swayam)

Multimedia Signal Processing	L	T	P	C
	3	0	0	3
DETECTION & ESTIMATION OF SIGNALS				

Course Description

The Purpose of the Course is to introduce the basic Detection and Estimation of Signals.The Course aims to provide the techniques implemented for analysis of Random Processes. The Target audience are Third-Year engineering students. The statistical Techniques will be discussed for Signal analysis in real time scenarios.. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. The main objective of this course is to provide basic estimation and detection background
2. This course provides the main concepts and algorithms for detection and estimation
3. Students learn the statistics and estimating the parameters of Random Process from detection
4. To apply estimation methods for real time engineering problems.

Course Outcomes

1. Understand the basic Random Process and detection methods.
2. Know the significance of Probability of error
3. Learn about basic estimation methods and filters
4. Measure the statistical parameters for random processes

Unit 1: RANDOM PROCESSES

This unit focuses on introduction of Random Processes. The statistical parameters of Random Processes will be covered.

Syllabus Topics

Discrete Linear Models, Markov Sequences and Processes, Point Processes and Gaussian Processes.

Examples/Applications/Case Studies

- Types of Random Processes
- Conditions of Random Processes
- To study the importance of Gaussian Random Process

Exercise/Project Problems

1. Use MATLAB tool to study Random Processes
2. To Compute Moments in a Random Processes
3. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Random Processes
- *Online Octave Compiler for MATLAB*

Learning Outcomes

2. Understand the basic of Random Process

References/e-Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

Unit 2: DETECTION THEORY

This unit focuses on introduction of Classfier. The stakeholders Mathematical Skills will be improved.

Syllabus Topics

Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

Examples/Applications/Case Studies

- To study Probability of Error
- To study Bayes Decision Rule
- To study the types of classifier

Exercise/Project Problems

1. Use MATLAB tool to study Classifier
2. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Probability of Error & Classifier
- *Online Octave Compiler for MATLAB*

Learning Outcomes

3. Understand the basic of Detection Theory

References/e-Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

Unit 3: LINEAR MINIMUM MEAN-SQUARE ERROR FILTERING

This unit focuses on introduction of Mean Squared Error Estimators. The stakeholders will be introduced with Real time Digital Filters .

Syllabus Topics

Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

Examples/Applications/Case Studies

- To study Minimum Mean Squared Error
- To study Digital Filters
- To compare Wiener Filter and Kalman Filter

Exercise/Project Problems

1. Use MATLAB tool to study Digital Filter
2. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Digital Filter
- *Online Octave Compiler for MATLAB*

Learning Outcomes

1. Learn about basic estimation methods and filters

References/e-Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

Unit 4: STATISTICS

This unit focuses on introduction of Non Parametric Estimators. The stakeholders will be introduced with Regression Models.

Syllabus Topics

Measurements, Non parametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

Examples/Applications/Case Studies

- To study Non Parametric Estimators
- To study Regression models

Exercise/Project Problems

1. Use MATLAB tool to study Non Parametric Estimators
2. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding Regression Models*
- *Online Octave Compiler for MATLAB*

Learning Outcomes

1. Learn about Regression Models

References/e-Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

Unit 5: ESTIMATING THE PARAMETERS OF RANDOM PROCESSES FROM DATA

This unit focuses on Parameters of Random Processes. The stakeholders Analytical Skills will be improved.

Syllabus Topics

Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions..

Examples/Applications/Case Studies

- To study conditions of Stationarity and Egrodicity
- To study relation between Auto Correlation Function and Power Spectrum Density

Exercise/Project Problems

1. Use MATLAB tool to compute Power Spectrum Density
2. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding Random Process Parameters*
- *Online Octave Compiler for MATLAB*

Learning Outcomes

1. Measure the statistical parameters for random processes

References/e-Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Random Processes

- **Lab 1**: To generate Gaussian Random Processes (understanding the concept)
- **Lab 2**: To generate Markov Sequence(understanding the concept)

Week 3-4: Detection Theory

- **Lab 3**: To study Bayes Decision Rule (understanding the concept)
- **Lab 4**: To study Neyman-Pearson Classifier (understanding the concept)

Week 5-6: Filtering

- **Lab 5**: To Study Wiener Filter (understanding the concept)
- **Lab 6**: To Study Kalman Filter(understanding the concept)

Week 7-8: Statistics

- **Lab 7**: To Study Simple Linear Regression using MATLAB (understanding the concept)
- **Lab 8**: To Study Multiple Linear Regression using MATLAB (understanding the concept)

Week 9-10: Parameters of Random Processes

- **Lab 9**: To Study Stationarity and Ergodicity (understanding the concept)
- **Lab 10**: To Study Autocorrelation Functions, Power Special Density Functions (understanding the concept)

Textbooks and References
Textbooks

3. K. Sam Shanmugan & A.M.Breipohl (2011).*Random Signals: Detection, Estimation and Data Analysis*, Wiley India Pvt. Ltd.
4. Lonnie C. Ludeman, (2010).*Random Processes: Filtering, Estimation and Detection,* Wiley India Pvt. Ltd.

.

References

3. Steven. M. Kay,(1998).*Fundamentals of Statistical Signal Processing: Volume I Estimation Theory*, Prentice Hall.
4. Srinath, Rajasekaran, Viswanathan, (2003).*Introduction to Statistical Signal Processing with Applications* , PHI.
5. Louis L.Scharf, (1991),*Statistical Signal Processing: Detection, Estimation and Time Series Analysis* ,Addison Wesley.

Online Resources

- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)

<table>
<tr><td rowspan="2">Multimedia Signal Processing</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="5">STATISTICAL SIGNAL PROCESSING</td></tr>
</table>

Course Description

The Purpose of the Course is to introduce the basic of Statistical Signal Processing.The Course aims to provide the techniques implemented for Noise estimation & Adaptive Filtering. The Target audience are Third-Year engineering students. The Spectral analysis are discussed for real time scenarios.. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. To familiarize with Random Signal Modeling
2. To provide students an understanding of the concepts related to application of statistical hypothesis testing to the detection of signals in noise
3. To familiarize students on the concepts of statistical parameter estimation methods to extract information from signals in noise.
4. To summarize the adaptive of filtering in signal detection and estimation process.
5. To explore the students with spectral analysis

Course Outcomes

1. Able to learn Random Signal Modeling
2. Able to use the statistical information in basic detection theory to solve the problems that involve detection of signals in the presence of noise
3. Able to Learn about filtering techniques for Noise Estimation
4. Able to understand Adaptive filtering
5. Able to understand Spectral Analysis

Unit 1: REVIEW OF RANDOM VARIABLES

This unit focuses on introduction of Random Variables. The statistical parameters of Random Processes will be covered. The Random Signal Modeling is discussed

Syllabus Topics

Distribution and density functions, moments, independent, Uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process. Random signal modelling: MA(q), AR(p) , ARMA(p,q) models..

Examples/Applications/Case Studies

- To Study Orthogonality
- To Study Random Processes
- To study the Random Signal Modeling

Exercise/Project Problems

3. Use MATLAB tool to study Random Processes
4. Use MATLAB to learn Random Signal Modeling Algorithms
5. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Random Signal Modeling
- *Online Octave Compiler for MATLAB*

Learning Outcomes

3. Able to learn Random Signal Modeling

References/e-Resources

- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Unit 2: PARAMETER ESTIMATION THEORY

This unit focuses on statistical information in basic detection theory to solve the problems that involve detection of signals in the presence of noise

Syllabus Topics

Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties ; Baysean estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

Examples/Applications/Case Studies

- To study MMSE
- To study Estimation techniques

Exercise/Project Problems

3. Use MATLAB tool to study Estimation techniques
4. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Estimation techniques
- *Online Octave Compiler for MATLAB*

Learning Outcomes

1. Able to use the statistical information in basic detection theory to solve the problems that involve detection of signals in the presence of noise

References/e-Resources

- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Unit 3: FILTERING TECHNIQUES FOR NOISE ESTIMATION

This unit focuses on introduction of filtering techniques for noise estimation. The stakeholders will be introduced with IIR & FIR Filters .

Syllabus Topics

Estimation of signal in presence of white Gaussian Noise, Linear Minimum Mean-Square Error (LMMSE) Filtering, Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Non causal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.

.

Examples/Applications/Case Studies

- To study LMMSE Filtering
- To study FIR & IIR filter techniques
- To study prediction error Filter

Exercise/Project Problems

3. Use MATLAB tool to study IIR & FIR Filter techniques
4. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* IIR & FIR Filter techniques
- *Online Octave Compiler for MATLAB*

Learning Outcomes

2. Learn about filtering techniques for Noise estimation

References/e-Resources

- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Unit 4: ADAPTIVE FILTERING & KALMAN FILTERING

This unit focuses on introduction of Adaptive Filters. The stakeholders will be introduced with advantages of Kalman Filtering.

Syllabus Topics

Adaptive Filtering: Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Application of Adaptive filters ;RLS algorithm, derivation, Matrix inversion Lemma, Initialization, tracking of non stationarity.

Kalman filtering: State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

Examples/Applications/Case Studies

- To study LMS Algorithm
- To study Kalman Filtering

Exercise/Project Problems

3. Use MATLAB tool to study Adaptive Filters
4. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding Adaptive Filters*
- *Online Octave Compiler for MATLAB*

Learning Outcomes

- **Able to understand Adaptive filtering.**
  References/e-Resources
- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Unit 5: SPECTRAL ANALYSIS

This unit focuses on Spectral Analysis. The stakeholders will understand the concept of Parametric Estimation methods .

Syllabus Topics

Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Parametric method, AR(p), Spectral estimation and detection of Harmonic signals, MUSIC algorithm

Examples/Applications/Case Studies

- To study about Periodogram
- To study Parametric Estimation Methods

Exercise/Project Problems

3. Use MATLAB tool to compute Periodogram

4. To Study Signal Processing Tool box in MATLAB

Tools Study

- *MATLAB tool for understanding* Parametric Estimation Methods
- *Online Octave Compiler for MATLAB*

Learning Outcomes

1. Able to understand Spectral Analysis

References/e-Resources

- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Random Signal Modeling

- **Lab 1**: To study MA model(understanding the concept)
- **Lab 2**: To study ARMA model(understanding the concept)

Week 3-4: Parameter Estimation

- **Lab 3**: To study Bayes Estimation (understanding the concept)
- **Lab 4**: To study Cramer Rao bound (understanding the concept)

Week 5-6: Filtering

- **Lab 5**: To Study FIR Wiener filter (understanding the concept)
- **Lab 6**: To Study IIR Wiener filter (understanding the concept)

Week 7-8: Adaptive Filtering

- **Lab 7**: To Study Kalman filtering using MATLAB (understanding the concept)
- **Lab 8**: To Study RLS algorithm using MATLAB (understanding the concept)

Textbooks and References

Textbooks

5. Charles W. Therrien, (1992). *Discrete Random Signals and Statistical Signal Processing*, Prentice Hall Signal Processing Series
6. K. Sam Shanmugan & A.M.Breipohl (2011).*Random Signals: Detection, Estimation and Data Analysis*, Wiley India Pvt. Ltd.
7. Lonnie C. Ludeman, (2010).*Random Processes: Filtering, Estimation and Detection,* Wiley India Pvt. Ltd.

References

6. D.G. Manolakis, V.K. Ingle and S.M. Kogon,(2000). *Statistical and Adaptive Signal Processing*, McGraw Hill .
7. Srinath, Rajasekaran, Viswanathan, (2003).*Introduction to Statistical Signal Processing with Applications* , PHI.

8. Louis L.Scharf, (1991),*Statistical Signal Processing: Detection, Estimation and Time Series Analysis* ,Addison Wesley.

Online Resources

- Stastical Signal Processing (Source:IIT Guwahati & NPTEL via Swayam)
- Signal Detection and Estimation Theory(Source:IIT Guwahati & NPTEL via Swayam)

Multimedia Signal Processing	L	T	P	C
	3	0	0	3
COMPUTER VISION				

Course Description

The Purpose of the Course is to introduce the Computer Vision. The Course aims to provide the techniques implemented for Object Recognition. The Target audience are Third-Year engineering students. The Techniques will deal with Pattern Recognition. This will help us to understand the Real time Tracking of Objects for Civil and Commercial applications. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. To introduce students the fundamentals of image formation
2. To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition
3. To develop an appreciation for various issues in the design of computer vision and object recognition systems
4. To provide the student with programming experience from implementing computer vision and object recognition applications

Course Outcomes

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
2. Describe known principles of feature detection and matching
3. Describe basic methods of computer vision related to image stitching, photography like high dynamic range imaging and blur removal.
4. Suggest a design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths

Unit 1: INTRODUCTION

This unit focus on introduction of basic Operators in Image Processing. The Data transformation techniques are introduced

Syllabus Topics

Image Formation: Geometric Primitives and Transformation, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, More Neighborhood Operators, Fourier Transforms, Pyramids and Wavelets, Geometric Transformations, Global Optimization.

Examples/Applications/Case Studies

- Study of Digital Camera
- Importance of Transformation for Data Storage and optimization
- Study of Wavelets for Data Compression

Exercise/Project Problems

6. Use MATLAB toolbox to understand Fourier Transform
7. Study of Wavelets using Image Processing Toolbox in MATLAB

Tools Study

- *MATLAB tool for understanding Image Processing Techniques*

Learning Outcomes

4. Identify basic concepts, terminology, theories, models and methods in the field of computer vision
5. To understand the concepts of Data Transformation

References/e-Resources

- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)

Unit 2: FEATURE DETECTION AND MATCHING

This unit focus on Feature extraction. The real time Feature based Alignment methods are covered. This unit will focus on Feature Estimation and Calibration.

Syllabus Topics

Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature-Based Alignment: 2D and 3D Feature-based Alignment, Pose Estimation, Geometric Intrinsic Calibration.

Examples/Applications/Case Studies

- Study of Segmentation Techniques
- Study of Feature Alignment and Estimation

Exercise/Project Problems

1. Using MATLAB tool to understand Segmentation
2. Study of Feature estimation using Image Processing Toolbox in MATLAB

Tools Study

- *MATLAB tool for understanding* Feature estimation *Techniques*

Learning Outcomes

4. Analyze the principles of feature detection and matching
5. To understand Segmentation Techniques

References/e-Resources

- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)

Unit 3: STRUCTURE AND MOTION

This unit focus on Motion Estimation. The real time Structure Modeling will be covered. This unit will focus on improvement of Analytical Skills of Stake holders

Syllabus Topics

Triangular, Two-frame Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion, Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline-based Motion, Optical Flow, Layered motion.

Examples/Applications/Case Studies

- Study of Motion estimation Techniques
- Study of Factorization

Exercise/Project Problems

1. Using MATLAB tool to understand Structure from Motion
2. Study of Structure analysis using Image Processing Toolbox in MATLAB

Tools Study

- *MATLAB tool for understanding Motion* estimation *Techniques*

Learning Outcomes

1. Analyze the principles of Motion Estimation
2. To understand algorithms for Structure analysis

References/e-Resources

- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)

Unit 4: IMAGE STITCHING

This unit focus on Dynamic Range Imaging. The Super-Resolution topics will be covered. This unit will focus on improvement of Analytical Skills of Stake holders.

Syllabus Topics

Motion Models, Global Alignment, Composing, Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super-Resolution and Blur Removal, Image Matting and Compositing, Texture Analysis and Synthesis.

Examples/Applications/Case Studies

- Study of Motion Models
- Study of High Dynamic Range Imaging
- Study of Texture Synthesis

Exercise/Project Problems

1. Using MATLAB tool to understand Super Resolution
2. Study of Texture analysis using Image Processing Toolbox in MATLAB

Tools Study

- *MATLAB tool for understanding Image Stitching Techniques*

Learning Outcomes

1. Able to understand the methods of computer vision related to image stitching
2. Able to understand the methods photography like high dynamic range imaging and blur removal

References/e-Resources

- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)

Unit 5: 3D RECONSTRUCTION

This unit focus on Algorithms for 3D Reconstruction. This unit will discuss about Image based Rendering.

Syllabus Topics

Shape From X, Active Range Finding, Surface Representation, Point- based Representation, Volumetric Representation, Model-based Reconstruction, Recovering Texture Maps and Albedos, Image- based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumigraphs, Environment Mattes, Video-based Rendering

Examples/Applications/Case Studies
- Study of Texture Maps
- Study of Lumigraphs
- Study of Model based Reconsruction

Exercise/Project Problems
1. Using MATLAB tool to understand Image based Rendering
2. Study of 3D Reconstruction using Image Processing Toolbox in MATLAB

Tools Study
- *MATLAB tool for understanding 3D Reconstruction Techniques*

Learning Outcomes

1. Able to understand the design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths

References/e-Resources
- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)

Laboratory Exercises
Week 1-2: Transformation Techniques
- **Lab 1**: To Study basic operations on Images(understanding the concept)
- **Lab 2**: To Apply Fourier Transform on Image Storage and Reconstruction (understanding the concept)

Week 3-4: Wavelets
- **Lab 3**: To Study Haar Wavelet on Image Storage(understanding the concept)
- **Lab 4**: To Study Low Frequency Components of Wavelet on Image Storage (understanding the concept)

Week 5-6: Motion Estimation
- **Lab 5**: To Study about Dense Motion Estimation (understanding the concept)
- **Lab 6**: To Study about High Dynamic Range Imaging (understanding the concept)

Week 7-8: 3D Reconstruction
- **Lab 7**: To Study about Volumetric Representation (understanding the concept)
- **Lab 8**: To Study about Model-based Reconstruction (understanding the concept)

Textbooks and References
Textbooks

8. Richard Szeliski, *(2011). Computer Vision: Algorithms and Applications.* Springer-Verlag London Limited.
9. Simon J.D Prince, *(2012). Computer Vision: Models, Learning and Inference,.* Cambridge University Press

.

References

9. D. Forsyth and J. Ponce, (2012). *Computer Vision - A modern approach*, Pearson
10. Haralick & Shapiro, *(1992). Computer and Robot Vision,* Addison-Wesley.

Online Resources

- Computer Vision(Source:IIT Kharagpur & NPTEL via Swayam)
- Computer Vision and Image Processing - Fundamentals and Applications (Source:IIT Guwahati & NPTEL via Swayam)
- Modern Computer Vision (Source:IIT Madras & NPTEL via Swayam)

Multimedia Signal Processing	L	T	P	C
	3	0	0	3
AUDIO SIGNAL PROCESSING				

Course Description

The Purpose of the Course is to introduce the basics of Audio Signal Processing. The Course aims to provide the techniques implemented for Speech analysis and Synthesis. The Target audiences are Third-Year engineering students. The Signal enhancement techniques will be discussed. This will help us to understand the Audio Processing Applications. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. To Study Speech Processing Models
2. To understand Signal Enhancement
3. To study Speech Analysis and Synthesis Systems
4. To study the Algorithms for Audio processing Applications

Course Outcomes

1. Understand different characteristics of Audio signals.
2. Understand Signal Acquisition and Enhancement Mechanisms
3. Analyze different speech analysis and synthesis systems.
4. Understand Acoustics for Audio Processing
5. Design models and algorithms for audio and speech processing applications

Unit 1: INTRODUCTION

This unit focus on introduction of basic of Speech Production Models . The Vocal cord models will be covered.

Syllabus Topics

Audio Signal Characteristics, Production model, Hearing and Auditory model, Acoustic characteristic of speech, Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model

Examples/Applications/Case Studies

- Audio Signal characteristics
- Speech production models
- Equivalent Circuits for Speech Production

Exercise/Project Problems

8. Use MATLAB tool to understanding speech processing
9. Study of Speech Processing Models

Tools Study

- *MATLAB tool for understanding Speech Processing Techniques*

Learning Outcomes

6. Understand different characteristics of Audio signals
7. Study of Vocal Tract Model

References/e-Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
- Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam)

Unit 2: SIGNAL ENHANCEMENT

This unit focus on introduction of basic of Speech Enhancement. The Enhancement models will be covered.

Syllabus Topics

Audio signal acquisition, Representation and Modeling, Enhancement of audio signals: Spectral Subtraction, Weiner based filtering, Neural nets

Examples/Applications/Case Studies

- Audio Signal acquisition
- Audio Signal enhancement

Exercise/Project Problems

1. Use MATLAB tool to understanding Enhancement techniques
2. Audio Signal Filtering

Tools Study

- *MATLAB tool for understanding Speech Enhancement Techniques*

Learning Outcomes

1. Understand Signal Acquisition and Enhancement Mechanisms
2. Study of Filtering Techniques

References/e-Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
- Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam)

Unit 3: AUDIO / SPEECH ANALYSIS AND SYNTHESIS SYSTEMS

This unit focus on introduction of basic of Speech Analysis. The Speech Analysis models will be discussed.

Syllabus Topics

Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction., Linear Predictive Coding Analysis.

Examples/Applications/Case Studies

- Spectral Analysis
- Short Time Fourier transform
- Sound Spectrogram

Exercise/Project Problems

1. Use MATLAB tool to understanding Spectral Analysis
2. Linear Predictive Coding Analysis

Tools Study

- *MATLAB tool for understanding Speech* Analysis *and Synthesis Techniques*

Learning Outcomes

1. Analyze different speech analysis and synthesis systems

References/e-Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
- Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam)

Unit 4: ACOUSTICS

This unit focus on impact of basic of Acoustic Models . The Audio processing models will be covered.

Syllabus Topics

Psychoacoustics, Multi-microphone audio processing: Room acoustics, Array beam forming. Acoustic sound source localization and tracking

Examples/Applications/Case Studies

- Room acoustics
- Acoustic sound source localization

Exercise/Project Problems

1. Use MATLAB tool to understanding Acoustic Models
2. Study of source localization and tracking

Tools Study

- *MATLAB tool for understanding* Acoustic Models

Learning Outcomes

1. Understand Acoustics for Audio Processing

References/e-Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
- Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam)

Unit 5: APPLICATIONS

This unit focus on Applications of Audio Signal Processing . The importance of HMM will be covered.

Syllabus Topics

Principles of Automatic Speech Recognition (ASR),Theory and implementation of Hidden Markov Model (HMM) for ASR, Speaker Recognition, Evolution of Speech APIs, Natural Language Processing, Sound source separation models

Examples/Applications/Case Studies

- Hidden Markov Model
- Speaker Recognition
- Sound source separation models

Exercise/Project Problems

1. Use MATLAB tool to understanding Hidden Markov Model
2. Study of Speech Processing Applications

Tools Study

- *MATLAB tool for understanding Speech Processing Applications*

Learning Outcomes

1. Design models and algorithms for audio and speech processing applications

References/e-Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
- Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Speech production models

- **Lab 1**: To study Hearing and Auditory model (understanding the concept)
- **Lab 2**: To study Vocal Cord Model (understanding the concept)

Week 3-4: Enhancement of audio signals

- **Lab 3**: To study Spectral Subtraction (understanding the concept)
- **Lab 4**: To study Weiner based filtering (understanding the concept)

Week 5-6: Audio/ Speech Analysis and Synthesis

- **Lab 5**: To Study Spectral structure of speech (understanding the concept)
- **Lab 6**: To Study Pitch Extraction (understanding the concept)

Week 7-8: Applications

- **Lab 7**: To Study HMM for Automatic Speech Recognition (understanding the concept)
- **Lab 8**: To Study Sound source separation models (understanding the concept)

Textbooks and References

Textbooks

10. Sen, Soumya, Dutta, Anjan Dey, Nilanjan,(2019) *Audio Processing and Speech Recognition*, Springer
11. Gold. B, Morgan.N, Ellis.D. ,(2011) *Speech and audio signal processing: processing and perception of speech and music*. Wiley.

References

11. Sadaoki Furui ,(2001). *Digital Speech Processing, Synthesis and Recognition,* CRC Press
12. Rabiner and Schafer, *(1978). Digital Processing of Speech Signals,* Pearson.

Online Resources

- Digital Speech Engineering(Source:IIT Kharagpur & NPTEL via Swayam)
  - Real-Time Digital Signal Processing (Source:IISc Bangalore & NPTEL via Swayam

Minors offered by ECE department to Other Branches

Electronics and Communications Engineering (All branches)

Note: A student must acquire additional 18 credits, for the award of Minor by fulfilling at least 3 credits must be earned from NPTEL/SWAYAM MOOC Courses

(As per Proc.NoE1/JNTUGV/DAP/Guidelines for B.Tech Minors/2025 Dt: 20-02-2025)

S.No	Course Code	Subject Title	L	T	P	C
1	R234MI01	Electronic Devices and Linear ICs	3	0	0	3
2	R234MI02	Fundamentals of Digital Signal Processing	3	0	0	3
3	R234MI03	Fundamentals of VLSI Design	3	0	0	3
4	R234MI04	Digital Design with Verilog	3	0	0	3
5	R234MI05	Principles of Communications	3	0	0	3
6	R234MI06	Quantum Communications	3	0	0	3
7	R234MI07	VLSI Design Flow: RTL to GDS	3	0	0	3
8	R234MI08	Microcontrollers and Interfacing	3	0	0	3
9	R234MI09	Sensors and Data Acquisition System	3	0	0	3
10	R234MI10	Fundamentals of Lab view	3	0	0	3
11	R234MI11	Medical Robotics	3	0	0	3
12	R234MI12	Coding Theory and Practice	3	0	0	3
13	R234MI13	Ad-hoc and Wireless Sensor Networks	3	0	0	3
14	R234MI14	Fundamentals of Multimedia Networking	3	0	0	3
15	R234MI15	Geographic Information Systems	3	0	0	3
16	R234MI16	Digital Image Processing	3	0	0	3

Electronic Devices and Linear ICs	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental principles and characteristics of semiconductor devices.
2. Provide an understanding of the construction, operation, and applications of electronic devices.
3. Explain the design and analysis of amplifier circuits using transistors.
4. Familiarize students with the operational amplifier (Op-Amp) and its linear and nonlinear applications.
5. Introduce commonly used linear ICs and their applications in analog electronic systems.

Course Outcomes (COs)

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

- Understand the characteristics and applications of semiconductor diodes and transistors.
- Analyze and design transistor-based amplifier circuits.
- Explain the internal structure, characteristics, and parameters of operational amplifiers.
- Design and implement linear and nonlinear applications using Op-Amps.
- Understand and apply commonly used linear ICs in analog systems like oscillators, voltage regulators, and filters.

Syllabus

Unit I: Semiconductor Devices

Introduction to semiconductors: intrinsic and extrinsic, PN junction diode: characteristics, applications (rectifiers, clippers, clampers, Zener diodes), Bipolar Junction Transistor (BJT): operation, configurations (CE, CB, CC), characteristics, Field Effect Transistors (FETs): JFET and MOSFET characteristics and applications.

Unit II: Transistor Amplifiers and Feedback

BJT biasing methods and stability, Small-signal equivalent circuits of BJT and FET, Frequency response of single-stage amplifiers, Concept of feedback: positive and negative, Types of negative feedback amplifiers and their characteristics.

Unit III: Operational Amplifiers (Op-Amps)

Introduction to Op-Amps: internal structure and characteristics, Op-Amp parameters: input offset voltage, bias current, slew rate, CMRR, PSRR. Op-Amp configurations: inverting, non-inverting, voltage follower, Practical limitations of Op-Amps.

Unit IV: Applications of Op-Amps

Mathematical operations: adder, subtractor, integrator, differentiator, Instrumentation amplifier, comparator, Schmitt trigger, Precision rectifiers, log and antilog amplifiers, Signal conditioning circuits.

Unit V: Specialized Linear ICs and Applications

555 Timer: block diagram, modes (astable, monostable), applications, 566 VCO and 565 PLL: working and applications, Voltage regulators: IC 78xx, 79xx, LM317, Active filters: low-pass, high-pass, band-pass, band-stop (1st and 2nd order).

Text Books

1. **David A. Bell**, *Electronic Devices and Circuits*, Oxford University Press, **5th Edition**, **2008**.
2. **Ramakant A. Gayakwad**, *Op-Amps and Linear Integrated Circuits*, Pearson Education, **4th Edition**, **2020**.

Reference Books

1. **Robert L. Boylestad & Louis Nashelsky**, *Electronic Devices and Circuit Theory*, Pearson Education, **11th Edition**, **2013**.
2. **Adel S. Sedra & Kenneth C. Smith**, *Microelectronic Circuits*, Oxford University Press, **8th Edition**, **2019**.
3. **D. Roy Choudhury & Shail B. Jain**, *Linear Integrated Circuits*, New Age International Publishers, **5th Edition**, **2018**.
4. **Jacob Millman & Christos C. Halkias**, *Integrated Electronics: Analog and Digital Circuits and Systems*, McGraw Hill Education, **2nd Edition**, **2015**.

Fundamentals of Digital Signal Processing	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental concepts and mathematical tools of Digital Signal Processing (DSP).
2. Analyzing the characterization of discrete-time signals and systems.
3. Explore the design and implementation of digital filters.
4. Explain the application of the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
5. Introduce DSP implementation aspects and real-time application domains.

Course Outcomes (COs)

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

- Understand and analyze discrete-time signals and systems using time-domain and frequency-domain tools.
- Apply convolution, Z-transform, and DFT techniques to solve DSP problems.
- Design and analyze digital filters (FIR and IIR).
- Implement efficient computation of the DFT using FFT algorithms.
- Explore real-world DSP applications and implementation issues.

Syllabus

Unit I: Discrete-Time Signals and Systems

Classification and properties of signals, Classification of systems: linearity, time-invariance, causality, stability, Discrete-time system modeling: difference equations, Linear convolution and circular convolution.

Unit II: Z-Transform and Its Applications

Definition and properties of Z-transform, Region of convergence (ROC) and its significance, Inverse Z-transform: long division, partial fractions, and residue method, System analysis using Z-transform: stability and causality.

Unit III: Discrete Fourier Transform (DFT) and FFT

DFT and its properties, Linear and circular convolution using DFT, FFT algorithms: Radix-2 DIT and DIF, Efficient computation and applications of FFT.

Unit IV: Digital Filter Design

Introduction to digital filters: FIR and IIR, Design of IIR filters using impulse invariance and bilinear transformation, Design of FIR filters using windowing techniques, Frequency response and stability of filters.

Unit V: DSP Applications and Implementation

Overview of DSP applications: audio, speech, biomedical, image, and communication, Real-time DSP systems and processors (e.g., DSP chips like TMS320), Finite word length effects in digital filters, Introduction to MATLAB/Python for DSP simulations.

Textbooks

1. **John G. Proakis and Dimitris G. Manolakis**, *Digital Signal Processing: Principles, Algorithms, and Applications*, Pearson Education, **5th Edition**, **2021**.
2. **A.V. Oppenheim and R.W. Schafer**, *Discrete-Time Signal Processing*, Pearson Education, **3rd Edition**, **2021**.

Reference Books

1. **S. Salivahanan, A. Vallavaraj, C. Gnanapriya**, *Digital Signal Processing*, McGraw Hill Education, **4th Edition**, **2019**.
2. **Sanjit K. Mitra**, *Digital Signal Processing: A Computer-Based Approach*, McGraw Hill, **4th Edition**, **2010**.
3. **P. Ramesh Babu**, *Digital Signal Processing*, Scitech Publications, **6th Edition**, **2011**.
4. **Monson H. Hayes**, *Schaum's Outline of Digital Signal Processing*, McGraw Hill, **1st Edition**, **1999**.

Fundamentals of VLSI Design	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental principles and methodologies of VLSI design.
2. Familiarize students with CMOS technology and its design rules.
3. Develop skills in digital circuit design and layout using CMOS logic.
4. Understand the design and implementation of combinational and sequential subsystems.
5. Provide exposure to VLSI design flow and CAD tools used in the industry.

Course Outcomes (COs)

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

- Understand CMOS fabrication technology and the principles of VLSI design.
- Apply CMOS design rules to develop stick diagrams and layouts.
- Design and analyze basic combinational and sequential logic using CMOS circuits.
- Understand subsystem design and system-level integration.
- Describe the steps in the VLSI design flow and use basic EDA tools.

Syllabus

Unit I: Introduction to VLSI and CMOS Technology

Overview of VLSI design process, MOS transistors: structure and operation, CMOS technology: nMOS, pMOS, CMOS inverter, CMOS fabrication process: n-well, p-well, twin-tub, SOI.

Unit II: CMOS Design Rules and Layout

Stick diagrams and layout design, Lambda-based design rules, Design rules for wires, transistors, contacts, and wells, Design examples: CMOS inverter, NAND, NOR gates layout.

Unit III: Combinational and Sequential Logic Design

Static CMOS logic gates: NAND, NOR, XOR, Transmission gates and pass transistor logic, Sequential logic: latches, flip-flops, registers, Timing issues: setup time, hold time, clock skew.

Unit IV: Subsystem Design and Integration

Design of adders: ripple-carry, carry-lookahead, Multiplexers, decoders, encoders, Memory elements: SRAM, DRAM basics, Interconnects and scaling issues in VLSI.

Unit V: VLSI Design Methodologies and Tools

VLSI design flow: RTL to GDSII, Introduction to HDL (Verilog/VHDL) for digital design, Schematic and layout design using EDA tools, Introduction to FPGA and ASIC design concepts.

Textbooks

1. **Neil H.E. Weste, David Harris, and Ayan Banerjee**, *CMOS VLSI Design: A Circuits and Systems Perspective*, Pearson Education, **5th Edition**, **2023**.
2. **Douglas A. Pucknell and Kamran Eshraghian**, *Basic VLSI Design*, PHI Learning, **3rd Edition**, **2003**.

Reference Books

1. **S.M. Kang and Y. Leblebici**, *CMOS Digital Integrated Circuits: Analysis and Design*, McGraw Hill, **3rd Edition**, **2002**.
2. **John P. Uyemura**, *Introduction to VLSI Circuits and Systems*, Wiley, **1st Edition**, **2002**.
3. **Wayne Wolf**, *Modern VLSI Design: IP-Based Design*, Pearson Education, **4th Edition**, **2008**.
4. **Michele Morganti**, *Digital VLSI Design and Simulation with Verilog*, Springer, **1st Edition**, **2003**.

Digital Design with Verilog	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the principles of digital system design using Verilog Hardware Description Language (HDL).
2. Familiarize students with modeling techniques in Verilog for combinational and sequential logic.
3. Provide hands-on experience in simulation and synthesis of digital circuits.
4. Enable students to understand FSM design and module-based design practices.
5. Bridge the gap between digital logic design and implementation using programmable devices like FPGAs.

Course Outcomes (COs)

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

- Understand the syntax and semantics of Verilog HDL for modeling digital systems.
- Model combinational and sequential circuits in different levels of abstraction.
- Simulate, debug, and verify Verilog designs using test benches.
- Design and implement Finite State Machines (FSMs) using Verilog.
- Integrate Verilog-based designs into FPGA design flow using simulation and synthesis tools.

Syllabus

Unit I: Introduction to Digital Design and Verilog HDL

Basics of digital systems: logic gates, Boolean algebra, combinational & sequential logic, Introduction to Verilog: design flow, modules, ports, identifiers, operators, Verilog modeling styles: behavioral, dataflow, and structural, Simulation vs. synthesis concepts.

Unit II: Combinational Logic Design using Verilog

Verilog constructs for modeling combinational circuits, Design examples: adders, multiplexers, encoders, decoders, comparators, Conditional statements (if, case), continuous assignments, Modeling combinational logic using assign and always blocks.

Unit III: Sequential Logic Design and Test benches

Flip-flops, registers, counters, shift registers in Verilog, Synchronous and asynchronous designs, Writing and using test benches: stimulus generation, monitoring outputs, Timing and clocking in digital circuits.

Unit IV: Finite State Machines and RTL Design

FSM types: Mealy and Moore models, FSM coding techniques in Verilog, FSM design examples: vending machine, traffic light controller, serial detector, RTL design principles and best practices.

Unit V: FPGA Implementation and Design Flow

FPGA architecture basics: CLBs, IOBs, LUTs, routing, Design flow: HDL coding → simulation → synthesis → implementation → programming, Using EDA tools (e.g., Xilinx Vivado, Intel Quartus): simulation, synthesis, and timing analysis, Design examples on FPGA boards.

Textbooks

1. **Morris Mano and Michael D. Ciletti**, *Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog*, Pearson Education, **6th Edition**, **2017**.
2. **Samir Palnitkar**, *Verilog HDL: A Guide to Digital Design and Synthesis*, Pearson Education, **2nd Edition**, **2003**.

Reference Books

1. **Stephen Brown and Zvonko Vranesic**, *Fundamentals of Digital Logic with Verilog Design*, McGraw Hill Education, **3rd Edition**, **2013**.
2. **Zainalabedin Navabi**, *Verilog Digital System Design*, McGraw Hill Education, **2nd Edition**, **2005**.
3. **Douglas L. Perry**, *VHDL: Programming by Example*, McGraw Hill Education, **4th Edition**, **2002**.
4. **Richard S. Sandige & Michael L. Sandige**, *Fundamentals of Digital and Computer Design with VHDL*, McGraw Hill Education, **1st Edition**, **2012**.

PRINCIPLES OF COMMUNICATIONS	L	T	P	C
	3	0	0	3

Course Description

The Purpose of the Course is to introduce the basic principles of communications.The Course aims to provide the techniques implemented for real-time communication. The Target audience are Third-Year engineering students. The Modulation Techniques will be discussed and Noise analysis will be done for different methods. This will help us to understand the Real time Data Transfer and its pros and corns. The Stake holders will develop Analytical Skills.

Teaching Objectives

1. To understand the basic algorithms of communication
2. To improve the Mathematical analytical skills
3. To understand Role of Noise in Communication
4. To understand the principles of Analog & Digital Modulation Techniques

Course Outcomes

1. Analyze the performance of analog modulation schemes in time and frequency domains.
2. Analyze the performance of angle modulated signals
3. Characterize the influence of channel on analog modulated signals
4. Determine the performance of analog communication systems in terms of SNR
5. Analyze pulse amplitude modulation, pulse position modulation, pulse code modulation and TDM systems.

Unit 1: AMPLITUDE MODULATION

This unit focus on introduction of basic analog modulation schemes. The merits and demerits of different techniques will be covered.

Syllabus Topics

Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector.

Double side band-suppressed carrier modulation: Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

Single side–band and vestigial side-band methods of modulation: SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television

Examples/Applications/Case Studies

- Radio Transmission using AM
- Televison Transmission using VSB
- Traffic Monitoring using Wireless communication

Exercise/Project Problems

1. Use MATLAB tool to understand Modulation
2. To Compare the Merits and Demerits of AM,DSBSC,SSB,VSB
3. To Connect and verify Ring Modulator in Communication Laboratory

Tools Study

- *MATLAB tool for understanding Analog Modulation Techniques*
- *Hardware Kits in Communication Lab*

Learning Outcomes

1. Analyze the performance of analog modulation schemes in time and frequency domains
2. Memorize various analog modulation schemes

References/e-Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)

Unit 2: ANGLE MODULATION

This unit focus on Angle modulation schemes. The real time Super hetrodyne Receiver and its applications are covered. This unit will focus on real-time Transceiver system.

Syllabus Topics

Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing

Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Super-heterodyne Receiver

Examples/Applications/Case Studies

- Music Stations using FM
- Television Sound Transmission using FM
- Case Study of SNR of FM compared with AM

Exercise/Project Problems

1. Use MATLAB tool to understand Frquency Modulation
2. To Compare the Merits and Demerits of FM, AM
3. To Connect and verify FM in Communication Laboratory

Tools Study

- *MATLAB tool for understanding* Frquency *Modulation Techniques*
- *Hardware Kits in Communication Lab*

Learning Outcomes

1. Analyze the performance of angle modulated signals
2. Memorize various analog modulation schemes

References/e-Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)

Unit 3: RANDOM VARIABLES & PROCESS

This unit focus on Random Variables & Process. The real time Signal nature can be studied through Stochastic Processes . This unit will focus on types of Noises and their Properties.

Syllabus Topics

Random Variables&Process: Introduction, Probability, Conditional Probability,Random variables, Several Random Variables. Statistical Averages:Function of a random variable, Moments,Random Processes, Mean, Correlation and Covariance function:Properties of auto correlation function, Cross–correlationfunctions.

Noise: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth,Noise Figure.

Examples/Applications/Case Studies

- Stastical Averages
- Relation between moments
- Relation between Modulation and Convolution
- SNR importance in Real world Scenario's

Exercise/Project Problems

1. Use MATLAB tool to caliculate Stastical Parameters
2. To Calculate and observe SNR using MATLAB
3. To generate Thermal Noise in Communication Laboratory

Tools Study

- *MATLAB tool for understanding Noise Properties*
- *Hardware Kits in Communication Lab*

Learning Outcomes

1. To understand Role of Noise in Communication
2. Calculate Stochastic Parameter of Random Signals

References/e-Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)

Unit 4: NOISE IN ANALOG MODULATION

This unit focus on Noises generated in Analog Modulation Schemes and Frequency Modulation Schemes. This unit will discuss about SNR in Communication.

Syllabus Topics

Noise in analog modulation: Introduction, Receiver Model, Noise in DSB-SC receivers, 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.

Examples/Applications/Case Studies

- Study of Super Hetrodyne Receiver in Communication Laboratory
- Usage of MATLAB SIMLINK Tool for Study of Noise Models
- Study of Pre-emphasis and De-emphasis

Exercise/Project Problems

1. Use MATLAB tool to Study Noise Models
2. To Calculate and observe Pre-emphasis and De-emphasis using MATLAB
3. To Develop a basic model FM Transreiver Model

Tools Study

- *MATLAB tool for understanding SNR*
- *Hardware Kits in Communication Laboratory*

Learning Outcomes

1. Determine the performance of analog communication systems in terms of SNR
2. Calculate SNR of Modulation Systems

References/e-Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)

Unit 5: DIGITAL REPRESENTATION OF ANALOG SIGNALS & PCM

This unit focus on generation of PAM,PPM and PWM. This unit will discuss about Pulse code modulation.

Syllabus Topics

Digital representation of analog signals: Introduction, Why Digitize Analog Sources?, The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise

Pulse Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing

Examples/Applications/Case Studies

- *Relation between PPM & PWM*
- Usage of Time Division Multiplexing in Communication
- Applications of Multiplexing

Exercise/Project Problems

1. Use MATLAB tool to Study PPM & PAM
2. To Develop a sampler circuit in the laboratory
3. To Develop a basic Time Division Multiplexing model

Tools Study

- *MATLAB tool for understanding Pulse Modulation schemes*
- *Hardware Kits in Communication Laboratory*

Learning Outcomes

1. Analyze pulse amplitude modulation, pulse position modulation, pulse code modulation and TDM systems
2. Understand the Pulse Modulation Schemes

References/e-Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)

Laboratory Exercises

Week 1-2: Amplitude modulation

- **Lab 1**: To generate Amplitude Modulation (understanding the concept)
- **Lab 2**: To generate Amplitude Demodulation(understanding the concept)

Week 3-4: Frequency modulation

- **Lab 3**: To generate Frequency Modulation (understanding the concept)
- **Lab 4**: To generate Frequency Demodulation(understanding the concept)

Week 5-6: Superheterodyne Receiver

- **Lab 5**: To Study and obverse the results of Superhetrodyne Receiver (understanding the concept)
- **Lab 6**: To Study about AGC Circuit(understanding the concept)

Week 7-8: Random Variables and Process

- **Lab 7**: Calculate Stochastic Parameter of Random Signals using MATLAB (understanding the concept)
- **Lab 8**: Calculate SNR of Modulation Systems using MATLAB (understanding the concept)

Week 9-10: Pulse Modulation Schemes

- **Lab 9**: To Study and obverse the results of PAM,PPM (understanding the concept)
- **Lab 10**: To Study and obverse the results of PCM (understanding the concept)

Textbooks and References

Textbooks

1. H Taub& D. Schilling, Gautam Sahe, *(2007). Principles of Communication Systems.* TMH.
2. B.P.Lathi, *(2006). Communication Systems.* BSPublication
3. R.P. Singh,S P Sapre, *(2007). Communication Systems.* TMH.

References

1. Simon Haykin, MichaelMoher (2007). *Introduction to Analog and Digital Communications*, John Wiley
2. R.P. Singh,S P Sapre, *(2017). Communication Systems: Analog and Digital*,TMH.
3. George Kennedy and Bernard Davis. *(2004). Electronics & Communication System.* TMH
4. Kwang-Cheng Chen,. (2023). *Principles of Communication: A First Course in Communication.* River Publishers.
5. Rodger E. Ziemer, William H. Tranter (2015). **PRINCIPLES OF. COMMUNICATIONS**. *Systems, Modulation, and Noise*,Wiley

Online Resources

- Analog Communication(Source:IIT Kharagpur & NPTEL via Swayam)
- Communication Engineering (Source:IIT Delhi & NPTEL via Swayam)
- Principles of Communication Systems-I(Source:IIT Kanpur & NPTEL via Swayam)

Quantum Communications	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental principles of quantum mechanics relevant to communication.
2. Explore the concepts of quantum bits (qubits), entanglement, and quantum states.
3. Study the architecture and working of quantum communication systems.
4. Understand protocols for quantum key distribution and quantum cryptography.
5. Discuss real-world applications, challenges, and the future of quantum communication networks.

Course Outcomes (COs)

After completing the course, students will be able to:

- Understand the foundational principles of quantum mechanics used in communication.
- Analyze the behavior of quantum bits and their role in information theory.
- Apply concepts like entanglement and superposition in quantum communication protocols.
- Explain and evaluate quantum key distribution (QKD) and its applications in secure communication.
- Explore real-world quantum communication systems and emerging research trends.

Syllabus

Unit I: Fundamentals of Quantum Mechanics for Communication

Postulates of quantum mechanics, Qubits vs classical bits, Superposition and measurement, Quantum gates and unitary operations, Quantum entanglement and its significance.

Unit II: Quantum Information and Qubit Systems

Quantum states and density matrices, Bloch sphere representation, Quantum no-cloning theorem, Quantum teleportation, Bell's inequalities and quantum nonlocality

Unit III: Quantum Communication Protocols

Quantum communication architecture, Quantum teleportation protocol, Super dense coding, Quantum repeaters and long-distance communication.

Unit IV: Quantum Cryptography and QKD

Introduction to quantum cryptography, Quantum Key Distribution (QKD): BB84, E91 protocols, Security proofs and eavesdropping, Comparison with classical cryptographic techniques, Practical implementations and QKD networks.

Unit V: Quantum Communication Technologies and Applications

Physical realization of qubits: photons, ions, quantum dots, Quantum channels: fiber optics, free space optics, satellite links, Recent advances: quantum internet, quantum memory, quantum network protocols, Challenges and future trends in quantum communication.

Textbooks

1. **Michael A. Nielsen and Isaac L. Chuang**, *Quantum Computation and Quantum Information*, Cambridge University Press, **10th Anniversary Edition**, **2011**.
2. **Mark M. Wilde**, *Quantum Information Theory*, Cambridge University Press, **2nd Edition**, **2017**.

Reference Books

1. **Giuliano Benenti, Giulio Casati, Davide Rossini, and Giuliano Strini**, *Principles of Quantum Computation and Information: A Comprehensive Textbook*, World Scientific Publishing, **2nd Edition**, **2019**.
2. **Alexander Sergienko (Ed.)**, *Quantum Communication and Quantum Networking: First International Conference, QuantumComm 2009, Naples, Italy, October 26–30, 2009, Revised Selected Papers*, Springer, **1st Edition**, **2010**.
3. **Rodney Loudon**, *The Quantum Theory of Light*, Oxford University Press, **3rd Edition**, **2000**.

VLSI Design Flow: RTL to GDS	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the complete VLSI design flow from Register Transfer Level (RTL) to GDSII layout.
2. Familiarize students with industry-standard tools and methodologies used in ASIC and SoC design.
3. Enable understanding of synthesis, floorplanning, placement, clock tree synthesis, routing, and physical verification.
4. Explore key issues in timing, power, and area optimization.
5. Provide practical exposure to digital implementation using EDA tools.

Course Outcomes (COs)

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

- Understand the complete VLSI design flow from RTL to GDSII layout.
- Perform RTL design, functional verification, and logic synthesis.
- Apply floorplanning, placement, clock tree synthesis, and routing techniques.
- Analyze and optimize timing, power, and area in digital designs.
- Use physical verification and signoff techniques to finalize the chip layout.

Syllabus

Unit I: Overview of VLSI Design Flow

Introduction to ASIC and SoC design, VLSI design hierarchy: RTL, gate-level, and layout, Design abstraction levels and VLSI design styles, EDA tools used in front-end and back-end design, Overview of standard cell-based design.

Unit II: RTL Design and Functional Verification

RTL coding guidelines using Verilog/VHDL, Finite State Machines, datapath/control logic design, Functional simulation and test benches, Introduction to formal verification and linting, Code coverage metrics.

Unit III: Logic Synthesis and Static Timing Analysis

Logic synthesis flow and constraints (SDF, SDC), Gate-level netlist generation and analysis, Technology mapping and optimization, Static Timing Analysis (STA): setup and hold checks, Timing paths, slack, and timing reports.

Unit IV: Physical Design – Floor planning to Routing

Floor planning and partitioning, Placement of standard cells and macros, Clock Tree Synthesis (CTS) and buffering, Routing: global and detailed routing strategies, Congestion analysis and ECO (Engineering Change Order).

Unit V: Physical Verification and Signoff

Design Rule Checking (DRC) and Layout vs Schematic (LVS), Parasitic extraction (RC extraction), Signal integrity and IR drop analysis, Power and area optimization techniques, Tape-out and GDSII generation.

Textbooks

1. **S. K. Lim**, *Practical Problems in VLSI Physical Design Automation*, Springer, **1st Edition**, **2013**.
2. **Wayne Wolf**, *Modern VLSI Design: IP-Based Design*, Pearson Education, **4th Edition**, **2008**.
3. **Douglas L. Perry**, *VHDL and Verilog HDL*, Tata McGraw Hill, **1st Edition**, **2002**.

Reference Books

1. **Michael John Sebastian Smith**, *Application-Specific Integrated Circuits*, Addison-Wesley, **1st Edition**, **1997**.
2. **Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic**, *Digital Integrated Circuits: A Design Perspective,* Pearson, **2nd Edition**, **2003**.
3. **Khosrow Golshan**, *EDA for IC Implementation, Circuit Design, and Process Technology*, Wiley-IEEE Press, **1st Edition**, **2010**.
4. **Hubert Kaeslin**, *Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication*, Cambridge University Press, **1st Edition**, **2017**.

Microcontrollers and Interfacing	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the architecture, programming, and applications of microcontrollers.
2. Provide a strong foundation in assembly and embedded C programming for microcontrollers.
3. Demonstrate the interfacing techniques for connecting microcontrollers with external peripherals and devices.
4. Develop skills for designing microcontroller-based systems.
5. Expose students to real-time applications and embedded systems development.

Course Outcomes (COs)

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

- Describe the architecture and functional components of microcontrollers.
- Develop assembly and embedded C programs for microcontroller applications.
- Interface microcontrollers with input/output devices, sensors, and actuators.
- Design real-time embedded applications using timers, interrupts, and serial communication.
- Integrate hardware and software components for microcontroller-based systems.

Syllabus

Unit I: Introduction to Microcontrollers

Evolution and classification of microcontrollers, Overview of 8051 and ARM Cortex-M microcontrollers, Architecture of 8051: CPU, registers, memory, I/O ports, Harvard vs Von Neumann architecture, Comparison of microprocessors and microcontrollers.

Unit II: 8051 Programming and Instruction Set

Addressing modes and instruction formats, Data transfer, arithmetic, logical, and control instructions, Assembly language programming for 8051, Embedded C programming: data types, control structures, I/O operations, Program examples using KEIL IDE.

Unit III: Timers, Counters, and Interrupts

8051 timer/counter architecture and modes, Timer programming for delay generation and event counting, Interrupt structure of 8051: vector addresses and priorities, Interrupt programming examples, Real-time application examples using timers and interrupts.

Unit IV: Interfacing I/O Devices and Communication

Interfacing LEDs, switches, 7-segment displays, Interfacing LCDs, keypads, stepper motors, and DC motors, ADC and DAC interfacing techniques, Serial communication: UART, RS232 protocols, Basics of SPI and I2C protocols.

Unit V: Introduction to Advanced Microcontrollers (ARM Cortex-M)

ARM Cortex-M architecture basics, Cortex-M features and programming model, GPIO programming and peripheral interfacing, Overview of real-time embedded system design, Case studies: temperature monitoring, motor control, sensor data acquisition.

Textbooks

1. **Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay**, *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*, Pearson Education, **2nd Edition**, **2006**.
2. **Raj Kamal**, *Microcontrollers: Architecture, Programming, Interfacing and System Design*, Pearson Education, **2nd Edition**, **2011**.

Reference Books

1. **Kenneth J. Ayala**, *The 8051 Microcontroller*, Cengage Learning, **3rd Edition**, **2010**.
2. **John B. Peatman**, *Design with Microcontrollers*, McGraw Hill Education, **1st Edition**, **1997**.
3. **Jonathan W. Valvano**, *Embedded Systems: Introduction to ARM Cortex-M Microcontrollers*, CreateSpace Independent Publishing Platform, **3rd Edition**, **2016**.
4. **Steven F. Barrett and Daniel J. Pack**, *Microcontrollers: Fundamentals and Applications with PIC*, Prentice Hall, **1st Edition**, **2006**.

Sensors and Data Acquisition System	L	T	P	C
	3	0	0	3

Course Objectives

The course aims to:

1. Provide an understanding of different types of sensors, their characteristics, and applications.
2. Introduce transduction mechanisms used in converting physical parameters into electrical signals.
3. Explain the architecture and design of data acquisition (DAQ) systems.
4. Teach interfacing of sensors with DAQ systems using signal conditioning techniques.
5. Develop the ability to design and analyze complete measurement and instrumentation systems.

Course Outcomes (COs)

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

- Explain the working principles and classifications of various sensors.
- Select appropriate sensors for specific physical measurements.
- Analyze the design and components of data acquisition systems.
- Apply signal conditioning techniques for accurate data acquisition.
- Design and implement basic sensor-DAQ interfacing systems using microcontrollers/DAQ hardware.

Syllabus

Unit I: Introduction to Sensors and Transducers

Classification of sensors: active, passive, analog, digital, Static and dynamic characteristics of sensors: accuracy, sensitivity, resolution, repeatability, Generalized measurement system, Types of transducers: resistive, capacitive, inductive, piezoelectric, optical, Selection criteria for sensors.

Unit II: Measurement of Physical Parameters

Temperature sensors: RTD, thermistors, thermocouples, Pressure and force sensors: strain gauges, piezoelectric sensors, Displacement sensors: LVDT, capacitive sensors, Flow sensors: electromagnetic, turbine, ultrasonic flow meters, Humidity, light, and level sensors.

Unit III: Signal Conditioning Circuits

Need for signal conditioning, Amplification: instrumentation amplifiers, Filtering: analog filters (low-pass, high-pass, band-pass), Linearization, isolation, and protection, A/D and D/A conversion: resolution, sampling rate, quantization error.

Unit IV: Data Acquisition Systems

Architecture of data acquisition systems, DAQ hardware components: multiplexers, sample-and-hold circuits, ADCs, microcontrollers, DAQ software and data logging, Interface standards: USB, RS232, SPI, I2C, Case study: LabVIEW-based DAQ system.

Unit V: Sensor Interfacing and Applications

Interfacing sensors with microcontrollers (Arduino, PIC, ARM), Wireless sensor networks (WSNs) and IoT-based data acquisition, Remote data monitoring and control, Case studies: biomedical monitoring, industrial automation, smart agriculture, Calibration techniques and error analysis.

Textbooks

1. **R. S. Khandpur**, *Handbook of Analytical Instruments*, Tata McGraw Hill, **3rd Edition**, **2013**.
2. **John G. Webster (Editor)**, *Measurement, Instrumentation, and Sensors Handbook*, CRC Press, **2nd Edition**, **2014**.
3. **Ernest O. Doebelin and Dhanesh N. Manik**, *Measurement Systems: Application and Design*, McGraw Hill, **5th Edition**, **2007**.

Reference Books

1. **D. Patranabis**, *Sensors and Transducers*, PHI Learning, **2nd Edition**, **2013**.
2. **Rangan, Mani, and Sharma**, *Instrumentation Devices and Systems*, Tata McGraw Hill, **2nd Edition**, **2010**.
3. **Jacob Fraden**, *Handbook of Modern Sensors: Physics, Designs, and Applications*, Springer, **4th Edition**, **2016**.
4. **Paul Horowitz and Winfield Hill**, *The Art of Electronics*, Cambridge University Press, **3rd Edition**, **2015**.

Fundamentals of LabVIEW	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the graphical programming environment of LabVIEW and its applications in engineering.
2. Demonstrate the fundamentals of data acquisition, signal processing, and instrumentation using LabVIEW.
3. Develop skills to design and implement virtual instruments (VIs) for automation and control.
4. Familiarize students with LabVIEW programming structures such as loops, case structures, and arrays.
5. Enable students to build real-time data monitoring and control systems using LabVIEW.

Course Outcomes (COs)

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

- Understand LabVIEW environment, tools, and programming basics.
- Develop virtual instruments (VIs) using graphical programming.
- Apply data acquisition and signal processing techniques in LabVIEW.
- Implement control structures, arrays, and file handling in LabVIEW programs.
- Design real-time monitoring and automated testing systems using LabVIEW.

Syllabus

Unit I: Introduction to LabVIEW Environment

Overview of LabVIEW and graphical programming, LabVIEW environment and components: Front Panel, Block Diagram, Controls and Indicators, Data types and variables in LabVIEW, Creating, saving, and running a simple VI, Understanding controls, indicators, and connectors.

Unit II: Programming Structures and Dataflow

Dataflow programming model in LabVIEW, Sequence structures: while loops, for loops, and case structures, Shift registers and feedback nodes, Arrays and clusters: creation, manipulation, and applications, Error handling and debugging tools.

Unit III: Data Acquisition and Signal Processing

Interfacing LabVIEW with DAQ hardware, Analog and digital input/output operations, Signal generation and analysis: waveform generation, filtering, and FFT, Timing and synchronization techniques, Basic signal processing applications.

Unit IV: File I/O and Communication

File input/output operations: reading from and writing to files, Data logging and data management, Introduction to VI server and subVIs, Communication protocols: Serial communication (RS232), TCP/IP basics in LabVIEW, Remote monitoring using LabVIEW Web Services.

Unit V: Applications and Project Development

Design of automated test and measurement systems, Real-time data acquisition and control, Case studies: Temperature monitoring, motor control, sensor interfacing, User interface design and optimization, Overview of LabVIEW advanced toolkits (brief introduction).

Textbooks

1. **Lisa K. Wells and Jeffrey Travis**, *LabVIEW for Everyone: Graphical Programming Made Easy and Fun*, Prentice Hall, **3rd Edition**, **2011**.
2. **J. Patrick Levesque**, *LabVIEW: A Developer's Guide to Real World Integration*, Prentice Hall, **1st Edition**, **2001**.

Reference Books

1. **Gary W. Johnson**, *LabVIEW Graphical Programming: Practical Applications in Instrumentation and Control*, McGraw Hill, **2nd Edition**, **1997**.
2. **Jonathan W. Valvano**, *Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment*, CreateSpace, **2nd Edition**, **2011**. *(For interfacing concepts)*
3. **Rick Bitter, Taqi Mohiuddin, Matt Nawrocki**, *LabVIEW: Advanced Programming Techniques*, CRC Press, **1st Edition**, **2007**.

Medical Robotics	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental concepts of robotics applied in the medical field.
2. Explore various types of medical robots and their applications in surgery, rehabilitation, and diagnostics.
3. Demonstrate kinematics, dynamics, and control techniques specific to medical robots.
4. Discuss human-robot interaction, safety, and ethical considerations in medical robotics.
5. Provide knowledge about the design, development, and integration of medical robotic systems.

Course Outcomes (COs)

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

- Understand the basics of robotics with a focus on medical applications.
- Analyze the kinematics and control of medical robotic manipulators.
- Describe different types of medical robots and their roles in healthcare.
- Evaluate human-robot interaction and safety standards in medical robotics.
- Design basic medical robotic systems for surgical and rehabilitation applications.

Syllabus

Unit I: Introduction to Medical Robotics

Overview of robotics and medical robotics, History and evolution of medical robots, Classification of medical robots: surgical, rehabilitation, diagnostic, assistive robots, Components of medical robotic systems: sensors, actuators, controllers, Advantages and challenges of medical robotics.

Unit II: Kinematics and Dynamics of Medical Robots

Review of robotic manipulator kinematics, Forward and inverse kinematics of medical robot arms, Workspace analysis for medical robots, Dynamics and force control strategies, End-effector design considerations for medical applications.

Unit III: Control Systems in Medical Robotics

Control architectures: position, force, impedance control, Teleoperation and master-slave robotic systems, Haptic feedback and tactile sensing, Safety and reliability in control systems, Real-time control challenges.

Unit IV: Human-Robot Interaction and Safety

Human factors in medical robotics, Ergonomics and user interface design, Safety standards and regulatory aspects (FDA, ISO), Risk analysis and fault tolerance, Ethical considerations and patient safety.

Unit V: Applications and Case Studies

Surgical robots: Da Vinci system, orthopedic robots, Rehabilitation robots: exoskeletons, prosthetics, Diagnostic and imaging robots, Robot-assisted therapy and telemedicine, Future trends: AI integration, autonomous medical robots.

Textbooks

1. **Paolo Dario, Vijay Kumar (Eds.)**, *Medical Robotics: Minimally Invasive Surgery*, Wiley-IEEE Press, **1st Edition**, **2011**.
2. **Robin R. Murphy**, *Introduction to AI Robotics*, MIT Press, **1st Edition**, **2000**. *(For robotics fundamentals)*
3. **J. P. Desai, P. Kazanzides, R. H. Taylor**, *Medical Robotics*, CRC Press, **1st Edition**, **2011**.

Reference Books

1. **Sherif M. El-Hefnawy**, *Medical Robotics: Minimally Invasive Surgery*, CRC Press, **1st Edition**, **2017**.
2. **Jacques Marescaux, Michel Gagner**, *Robotic Surgery: Current Applications and New Trends*, Springer, **1st Edition**, **2018**.
3. **Timothy A. P. Spicer**, *Robot-Assisted Surgery: An Introduction*, Wiley, **1st Edition**, **2015**.
4. **J. J. Craig**, *Introduction to Robotics: Mechanics and Control*, Pearson, **4th Edition**, **2014**.

Coding Theory and Practice	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce fundamental concepts of coding theory and error control coding.
2. Provide knowledge of various types of error-detecting and error-correcting codes.
3. Explore encoding and decoding algorithms for linear block codes, cyclic codes, and convolutional codes.
4. Understand the practical applications of coding techniques in digital communication systems.
5. Develop skills to design and analyze codes for reliable data transmission and storage.

Course Outcomes (COs)

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

- Understand basic principles and terminology of coding theory.
- Construct and analyze linear block codes and cyclic codes.
- Implement encoding and decoding algorithms for error control codes.
- Apply convolutional coding and Viterbi decoding in communication systems.
- Evaluate performance of coding schemes and understand practical coding standards.

Syllabus

Unit I: Introduction to Coding Theory

Importance of coding in communication and data storage, Types of errors and error models, Basics of coding theory: code words, code rate, minimum distance, Hamming distance and weight, Types of codes: block codes and convolutional codes.

Unit II: Linear Block Codes

Definition and properties of linear block codes, Generator and parity-check matrices, Encoding methods, Syndrome decoding and error detection, Hamming codes and their properties.

Unit III: Cyclic Codes

Definition and properties of cyclic codes, Polynomial representation of codewords, Generator polynomial and parity-check polynomial, Encoding using shift registers, BCH and Reed-Solomon codes: basics and applications.

Unit IV: Convolutional Codes

Structure of convolutional codes, Encoder representation: shift registers and trellis diagrams, Parameters: constraint length, code rate, Viterbi decoding algorithm and its implementation, Applications of convolutional codes.

Unit V: Advanced Topics and Applications

Concatenated codes and turbo codes, Low-density parity-check (LDPC) codes, Performance evaluation: bit error rate (BER) and coding gain, Coding standards in digital communication (e.g., GSM, LTE), Practical coding applications in wireless and storage systems.

Textbooks

1. **S. Lin and D. J. Costello Jr.**, *Error Control Coding: Fundamentals and Applications*, Pearson Education, **2nd Edition**, **2004**.
2. **Ranjan Bose**, *Information Theory, Coding and Cryptography*, Tata McGraw Hill, **2nd Edition**, **2008**.
3. **F. J. MacWilliams and N. J. A. Sloane**, *The Theory of Error-Correcting Codes*, North-Holland (Elsevier), **1st Edition**, **1977**.

Reference Books

1. **R. E. Blahut**, *Theory and Practice of Error Control Codes*, Addison-Wesley, **1st Edition**, **1983**.
2. **W. Cary Huffman and Vera Pless**, *Fundamentals of Error-Correcting Codes*, Cambridge University Press, **1st Edition**, **2003**.
3. **T. K. Moon**, *Error Correction Coding: Mathematical Methods and Algorithms*, Wiley-IEEE Press, **1st Edition**, **2005**.
4. **John G. Proakis and Masoud Salehi**, *Digital Communications*, McGraw Hill, **5th Edition**, **2008**.

Ad-hoc and Wireless Sensor Networks	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental concepts of wireless ad-hoc and sensor networks.
2. Explore network architectures, protocols, and algorithms specific to wireless sensor networks (WSNs) and Mobile Ad-hoc Networks (MANETs).
3. Understand key challenges such as energy efficiency, routing, and security in wireless sensor and ad-hoc networks.
4. Provide knowledge about medium access control and transport layer protocols tailored for WSNs and MANETs.
5. Enable students to analyze and design wireless sensor network applications and protocols.

Course Outcomes (COs)

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

- Explain the architecture and characteristics of ad-hoc and wireless sensor networks.
- Analyze various routing and MAC protocols designed for WSNs and MANETs.
- Identify and address challenges related to energy management and scalability in wireless networks.
- Evaluate security threats and implement basic security mechanisms in wireless sensor networks.
- Design simple applications and protocols for wireless sensor networks.

Syllabus

Unit I: Introduction to Wireless Sensor Networks (WSNs) and Ad-hoc Networks

Overview and characteristics of WSNs and MANETs, Applications: environmental monitoring, military, healthcare, smart cities, Sensor node architecture and deployment strategies, Challenges: resource constraints, dynamic topology, scalability, Comparison of WSNs and traditional wireless networks.

Unit II: Network Architectures and Protocols

WSN architecture: flat, hierarchical, location-based, MANET architecture and protocol stack overview, Routing challenges in ad-hoc and sensor networks, Classification of routing protocols: proactive, reactive, hybrid, Examples of routing protocols: AODV, DSR, LEACH, PEGASIS.

Unit III: Medium Access Control (MAC) Protocols and Energy Management

MAC protocols for WSNs and MANETs: contention-based and schedule-based, Energy-efficient MAC protocols: S-MAC, T-MAC, B-MAC, Sleep/wake-up mechanisms and duty cycling, Energy conservation techniques and power-aware routing, QoS considerations in MAC protocols.

Unit IV: Transport Layer and Security in Wireless Networks

Transport layer protocols and challenges in WSNs, Congestion control and reliable data delivery, Security issues: attacks on WSNs and MANETs (e.g., wormhole, Sybil), Security mechanisms: cryptography, key management, secure routing, Trust management and intrusion detection.

Unit V: Applications, Tools, and Case Studies

Case studies: Smart agriculture, healthcare monitoring, disaster management, Sensor network platforms and simulation tools: TinyOS, NS-2/NS-3, OMNeT++, Integration with IoT and cloud computing, Recent trends: mobile sensor networks, cognitive radio sensor networks, Future directions and research challenges.

Textbooks

1. **C. Siva Ram Murthy and B. S. Manoj**, *Ad Hoc Wireless Networks: Architectures and Protocols*, Pearson Education, **1st Edition**, **2004**.
2. **Kazem Sohraby, Daniel Minoli, and Taieb Znati**, *Wireless Sensor Networks: Technology, Protocols, and Applications*, Wiley, **1st Edition**, **2007**.
3. **Samarjit Chakraborty**, *Wireless Sensor Networks*, Oxford University Press, **1st Edition**, **2014**.

Reference Books

1. **John A. Stankovic**, *Wireless Sensor Networks*, Springer, **1st Edition**, **2021**.
2. **Erik D. Veenstra and Mark van Eeten**, *Wireless Sensor Networks and Applications*, CRC Press, **1st Edition**, **2018**.
3. **Debashis Saha**, *Ad Hoc and Sensor Networks: Theory and Applications*, Cambridge University Press, **1st Edition**, **2020**.

4. **K. Akkaya and M. Younis**, *Wireless Sensor Networks: Principles and Practice*, Wiley, **1st Edition**, **2020**.

Fundamentals of Multimedia Networking	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce multimedia networking concepts and protocols for efficient transmission of multimedia data.
2. Explore multimedia compression techniques and their impact on network performance.
3. Understand Quality of Service (QoS) requirements and mechanisms for multimedia communication.
4. Study transport, session, and application layer protocols supporting multimedia applications.
5. Analyze emerging trends and challenges in multimedia networking, including streaming and real-time communication.

Course Outcomes (COs)

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

- Describe the components and architecture of multimedia networking systems.
- Explain multimedia data formats and compression techniques.
- Analyze network protocols for multimedia transport and control.
- Understand QoS requirements and mechanisms for multimedia applications.
- Design basic multimedia communication systems and evaluate their performance.

Syllabus

Unit I: Introduction to Multimedia Networking

Overview of multimedia data types: audio, video, images, text, Characteristics and challenges of multimedia networking, Multimedia communication system architecture, Network requirements for multimedia applications, Multimedia networking models and standards.

Unit II: Multimedia Compression and Coding

Principles of data compression: lossless and lossy, Audio compression standards: PCM, ADPCM, MP3, Image compression: JPEG, JPEG2000, Video compression techniques: MPEG-1, MPEG-2, MPEG-4, H.264, Impact of compression on bandwidth and quality.

Unit III: Network Protocols for Multimedia

Transport protocols: UDP, RTP (Real-time Transport Protocol), Session protocols: RTSP (Real Time Streaming Protocol), Signaling protocols: SIP (Session Initiation Protocol), Multicast communication for multimedia, Error control and concealment techniques.

Unit IV: Quality of Service (QoS) in Multimedia Networking

QoS parameters: delay, jitter, bandwidth, packet loss, QoS provisioning and guarantees, Integrated Services (IntServ) and Differentiated Services (DiffServ), Traffic shaping and admission control, Resource reservation protocols (RSVP).

Unit V: Multimedia Networking Applications and Trends

Streaming media and Video on Demand (VoD), Voice over IP (VoIP) and video conferencing, Multimedia over wireless and mobile networks, Cloud multimedia services and content delivery networks (CDNs), Emerging trends: 5G multimedia networking, augmented and virtual reality.

Textbooks

1. **Fred Halsall**, *Multimedia Communications: Applications, Networks, Protocols and Standards*, Pearson Education, **1st Edition**, **2001**.
2. **K. R. Rao, Zoran S. Bojkovic, and Dragorad A. Milovanovic**, *Multimedia Communication Systems: Techniques, Standards, and Networks*, Pearson Education, **1st Edition**, **2002**.
3. **Stefan Winkler**, *Multimedia Networking: Technologies, Management and Applications*, Wiley, **1st Edition**, **2008**.

Reference Books

1. **Timothy S. Rappaport**, *Wireless Communications: Principles and Practice*, Pearson Education, **2nd Edition**, **2002**.
2. **Mark S. Drew and Zixiang Xiong**, *Multimedia Security: Steganography and Digital Watermarking Techniques for Protection of Intellectual Property*, Wiley, **1st Edition**, **2007**.
3. **Raj Jain**, *The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling*, Wiley, **1st Edition**, **1991**.
4. **James F. Kurose and Keith W. Ross**, *Computer Networking: A Top-Down Approach*, Pearson Education, **8th Edition**, **2021**.

Geographic Information Systems (GIS)	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental concepts, components, and applications of Geographic Information Systems.
2. Demonstrate spatial data models, data structures, and spatial database management.
3. Explore spatial analysis techniques and GIS modeling.
4. Understand GIS software, tools, and data visualization methods.
5. Enable students to apply GIS technology in real-world problems like urban planning, environmental management, and resource mapping.

Course Outcomes (COs)

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

- Explain the basic concepts, components, and architecture of GIS.
- Understand spatial data types, data models, and data acquisition methods.
- Perform spatial analysis and queries using GIS tools.
- Manage and manipulate spatial databases effectively.
- Apply GIS for solving practical problems in various domains.

Syllabus

Unit I: Introduction to Geographic Information Systems

Definition, history, and evolution of GIS, Components and architecture of GIS, Geographic data types: spatial and non-spatial data, GIS applications in environment, urban planning, agriculture, disaster management, Overview of GIS software platforms.

Unit II: Spatial Data Models and Data Structures

Raster and vector data models: concepts and differences, Topology and network models, Data formats and standards (e.g., Shapefile, GeoJSON), Spatial data acquisition: GPS, remote sensing, digitization, Coordinate systems, projections, and georeferencing.

Unit III: Spatial Database Management and Data Input

Spatial database concepts and management systems (Spatial DBMS), Data quality and error handling, Data input and editing techniques, Metadata and data standards, Integration of GIS with other information systems.

Unit IV: Spatial Analysis and Modeling

Basic spatial analysis operations: buffering, overlay, and spatial queries, Network analysis and terrain analysis, Spatial interpolation and geostatistics, GIS modeling and decision support systems, Map algebra and suitability analysis.

Unit V: Visualization, GIS Software and Applications

Cartography and map design principles, Visualization tools and techniques in GIS, Web GIS and cloud GIS services, Case studies: Urban planning, natural resource management, disaster response, Future trends: Mobile GIS, real-time GIS, 3D GIS.

Textbooks

1. **Ian Heywood, Sarah Cornelius, and Steve Carver**, *An Introduction to Geographical Information Systems*, Pearson Education, **4th Edition**, **2011**.
2. **Kang-tsung Chang**, *Introduction to Geographic Information Systems*, McGraw Hill, **9th Edition**, **2019**.
3. **Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd**, *Principles of Geographical Information Systems*, Oxford University Press, **3rd Edition**, **2015**.

Reference Books

1. **Chor Pang Lo and Albert K.W. Yeung**, *Concepts and Techniques of Geographic Information Systems*, Prentice Hall, **2nd Edition**, **2007**.
2. **Michael N. DeMers**, *GIS Modeling in Raster*, Wiley, **1st Edition**, **2002**.
3. **Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind**, *Geographic Information Science and Systems*, Wiley, **4th Edition**, **2015**.
4. **Chunrong Jia**, *GIS Fundamentals: A First Text on Geographic Information Systems*, XanEdu Publishing, **5th Edition**, **2016**.

Digital Image Processing	L	T	P	C
	3	0	0	3

Course Objectives

The objectives of this course are to:

1. Introduce the fundamental concepts and techniques of digital image processing.
2. Demonstrate image representation, enhancement, and restoration methods.
3. Explore image segmentation and feature extraction techniques.
4. Provide knowledge of image compression standards and methods.
5. Enable practical understanding through implementation of image processing algorithms.

Course Outcomes (COs)

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

- Understand digital image fundamentals and image acquisition techniques.
- Apply various image enhancement and restoration techniques.
- Perform image segmentation and extract meaningful features.
- Analyze and implement image compression algorithms.
- Use digital image processing tools and libraries for practical applications.

Syllabus

Unit I: Introduction and Digital Image Fundamentals

Digital image processing overview and applications, Image acquisition, sampling, and quantization, Image representation: pixels, resolution, color models (RGB, HSV, CMYK), Basic operations on images: pixel arithmetic, geometric transformations, Image file formats and storage.

Unit II: Image Enhancement Techniques

Spatial domain methods: point processing (contrast stretching, thresholding), histogram processing, Spatial filtering: smoothing filters, sharpening filters, edge enhancement, Frequency domain methods: Fourier transform, filtering in frequency domain, Noise models and noise reduction techniques, Color image enhancement basics.

Unit III: Image Restoration and Segmentation

Image degradation models, Inverse filtering and Wiener filtering, Morphological image processing: dilation, erosion, opening, closing, Image segmentation techniques: thresholding, region growing, edge-based segmentation, watershed, Feature extraction: edges, corners, texture analysis.

Unit IV: Image Compression

Need for image compression, Lossless compression techniques: Run-Length Encoding, Huffman coding, Arithmetic coding, Lossy compression techniques: Transform coding, JPEG standard, JPEG2000, Performance measures: compression ratio, PSNR, Introduction to video compression basics.

Unit V: Advanced Topics and Applications

Color image processing techniques, Object recognition basics, Introduction to pattern recognition, Applications: medical imaging, remote sensing, biometrics, Tools and software: MATLAB Image Processing Toolbox, OpenCV.

Textbooks

1. **Rafael C. Gonzalez and Richard E. Woods**, *Digital Image Processing*, Pearson Education, **4th Edition**, **2022**.
2. **Anil K. Jain**, *Fundamentals of Digital Image Processing*, Prentice Hall, **1st Edition**, **1989**.
3. **S. Jayaraman, S. Esakkirajan, and T. Veerakumar**, *Digital Image Processing*, McGraw Hill, **2nd Edition**, **2019**.

Reference Books

1. **William K. Pratt**, *Digital Image Processing: PIKS Scientific Inside*, Wiley-Interscience, **4th Edition**, **2007**.
2. **Scott E. Umbaugh**, *Digital Image Processing and Analysis: Computer Vision and Image Analysis*, CRC Press, **4th Edition**, **2022**.
3. **Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins**, *Digital Image Processing Using MATLAB*, Gatesmark Publishing, **3rd Edition**, **2020**.
4. **K. R. Castleman**, *Digital Image Processing*, Prentice Hall, **2nd Edition**, **1996**.