

**R23 ACADEMIC REGULATIONS  
COURSE STRUCTURE AND SYLLABI**  
of  
**B.TECH. ELECTRONICS AND  
COMMUNICATION ENGINEERING**

**FOR  
B.TECH. REGULAR FOUR YEAR DEGREE PROGRAM**

*(For the batches admitted from 2023-24)*

**&**

**B.TECH. LATERAL ENTRY PROGRAM**

*(For the batches admitted from 2024-25)*

**CHOICE BASED CREDIT SYSTEM**



**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**SRI VENKATESWARA COLLEGE OF ENGINEERING**

**(AUTONOMOUS)**

**(Affiliated to J.N.T. University Anantapur, Ananthapuramu, Accredited by NBA & NAAC "A")**

**Karakambadi Road, Tirupati - 517 507**



### **Vision**

To be a centre of excellence focusing on high quality technical education, research and technical services with global leadership competence to succeed in employment and higher education with ethical, social, entrepreneurial aspects updating to the real time requirements.

### **Mission**

- M 1:** To impart high quality technical education by providing the state-of-the art infrastructure, core instruction.
- M 2:** Advanced research and technical consultancy services with qualified and senior faculty.
- M 3:** To prepare the students professionally deft and intellectually adept possessing excellent skill, knowledge and behavior with global competence.



## Department of Electronics and Communication Engineering

### Vision

To be a focal centre for Academic excellence in competing global standards and dynamics in the field of Electronics and Communication Engineering with research and services focusing on effective communication skills, entrepreneurial, ethical and social concern.

### Mission

- M 1:** To impart quality technical education in Electronics and Communication Engineering with well-established infrastructure, state-of-art laboratories core instructions and cognizant faculty.
- M 2:** To prepare the young and dynamic Electronics and Communication Engineers professionally deft and intellectually adept with knowledge, behavior and information competency.
- M 3:** To enable the learners for changing trends in the field of Electronics and Communication Engineering with a focus on career guidance, placements and higher education by industry institute relationship.



## **PROGRAM EDUCATIONAL OBJECTIVES**

- PEO1:** Graduates should be cognizant in basic science, fundamental engineering stream along with core related domains in ECE and Allied fields.
- PEO2:** Graduates should understand issues related to design, problem solving, and intellectually adept with knowledge, behavior and information competency.
- PEO3:** Graduates should demonstrate their technical, communication, research, aptitudes along with leadership skills in professional environment to empower employability, higher education and entrepreneurs successfully through industry-institute interaction.
- PEO4:** Graduates should be motivated with high ethical, human values and team work towards development of the society.



## PROGRAM OUTCOMES

- PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- PO4: Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12: Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.



### **PROGRAM SPECIFIC OUTCOMES**

- PSO 1:** An ability to get an employment in Electronics and Communication Engineering field and related industries and to participate & succeed in competitive examinations like GRE, GATE, TOEFL, PSUs, etc.
  
- PSO 2:** Should be able to design and test various electronic systems that perform analog and digital processing functions.

## PRELIMINARY DEFINITIONS AND NOMENCLATURE

**AICTE:** Means All India Council for Technical Education, New Delhi.

**Autonomous Institute:** Means an institute designated as Autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (**Jawaharlal Nehru Technological University Anantapur**).

**Academic Autonomy:** Means freedom to an institute in all aspects of conducting its academic programs granted by UGC for promoting excellence.

**Academic Council:** The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

**Branch:** Means specialization in a program like B.Tech. degree program in Civil Engineering, B.Tech. degree program in Computer Science and Engineering etc.

**Board of Studies (BOS):** BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

**Backlog Course:** A course is considered to be a backlog course, if the student has obtained a failure grade in that course.

**Commission:** Means University Grants Commission (UGC), New Delhi.

**Certificate Course:** It is a course that makes a student to have hands-on expertise and skills required for holistic development in a specific area/field.

**Internal Examination:** It is an examination conducted towards sessional assessment.

**Core:** The courses that are the essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

**Course:** A course is a subject offered by a department for learning in a particular semester.

**Course Outcomes:** The essential skills that need to be acquired by every student through a course.

**Credit:** A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value.

**Credit Point:** It is the product of grade point and number of credits for a course.

**Cumulative Grade Point Average (CGPA):** It is a measure of cumulative performance of a student overall the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

**Curriculum:** Curriculum incorporates the planned interaction of students with instructional content, materials & resources.

**Department:** An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

**Detention in a Semester:** Student who does not obtain minimum prescribed attendance in a Semester shall be detained in that particular Semester. A Student can also be detained for lack of required number of credits at the end of IV semester or VI semester respectively.

**Elective Course:** A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

**Evaluation:** Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal examinations and semester end examinations.

**Grade:** It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

**Grade Point:** It is a numerical weight allotted to each letter grade on a 10 - point scale.

**Institute:** Represents Sri Venkateswara College of Engineering, Tirupati unless indicated otherwise by the context.

**Massive Open Online Courses (MOOC):** MOOCs inculcate the habit of self-learning. MOOCs would be additional choices in all the elective group courses.

**Minor:** Minor are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech. degree.

**Pre-requisite:** A specific course or subject, the knowledge of which is required to complete before student register another course at the next grade level.

**Professional Elective:** It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

**Program:** Denotes UG degree program: Bachelor of Technology (B.Tech.).

**Project work:** It is a design or research-based work to be taken up by a student during his / her VIII semester to achieve a particular aim. It is a credit-based course and is to be planned carefully by the student.

**Registration:** Process of enrolling into a set of courses in a semester of a program.

**Regulations:** The regulations, common to all B.Tech. programs offered by Institute, are designated as "SVCE – R23" and are binding on all the stakeholders.

**Semester:** It is a period of study consisting of 90 working/instructional days. Odd semester commences usually in July and even semester in December of every year.

**Semester End Examinations:** It is an examination conducted for all courses offered in a semester at the end of the semester.

**University:** Represents Jawaharlal Nehru Technological University Anantapur (JNTUA), Ananthapuramu.

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## 1. About the College

Sri Venkateswara College of Engineering (SVCE), Tirupati (Main Campus) is part of the SV Colleges group established in the year 2007 with a vision to become a leader in providing quality educational services. College is affiliated to JNTUA & Approved by AICTE, recognized under sections 2(f) & 12(B) of UGC act 1956, Accredited by NAAC with 'A' Grade. Six B.Tech. Programs CSE, ECE, EEE, IT, ME & CE are accredited by NBA, New Delhi. The College offers UG Programs [CE, CSE, CSE (AI & ML), CSE (CS), CSE (DS), ECE, EEE, IT & ME], PG Programs [M.Tech. (VLSI Design), M.Tech. (CSE), MCA & MBA]. The Institution conferred 'Autonomy' by UGC, New Delhi in the year 2020.

The Campus is equipped with state of art laboratories of centre of excellence through advanced tools and technologies. Learning at Sri Venkateswara College of Engineering has a pragmatic approach with a clear focus, valuing individual vision, intellectual discipline, and a sense of teamwork. We aim at developing our students to their full potential, preparing them to take the next step towards career success.

Sri Venkateswara College of Engineering is committed to its role in creating leaders through its innovative programs, outstanding faculty and thought leadership. Sri Venkateswara College of Engineering nurtures global leaders who can speak their minds and work well with others in a wide range of cultural contexts. It will develop their ability to manage a career successfully in the global economy.

Our teaching modes and methods of assessment vary between courses to ensure that you gain the most benefit from the interactive course content, faculty members, fellow students, and invited guests. Lectures comprise only a portion of course delivery, with the remaining taken up by discussions, seminars, case analysis, simulation, individual and group projects, and presentations.

From the academic year 2025–26, SV Colleges has also converted **Sri Venkateswara College of Engineering, Kadapa** as **Off Campus** to **Sri Venkateswara College of Engineering (SVCE), Tirupati (Main Campus)**. The College at off campus offers UG Programs [ECE, CSE, CSE (AI & ML)]. While **SVCE Tirupati continues to be the main campus**, both campuses adhere to the same academic framework, quality standards, and regulatory guidelines of JNTUA, AICTE, UGC, and other statutory bodies.

The academic programs of the College are governed by the rules and regulations approved by the Academic Council, which is the highest academic body of the College. These rules and regulations are effective from the academic year 2023–24 for students admitted into the four-year Undergraduate B.Tech. program offered at the SVCE Main Campus, and from the academic year 2025–26 for students admitted at the SVCE Off-Campus (SVCE Kadapa)

## 2. Applicability

All the rules specified herein, approved by the Academic Council, shall be in force and applicable to students admitted from the academic year 2023 – 24 onwards. Any reference to "College" in these rules and regulations stands for Sri Venkateswara College of Engineering.

## 3. Extent

All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation and as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. It shall be ratified by the Academic Council in the forthcoming meeting. As per the requirements of statutory bodies, Principal, **Sri Venkateswara College of Engineering** shall be the Chairman, Academic Council.

## 4. Vision and Mission:

### Vision

To be a centre of excellence focusing on high quality technical education, research and technical services with global leadership competence to succeed in employment and higher education with ethical, social, entrepreneurial aspects updating to the real time requirements.

### Mission

To impart high quality technical education by providing the state-of-the art infrastructure, core instruction. Advanced research and technical consultancy services are carried with

qualified and senior faculty to prepare the students professionally deft and intellectually adept possessing excellent skill, knowledge and behaviour with global competence.

### 5. Programs Offered

Following programs are offered in various branches at **Sri Venkateswara College of Engineering** leading to the award of B.Tech. Degree

| S. No. | Branch   |
|--------|--|
| 1      | Civil Engineering  |
| 2      | Computer Science and Engineering   |
| 3      | Computer Science and Engineering<br>(Artificial Intelligence and Machine Learning) |
| 4      | Computer Science and Engineering<br>(Cyber Security)                               |
| 5      | Computer Science and Engineering<br>(Data Science)                                 |
| 6      | Electronics and Communication Engineering  |
| 7      | Electrical and Electronics Engineering   |
| 8      | Information Technology   |
| 9      | Mechanical Engineering   |

### 6. Award of the Degree

- a) Award of the B.Tech. Degree 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 163 credits and secures all 163 credits.
- b) Award of B.Tech. degree with Minors/Honors if he/she fulfils the following:
  - (i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 163 credits.
  - (ii) Registering for Minors/Honors is optional.
  - (iii) Minors/Honors is to be completed simultaneously with B.Tech. program.
- c) Students, who fail to fulfill 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 6 a) i).**

### 7. 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.

### 8. 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 Hr. Practical (P) per week | 1 credit   |

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

**Choice Based Credit System (CBCS):** The CBCS provides a choice for students to select from the prescribed courses. Choice Based Credit System (CBCS) is introduced in line with UGC guidelines in order to promote:

- i. Student centered learning
- ii. Students to learn courses of their choice
- iii. Interdisciplinary learning

#### 9. Semester/Credits:

- i. A semester comprises 90 working/instructional 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.

#### 10. Structure of the Undergraduate Program

All courses offered for the undergraduate program (B.Tech.) are broadly classified as follows:

| S. No. | Category  | Breakup of Credits (Total 163) | Percentage of Total Credits | AICTE Recommendations |
|--------|---|--------------------------------|-----------------------------|-----------------------|
| 1      | Humanities and Social Science including Management (HS)                                   | 13                             | 8%                          | 8-9%                  |
| 2      | Basic Sciences (BS)   | 20                             | 12%                         | 12-16%                |
| 3      | Engineering Sciences (ES)   | 26.5                           | 16%                         | 10-18%                |
| 4      | Professional Core (PC)  | 54.5                           | 33%                         | 30-36%                |
| 5      | Electives – Professional (PE) & Open (OE); Domain Specific Skill Enhancement Courses (SC) | 33                             | 20%                         | 19-23%                |
| 6      | Internships (IP), Community Service (CS) & Project Work (PW)                              | 16                             | 10%                         | 8-11%                 |
| 7      | Mandatory Courses (MC) / Audit Courses (AC)   | Non-Credit                     | Non-Credit                  | -                     |

#### 11. Course Classification

All subjects/ courses offered for the undergraduate program in Engineering & Technology (B.Tech. degree programs) are broadly Classified as follows:

| S. No. | Broad Course Classification | Course Category  | Description  |
|--------|-----------------------------|--|--|
| 1      | Foundation Course           | Basic Science (BS) Courses                               | Includes Mathematics, Physics and Chemistry.                 |
|        |                             | Engineering Science (ES) Courses                         | Includes Fundamental Engineering courses                     |
|        |                             | Humanities and Science including Management (HS) Courses | Includes Humanities, Social Sciences and Management courses. |

| S. No. | Broad Course Classification               | Course Category   | Description   |
|--------|---|---|---|
| 2      | Core Courses                              | Professional Core Courses (PC)  | Includes courses related to the parent discipline / department / branch of Engineering  |
| 3      | Elective Courses                          | Professional Elective Courses (PE)  | Includes elective courses related to the parent discipline / department / branch of Engineering   |
|        |   | Open Elective Courses (OE)  | Elective courses which include interdisciplinary courses or courses in an area outside the parent discipline / department / branch of Engineering |
| 4      | Domain Specific Skill Enhancement Courses | Skill Courses (SC)  | Interdisciplinary / job-oriented / domain courses which are relevant to the industry  |
| 5      | Projects and Internships                  | Project Work (PW)   | B.Tech. Project or Major Project  |
|        |   | Community Service (CS)  | Community Service Projects during summer vacation   |
|        |   | Internships (IP)  | Summer Industry Internship Programs; Industry oriented Full Semester Internship Programs  |
| 6      | Mandatory and Audit Courses               | Mandatory Courses (MC)<br><i>(Non-credit Courses with Internal Examination)</i>                               | Covering courses of developing desired attitude and awareness among the learners  |
|        |   | Audit Courses (AC)<br><i>(Non-credit Courses without Internal Examination but with Formative Assessments)</i> | Covering value added courses  |

## 12. Program Pattern

- i. Total duration of the of B.Tech (Regular) Program is four academic years.
- ii. Each academic year of study is divided into two semesters.
- iii. Minimum number of instructional 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 under graduate 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. Audit courses are offered as non-credit mandatory courses covering value added courses, without internal examination but with formative assessments.
- viii. Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
- ix. A mandatory one-week domain-specific workshop shall be organized during VI semester
- x. It is mandatory for every student to undertake a minimum of one industrial visit during any semester between the V and VIII semesters
- xi. Department should conduct one domain-specific expert lecture in every semester

- from the V semester to VII semester.
- xii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.
  - xiii. 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.
  - xiv. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.
  - xv. 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 a minimum of 05 skill-oriented courses offered during III to VII semesters. Among them, one course shall be a soft skills course.
  - xvi. Students shall undergo mandatory summer internships, for a minimum of eight weeks' duration at the end of second and third year of the program. The internship at the end of second year shall be community oriented and industry internship at the end of third year.
  - xvii. There shall also be mandatory full internship in the final semester of the program along with the project work.
  - xviii. Undergraduate degree with Honors / Minors is introduced by the college for the students having good academic record.
  - xix. 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 concepts through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.
  - xx. 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.
  - xxi. Preferably 25% of course work for the theory courses in every semester shall be conducted in the blended mode of learning.

### 13. Evaluation Process

- i. The performance of a student in each semester shall be evaluated course wise with a maximum of 100 marks for theory and 100 marks for practical course. Summer Internships shall be evaluated for 50 marks, Full Internship & Project Work in final semester shall be evaluated for 100 marks and 200 marks respectively, mandatory courses with no credits shall be evaluated for 30 mid semester marks.
- ii. A student has to secure not less than 35% of marks in the semester end examination and a minimum of 40% of marks in the sum total of the mid semester and semester end examination marks taken together for the theory, practical, design, drawing course or project etc. In case of a mandatory courses, he/she should secure 40% of the total marks. In case of audit courses, he/she should submit formative assessments only.

#### 13.1 Theory Courses

| Assessment Method              | Marks      |
|--------------------------------|------------|
| Continuous Internal Assessment | 30         |
| Semester End Examination       | 70         |
| <b>Total</b>                   | <b>100</b> |

- i. For theory course, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the Semester End Examination.
- ii. For practical course, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the Semester End Examination.
- iii. If any course contains two different branch courses, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and semester end

examination question paper shall be set with two parts each for 35 marks.

#### **a) Continuous Internal Evaluation**

- i. For theory courses, 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 on the day of subjective paper test itself.
- iii. 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.
- iv. The internal evaluation for the course on "Design Thinking and Innovation" shall be activity based, in the form of presentations / reports as per the curriculum and shall be evaluated for 15 marks by the concerned teacher and 15 marks for internal tests. There shall be two internal tests. The internal test shall be of 20 marks for subjective paper and 10 marks for objective paper, total shall be condensed to 15 marks.
- v. 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.
- vi. 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.
- vii. 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:  $(25 \times 0.8) + (20 \times 0.2) = 24$

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:  $(25 \times 0.8) + (0 \times 0.2) = 20$

#### **b) Semester End Examination Evaluation**

Semester End Examination of theory courses shall have the following pattern:

- i. There shall be 6 questions and all questions are compulsory.
- ii. Question 1 shall contain 10 compulsory short answer questions for a total of 20 marks such that each question carries 2 marks.
- iii. There shall be 2 short answer questions from each unit. 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.
- v. Semester end examination of theory courses consisting of two parts of different courses, for Example: Basic Electrical & Electronics Engineering shall have the following pattern:
    - a. Question paper shall be in two parts viz., Part A and Part B with equal weightage of 35 marks each.
    - b. In each part, question 1 shall contain 5 compulsory short answer questions for a total of 5 marks such that each question carries 1mark.
    - c. 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.
    - d. The questions from 2 to 4 shall be set by covering one unit of the syllabus for each question.

### 13.2 Practical Courses

| Assessment Method              | Marks      |
|--------------------------------|------------|
| Continuous Internal Assessment | 30         |
| Semester End Examination       | 70         |
| <b>Total</b>                   | <b>100</b> |

- i. For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and semester end examination shall be for 70 marks.
- ii. 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.
- iii. The semester end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the course from the same department.
  - Procedure: 20 marks
  - Experimental work & Results: 30 marks
  - Viva voce: 20 marks.

In a practical course consisting of two parts (Eg: Basic Electrical & Electronics Engineering Lab), the semester 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.

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

Day-to-day work shall be evaluated for 15 marks by the concerned course 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 weight age 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 course.

The semester 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 semester end examination. However, the semester end examination pattern for other courses related to design/drawing, multiple branches, etc is mentioned along with the syllabus.

- v. The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the institution as per the institutional norms and shall be produced to the Statutory Committees as and when the same are asked for.

### 14. Health and Wellness, Yoga & Sports; and NSS/NCC/Scout & Guides/Community Service Courses

Courses like HEALTH AND WELLNESS, YOGA & SPORTS; AND NSS/NCC/SCOUT & GUIDES/ COMMUNITY SERVICE are evaluated as follows.

- Evaluated for a total of 100 marks.
- A Student can select 6 activities of his/her choice with a minimum of 1 activity

per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totally to 90 marks.

- The student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the course.

### **15. Mandatory Courses**

There shall be no semester end 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 examination. In case, the student fails, a re-examination shall be conducted for failed candidates for 30 marks satisfying the conditions mentioned in **item 6** of the regulations. The performance of the student shall be indicated in the grade sheet as **"Satisfactory"** or **"Not Satisfactory"**, as specified in **Clause 26** and this will not be counted for the computation of SGPA/CGPA/Percentage. The student shall pass all the mandatory courses, for the award of B.Tech. degree.

### **16. Audit Courses**

Audit courses carry "zero" credits. There shall be no internal and semester end examinations. However, formative assessments shall be submitted, and attendance shall be considered while calculating the aggregate attendance. The student shall complete all the audit courses, and their performance shall be indicated in the GRADE Sheet as **"Satisfactory"** or **"Not Satisfactory"**, as specified in **Clause 26**.

### **17. Skill Oriented Courses**

- i. There shall be a minimum 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 semester 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 semester end examination similar to practical examination pattern shall be conducted by the concerned teacher and an expert in the course 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 College at the beginning of the semester.
- 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 College.

### **18. Massive Open Online Courses (MOOCs)**

In accordance with the University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulations, 2021, the college permits students to undertake up to 40% of the total courses offered in a specific program in a semester through SWAYAM /

SWAYAM plus (www.swayam.gov.in) / Institution Approved MOOC Platforms for credit transfer.

Students may pursue any course (i.e., professional core, professional electives or open elective courses) of curriculum (excluding laboratory courses), as approved by the College, through SWAYAM / SWAYAM plus MOOCs / Institution Approved MOOC Platforms. **Completion of at least one MOOC (Massive Open Online Course) is mandatory for the award of the degree.**

At the beginning of each semester, the College shall notify the list of approved courses from SWAYAM/ SWAYAM plus / Institution Approved MOOC Platforms eligible for credit transfer. Students must register for the courses offered through MOOC platform with the approval of Head of the Department. The Head of the Department shall appoint one mentor to monitor the students' progress in the MOOC.

A student must complete at least 75% of the assignments and quizzes on the SWAYAM / SWAYAM plus / Institution Approved MOOC Platforms to be eligible for the semester end examination. The semester end exam may be conducted by the National Testing Agency (NTA), the National Program on Technology Enhanced Learning (NPTEL), Institution Approved MOOC Service Provider or the College during the regular end-term exams. Evaluation shall comprise 70% weightage for the semester end examination and 30% for assignments and quizzes conducted by the SWAYAM / SWAYAM plus / Institution Approved MOOC Platforms course coordinator.

Students must earn a certificate by passing the SWAYAM/ SWAYAM plus/ Institution Approved MOOC Platforms examination and submit the same to the College to receive the credits as specified in the curriculum. Examination fees, if applicable, shall be borne by the student. Pass marks and grading will be as per the SVCE academic regulations. No relaxation is permitted. Credits will be awarded only after submission of the completion certificate.

Students who fail or are unable to appear in SWAYAM / SWAYAM plus / Institution Approved MOOC Platforms exams conducted by NTA / NPTEL / Institutional Approved MOOC Service Provider may write the College-conducted exam during the next subsequent semesters. Students who qualify through NTA / NPTEL / Institutional Approved MOOC Service Provider, but miss College registration for credit transfer may apply during the next supplementary notification.

Students who qualify in the proctored SWAYAM / SWAYAM plus exams are eligible for direct credit transfer and are exempted from both internal and external assessments for the equivalent College course.

In case of delays in result declaration by NTA / NPTEL, the College shall issue revised marks memos once results are available.

The College reserves the right to make amendments to these guidelines from time to time in alignment with UGC directives.

### **19. Credit Transfer Policy**

Adoption of Massive Open Online Courses (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 College shall allow up to a maximum of 40% of the total courses being offered in a particular program i.e., maximum of **64** credits through MOOCs platform (SWAYAM) / Institution Approved MOOC Platforms.

- i. The College shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses, as detailed in Table 1.

Table 1: Duration of the MOOC and Number of Credits

| S. No. | No. of Weeks | No. of Credits |
|--------|--------------|----------------|
| 1.     | 4            | 1              |
| 2.     | 8            | 2              |
| 3.     | 12           | 3              |
| 4.     | 16           | 4              |

- ii. The 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 theory courses only.
- iv. The concerned department shall identify the courses permitted for credit transfer.
- v. The College shall notify at the beginning of semester the list of online learning courses equivalent to the curriculum theory 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 College shall ensure no overlap of MOOC exams with that of the College examination schedule. In case of delay in results, the College 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 departments shall submit the following to the examination section of the College:
  - 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. If a student fails to attain credits through MOOCs, he shall have the option to attend the exam in conventional (pen & paper) mode at the end of the same semester along with Regular Examinations, or he can again re-register for the same MOOC course in the next academic year.
- xi. The institute shall ensure that students who have completed the entire MOOC and submitted a minimum of 75% of the assignments and quizzes on MOOC Platform shall only be allowed to appear for the semester end examination conducted by the institute. The MOOC Coordinator / SWAYAM Nodal Officer shall verify this from the MOOC Platform Admin dashboard.
- xii. Evaluation shall comprise 70% weightage for the semester end examination and 30% for assignments and quizzes conducted by the SWAYAM / SWAYAM plus / Institution Approved MOOC Platforms course coordinator.

**Evaluation of MOOC in Conventional Mode:**

- There shall be no internal evaluation
- The Semester End Examination of MOOCs shall have the following pattern:
  - ✓ There shall be 6 questions and all questions are compulsory, Part-A and Part-B, totaling 70 Marks.
  - ✓ **Part-A:** Question 1 shall contain 10 compulsory short answer questions for a total of 20 marks such that each question carries 2 marks. There shall be 2 short answer questions from each unit.
  - ✓ **Part-B:** In each of the questions from 2 to 6, there shall be either/or type questions of 10 marks each, totaling 50 Marks. Student shall answer any one of them. The questions from 2 to 6 shall be set by covering one unit of the syllabus for each question.
  - ✓ The student will be considered to have passed only if he/she scores a minimum of 35% of marks in the semester end examination and a minimum of 40% of marks in the sum total of the mid semester and semester end examination marks taken together for theory courses. In case of a mandatory course, he/she should secure 40% of the total marks.
- xiii. The College 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 College from time to time.

**20. Academic Bank of Credits (ABC)**

The College 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.

## **21. Mandatory Internships**

### **21.1 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 / College 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 College.

### **21.2 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 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.

#### **Full Semester Internship**

The student shall undergo a Full Semester Internship in an Industry/National Laboratories/ Academic institutions relevant to the branch specific or interdisciplinary through offline / online / blended mode. The Internship shall be submitted in a report form, and a presentation of the same shall be made before an Internship Evaluation Committee (IEC) and it shall be evaluated for 100 marks. The report and the oral presentation shall carry 40% and 60% weightage respectively. The IEC shall consist the concerned Supervisor and a Senior Faculty Member of the Department nominated by Head of the Department with the approval of the Principal. If required, multiple IECs shall be constituted for multiple sections with prior approval.

#### **Project Work**

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). The evaluation of remaining 30 marks shall be done by departmental Project Evaluation Committee (PEC) consisting of concerned supervisor, and 2 senior faculty members. At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external

examiner nominated by Head of the Department with the approval of the Principal and is evaluated for 140 marks.

## **22. Guidelines for offering a Minor**

The main objective of Minor in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B.Tech. program. Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department and as defined by the respective department offering Minor program.

- i. Minor 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. Minor programs shall be offered in emerging technologies by the respective departments or in collaboration with the relevant industries/agencies.
- iii. A student shall earn additional 18 credits in the specified area to be eligible for the award of B.Tech. degree with Minor. This is in addition to the credits essential for obtaining the Undergraduate Degree in Major Discipline (i.e., 163 credits).
- iv. A student shall study five theory courses each carrying three credits, along with either two laboratory courses of 1.5 credits each or a project course of three credits
- v. A student is permitted to register for a Minor offered by a department other than the parent department and as defined by the respective department offering Minor program.
- vi. Minor in Quantum Computing/Quantum Technologies/Internet of Things (IoT) can be studied by any branch of student.
- vii. A student is permitted to register for Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two courses per semester pertaining to their Minor from V Semester onwards.
- viii. The courses offered under Minor can have theory as well as laboratory component. If a course comes with a lab component, that component is to be cleared separately.
- ix. The Concerned HODs shall arrange separate class work and timetable of the courses offered under various Minor programs.
- x. Courses that are used to fulfil the student's primary major may not be double counted towards the Minor. Courses with content substantially equivalent to courses in the student's primary major may not be counted towards the Minor.
- xi. Students can complete the courses offered under Minor either in the college or in online platforms like SWAYAM/ SWAYAM plus with a minimum duration of 12 weeks for a 3-credit course and 8 weeks duration for a 2-credit course satisfying the criteria defined for credit mobility, as mentioned in **Clause 19**. If the courses under Minor are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B.Tech. courses.
- xii. **Minor Capstone Project** Report shall be evaluated with an external examiner. The total marks for Minor Capstone Project Work shall be 100 marks and distribution shall be 50 marks for internal and 50 marks for external evaluation. The Project Review Committee consisting of supervisor, a senior faculty and HOD assesses the student for 50 marks (Report: 30 marks, Seminar: 20 marks). The external evaluation of Minor Capstone Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner appointed by the College and is evaluated for 50 marks.
- xiii. The attendance for the registered courses under Minor and regular courses offered for Major degree in a semester are to be considered separately.
- xiv. A student shall maintain an attendance of 75% in all registered courses of Minor to be eligible for attending semester end examinations.
- xv. A student registered for Minor in a discipline shall pass in all courses that constitute the requirement for the Minor degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minor degree program.
- xvi. If a student drops or is terminated from the Minor 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.

- xvii. The Minor in a discipline will be mentioned in the degree certificate as Bachelor of Technology in XXX with Minor in YYY. For example, Bachelor of Technology in Mechanical Engineering with Minor in Machine Learning.

#### **Enrolment into a Minor:**

- i. Students without any backlog courses up to III semester will be permitted to register for a Minor.
- ii. If a student is detained due to lack of attendance in either Major or Minor program, registration shall be cancelled
- iii. Transfer of credits from a particular Minor to regular B.Tech. and vice-versa shall not be permitted
- iv. Minor is to be completed simultaneously with Major degree program.

#### **Registration for Minor:**

- i. The institution will announce specialization, eligibility and courses offered by the departments under Minor and seek registrations in IV Semester, after the results of III Semester are announced.
- ii. 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 Minor.
- iii. The selected students shall submit their willingness to the principal through his/her parent department which shall be forwarded to the concerned departments offering Minor. Both parent department and department offering minor shall maintain the record of student pursuing the Minor.
- iv. The students enrolled in the minor courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

### **23. 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 program 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 18 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., 163 credits).
- iii. A student shall study 05 theory courses each carrying 3 credits, along with either two practical courses of 1.5 credits each or a project course of 3 credits.
- iv. 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 courses per semester pertaining to the Honors from V Semester onwards.
- v. The concerned HOD shall arrange separate classwork and timetable of the courses offered under Honors program.
- vi. 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.
- vii. Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM/SWAYAM Plus 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.
- viii. The attendance for the registered courses under Honors and regular courses offered for Major degree in a semester are to be considered separately.

- ix. A student shall maintain an attendance of 75% in all registered courses under Honors to be eligible for attending semester end examinations.
- x. A student registered for Honors shall pass in all courses 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 program.
- xi. 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.
- xii. 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 courses 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 are 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.

#### **24. Attendance Requirements:**

- i. A student shall be eligible to appear for the College semester end examinations if he/she acquires a minimum of 40% attendance in each course and 75% of attendance in aggregate of all the courses. 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 College.
- iv. Students whose shortage of attendance is not condoned in any semester are not eligible to take their semester 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.
- viii. For induction program attendance shall be maintained as per AICTE norms.

#### **25. Promotion Rules:**

The following academic requirements must be satisfied in addition to the attendance

requirements mentioned in **section 24**.

- i. A student shall be promoted from first year to second year if he/she fulfils the minimum attendance requirement as per College 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 courses 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 courses 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 fulfillment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

## 26. 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 course fall | Grade                | Grade points |
|---|----------------------|--------------|
|   |                      | Assigned     |
| 90 & above                                  | S (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            |
| Mandatory Courses                           |                      |              |
| >= 12                                       | Satisfactory (Y)     | -            |
| < 12  | Not Satisfactory (N) | -            |
| Audit Courses                               |                      |              |
| -   | Satisfactory (Y)     | -            |
| -   | Not Satisfactory (N) | -            |

- i). A student obtaining Grade 'F' or Grade 'Ab' in a course shall be considered failed and will be required to reappear for that course when it is offered the next supplementary examination.
- ii). For non-credit mandatory courses and 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 Grade Point Average (CGPA)

### Semester Grade Point Average (SGPA)

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade point 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.,

$$SGPA = \frac{\sum_{i=1}^n (C_i \times G_i)}{\sum_{i=1}^n C_i}$$

Where,  $C_i$  is the number of credits of the  $i^{th}$  course,  $G_i$  is the grade point scored by the student in the  $i^{th}$  course and  $n$  is the no. of courses.

### **Cumulative Grade Point Average (CGPA)**

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

$$CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i}$$

Where  $S_i$  is the SGPA of the  $i^{th}$  semester,  $C_i$  is the total number of credits in that semester and  $n$  is the no. of semesters.

Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts (**Annexure – I**). While computing the SGPA the courses 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, E and F.

### **27. 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:

| <b>Class Awarded</b>         | <b>CGPA Secured</b> |
|------------------------------|---------------------|
| First Class with Distinction | $\geq 7.5$          |
| First Class                  | $\geq 6.5 < 7.5$    |
| Second Class                 | $\geq 5.5 < 6.5$    |
| Pass Class                   | $\geq 5.0 < 5.5$    |

### **CGPA to Percentage of Marks Conversion**

There shall be no formula prescribed for the conversion of CGPA into percentage of marks. Both the CGPA and the percentage of marks obtained by the student shall be printed on the Consolidated Marks Memo (CMM) at the time of its issuance.

### **28. Recounting / Revaluation:**

Students shall be permitted to apply for Recounting / Revaluation of the semester end examination answer scripts within a stipulated period after payment of the prescribed fee. After completion of the process of Recounting / Revaluation, the records are updated with changes if any, and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

The Revaluation shall be carried out by an expert not less than Associate Professor cadre, as per the scheme of evaluation supplied by the examination branch in the presence of Principal/Controller of Examinations. Neither the students nor his parents shall be permitted to the present during the valuation.

### **29. Supplementary Examinations:**

In addition to the regular semester end examinations conducted, the college may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such candidates writing supplementary examinations may have to write more than one examination per day. For eighth semester advanced supplementary examinations will be conducted.

### 30. Withholding of Results:

If the candidate has any dues not paid to the college or if any case of indiscipline or malpractice is pending against him/her, the result of the candidate shall be withheld in such cases, and he/she shall not be allowed/promoted to the next higher semester.

### 31. Re-Registration for Improvement of Internal Marks:

Following are the conditions to avail the benefit of improvement of internal marks.

- i. The candidate should have completed the 4 years of B.Tech. course work and obtained examinations results from I semester to VIII semester.
- ii. He/she should have passed all the courses for which the internal evaluation marks secured are more than 50%
- iii. Out of the courses the candidate has failed in the examinations due to internal evaluation marks secured being less than 50%, the candidate shall be given a chance for Theory courses and for a maximum of **three** theory courses for improvement of internal evaluation marks.
- iv. This provision is only for Theory courses. The candidate has to re-register for the chosen courses and fulfil the academic requirements (i.e., a student has to attend the classes regularly and appear for the mid-examinations and satisfy the attendance requirements to become eligible for appearing at the semester end examinations).
- v. For each course, the candidate has to pay a prescribed fee. In the event of availing the provision of Improvement of Internal evaluation marks, the internal evaluation marks as well as the Semester End Examinations marks secured in the previous attempt(s) for the re-registered courses shall stand cancelled.

### 32. Multiple Entry / Exit Option:

#### a) Exit Policy:

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

- i). **UG Certificate in (Field of study/discipline)** - Program duration: First year (first two semesters) of the undergraduate program, 40 credits followed by an additional exit 10-credit bridge / Skill oriented 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)** - Program duration: First two years (first four semesters) of the undergraduate program, 80 credits followed by an additional exit 10-credit bridge / Project oriented 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)** - Program duration: First three years (first six semesters) of the undergraduate program, 120 credits.

#### b) Entry Policy:

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

**Note:** The college 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.

### 33. 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 program/to establish start-ups. 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 College. An evaluation committee constituted by the College 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.

#### **34. Transitory Regulations:**

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfillment 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 courses as and when courses are offered, subject to **section 6. (c)** 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 6. (c)** and they will follow the academic regulations into which they are readmitted.

#### **35. Minimum Instructional Days for a Semester:**

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

#### **36. Medium of Instruction:**

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

#### **37. Student Transfers:**

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

#### **38. General Instructions:**

The academic regulations should be read as a whole for purpose of any interpretation.

- i. Malpractices **rules-nature** and punishments are appended.
- ii. Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
- iii. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Head of the institution is final.
- iv. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Head of the institution is final.

#### **39. Amendments to Regulations:**

The Academic Council of **Sri Venkateswara College of Engineering (Autonomous)** reserves the right to revise, amend, or change the Regulations, Scheme of Examinations, and / or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., with the recommendations of the concerned Board(s) of Studies. The changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the College.

**NOTE: FAILURE TO READ AND UNDERSTAND THE RULES & REGULATIONS IS NOT AN EXCUSE**

#### 40. Rules for Disciplinary Action for Malpractices / Improper Conduct in Examinations

| S. No.    | Nature of Malpractices/ Improper Conduct  | Punishment   |
|-----------|---|--|
|           | If the candidate  |  |
| 1.<br>(a) | Possesses or keeps accessible in Examination Hall, any paper, note book, programmable calculators, Cell phones, Pager, Palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he/she is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination). | Expulsion from the examination hall and cancellation of the performance in that course only.   |
| (b)       | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the Exam hall in respect of any matter.   | Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he/she will be handed over to the police and a case is registered against him/her.   |
| 2.        | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.  | Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that semester/year.<br><br>The Hall Ticket of the candidate is to be cancelled and sent to the notice of Principal.  |
| 3.        | Impersonates any other candidate in connection with the examination.  | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all Semester End Examinations. The continuation of the course by the candidate is subject to the Academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all semester end examinations, if his/her involvement is established.<br><br>Otherwise, the candidate is debarred |

| <b>S. No.</b> | <b>Nature of Malpractices/<br/>Improper Conduct</b>   | <b>Punishment</b>  |
|---------------|---|--|
|               |   | <p>for two consecutive semesters from class work and all Semester End Examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.</p> <p>If the imposter is an outsider, he will be handed over to the police and a case is registered against him/her.</p>  |
| 4.            | Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.   | Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all Semester End Examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.  |
| 5.            | Uses objectionable, abusive or offensive language in Cancellation of the performance in that course only. The answer paper or in letters to the examiners or writes to the examiner requesting him/her to award pass marks.   | Cancellation of the performance in that course only.   |
| 6.            | Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent / any Officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-In charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-In-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. If the candidate physically assaults the invigilator/ officer-In-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them. |

| <b>S. No.</b> | <b>Nature of Malpractices/ Improper Conduct</b>   | <b>Punishment</b>   |
|---------------|---|---|
| 7.            | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.   | Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 8.            | Possess any lethal weapon or firearm in the examination hall.   | Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.   |
| 9.            | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in <b>clause 6 to 8</b> . | Student of the college's expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. Person (s) who do not belong to the College will be handed over to police and, a police case will be registered against them .                                 |
| 10            | Comes in a drunken condition to the examination hall.   | Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year.   |
| 11.           | Copying detected on the basis of internal evidence, such as during valuation or during special scrutiny.  | Cancellation of the performance in that course only or in that course and all other courses the candidate has appeared including practical examinations and project work of that semester / year examinations, depending on the recommendation of the committee.  |

| <b>S. No.</b> | <b>Nature of Malpractices/<br/>Improper Conduct</b>  | <b>Punishment</b> |
|---------------|--|-------------------|
| 12.           | If any malpractice is detected which is not covered in the above <b>clauses 1 to 11</b> shall be reported to the Principal for further action and suitable punishment. |                   |

**Note:** Whenever the performance of a student is cancelled in any course/courses due to malpractice, he has to register for Semester End Examinations in that course/courses consequently and has to fulfill all the norms required for the award of Degree.

**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 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 123 credits and secures all 123 credits.
- (b) Award of B.Tech. Degree with Minors/Honors if he/she fulfils the following:
- i. Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 123 credits.
  - ii. Registering for Minors/Honors optional.
  - iii. Minors/Honors is to be completed simultaneously with B.Tech. program.

**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. in B.Tech. course and their admission stands cancelled. This clause shall be read along with **clause 1 a) i).**

**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 course or project if he secures not less than 35% of marks in the semester end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and semester 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 courses that have been studied up to V semester.

And in case if student is already detained for want of credits for a 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 semester end examination in a course but absent at it or has failed in the semester end examination may appear for that course 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 fulfillment 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).

**NOTE: FAILURE TO READ AND UNDERSTAND THE RULES & REGULATIONS IS NOT AN EXCUSE**

**SGPA and CGPA Calculations: An Illustrative Example for One Academic Year - B.Tech. Program (SVCE R23 Regulations)**

| <b>(a) SGPA Calculations: One Academic Year</b>                            |                        |                                       |              |              |  |  |   |
|--|------------------------|---------------------------------------|--------------|--------------|--|--|---|
| <b>Semester<br/>(Odd :I,<br/>Even: II)</b>                                 | <b>Course<br/>Code</b> | <b>Credits<br/>(<math>C_i</math>)</b> | <b>Marks</b> | <b>Grade</b> | <b>Grade<br/>Points<br/>(<math>G_i</math>)</b> | <b>Credit Points<br/>(<math>C_i \times G_i</math>)</b> | <b>SGPA<br/>(<math>S_i</math>)</b>  |
| I  | BB23AES101             | 3                                     | 78           | B            | 8  | $3 \times 8 = 24$                                      | $SGPA = \frac{\sum_{i=1}^n (C_i \times G_i)}{\sum_{i=1}^n C_i}$ $S_1 = \frac{145}{19.5} = 7.44$ |
| I  | BB23AHS101             | 2                                     | 90           | S            | 10   | $2 \times 10 = 20$                                     |   |
| I  | BB23ABS101             | 3                                     | 44           | E            | 5  | $3 \times 5 = 15$                                      |   |
| I  | BB23AES101             | 3                                     | 61           | C            | 7  | $3 \times 7 = 21$                                      |   |
| I  | BB23ABS101             | 3                                     | 67           | C            | 7  | $3 \times 7 = 21$                                      |   |
| I  | BB23AHS102             | 1                                     | 95           | S            | 10   | $1 \times 10 = 10$                                     |   |
| I  | BB23AES102             | 1.5                                   | 89           | A            | 9  | $1.5 \times 9 = 13.5$                                  |   |
| I  | BB23ABS102             | 1                                     | 62           | C            | 7  | $1 \times 7 = 7$                                       |   |
| I  | BB23AES103             | 1.5                                   | 58           | D            | 6  | $1.5 \times 6 = 9$                                     |   |
| I  | BB23ABS105             | 0.5                                   | 34           | A            | 9  | $0.5 \times 9 = 4.5$                                   |   |
| $\sum_{i=1}^n C_i$   |                        | <b>19.5<br/>(19.5*)</b>               | <b>678#</b>  | <b>Total</b> |  | $\sum_{i=1}^n (C_i \times G_i) = 145$                  |   |
| II   | BB23AES101             | 3                                     | 92           | S            | 10   | $3 \times 10 = 30$                                     | $S_2 = \frac{136.5}{20.5} = 6.66$   |
| II   | BB23ABS201             | 3                                     | 71           | B            | 8  | $3 \times 8 = 24$                                      |   |
| II   | BB23ABS201             | 3                                     | 42           | E            | 5  | $3 \times 5 = 15$                                      |   |
| II   | BB23AES102             | 3                                     | 84           | A            | 9  | $3 \times 9 = 27$                                      |   |
| II   | BB23APC201             | 3                                     | 64           | C            | 7  | $3 \times 7 = 21$                                      |   |
| II   | BB23ABS202             | 1                                     | 23           | F            | 0  | $1 \times 0 = 0$                                       |   |
| II   | BB23AES102             | 1.5                                   | AB           | F            | 0  | $1.5 \times 0 = 0$                                     |   |
| II   | BB23APC201             | 1.5                                   | 53           | D            | 6  | $1.5 \times 6 = 9$                                     |   |
| II   | BB23AES103             | 1                                     | 56           | D            | 6  | $1 \times 6 = 6$                                       |   |
| II   | BB23ABS106             | 0.5                                   | 35           | A            | 9  | $0.5 \times 9 = 4.5$                                   |   |
| $\sum_{i=1}^n C_i$   |                        | <b>20.5<br/>(17*)</b>                 | <b>520#</b>  | <b>Total</b> |  | $\sum_{i=1}^n (C_i \times G_i) = 136.5$                |   |
| * Total credits obtained in the current semester (without backlog courses) |                        |                                       |              |              |  |  |   |
| # Total marks obtained without considering mandatory courses               |                        |                                       |              |              |  |  |   |
| AFTER CLEARING BACKLOG COURSES   |                        |                                       |              |              |  |  |   |
| II   | BB23ABS202             | 1                                     | 49           | E            | 5  | $1 \times 5 = 5$                                       | $S_2 = \frac{150.5}{20.5} = 7.34$   |
| II   | BB23AES102             | 1.5                                   | 59           | D            | 6  | $1.5 \times 6 = 9$                                     |   |
| $\sum_{i=1}^n C_i$   |                        | <b>20.5<br/>(20.5*)</b>               | <b>605\$</b> | <b>Total</b> |  | <b>150.5</b>   |   |
| § Total marks obtained after clearing all backlog courses                  |                        |                                       |              |              |  |  |   |

| <b>(b) CGPA Calculation of the Program</b> |  |       |      |      |      |      |  |      |         |
|--|--|-------|------|------|------|------|--|------|---------|
| <b>Semester</b>                            | I  | II    | III  | IV   | V    | VI   | VII  | VIII | TOTAL   |
| <b>Semester Credits (<math>C_i</math>)</b> | 19.5   | 20.5  | 20   | 21   | 23   | 26   | 21   | 12   | 163     |
| <b>Total Max. Marks</b>                    | 1000   | 1000  | 800  | 900  | 1000 | 1000 | 750  | 300  | 6750    |
| <b>Total Marks Obtained</b>                | 678  | 605   | 755  | 735  | 678  | 628  | 638  | 187  | 4904    |
| <b>SGPA (<math>S_i</math>)</b>             | 7.44   | 7.32  | 8.67 | 8.63 | 7.59 | 7.67 | 7.65   | 8.5  | ----    |
| $\sum_{i=1}^n (C_i \times S_i)$            | 145  | 150.5 | 173  | 181  | 175  | 199  | 161  | 102  | 1286.50 |
| <b>For Regular Students</b>                | $CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i} = \frac{1286.50}{163} = 7.89$ |       |      |      |      |      | $\begin{aligned} & \text{Percentage of Marks} \\ & = \frac{\text{Total Marks Obtained}}{\text{Total Max. Marks}} * 100 \\ & = \frac{4904}{6750} * 100 = 72.65 \end{aligned}$ |      |         |
| <b>For Lateral Entry Students</b>          | $CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i} = \frac{991}{123} = 8.06$     |       |      |      |      |      | $\begin{aligned} & \text{Percentage of Marks} \\ & = \frac{\text{Total Marks Obtained}}{\text{Total Max. Marks}} * 100 \\ & = \frac{3621}{4750} * 100 = 76.23 \end{aligned}$ |      |         |

In Course Code:

For Example: BB23APC501

**BB- Correspond to Branch**

| <b>Branch</b>                                    | <b>Short Code (BB)</b> |
|--|------------------------|
| Civil Engineering                                | CE                     |
| Electrical & Electronics Engineering             | EE                     |
| Mechanical Engineering                           | ME                     |
| Electronics & Communication Engineering          | EC                     |
| Computer Science and Engineering                 | CS                     |
| Information Technology                           | IT                     |
| CSE (Data Science)                               | DS                     |
| CSE (Artificial Intelligence & Machine Learning) | AM                     |
| CSE (Cyber Security)                             | CY                     |
| English  | EG                     |
| Mathematics                                      | MA                     |
| Physics  | PH                     |
| Chemistry  | CH                     |
| MBA  | BA                     |
| MCA  | CA                     |

## **COURSE STRUCTURE**

### **B.Tech. – I Year I Semester**

| S. No        | Course Code | Course Name                                   | Category | Contact Periods per Week |          |           |           | Credits     | Scheme of Examination Max. Marks |            |             |
|--------------|-------------|---|----------|--------------------------|----------|-----------|-----------|-------------|----------------------------------|------------|-------------|
|              |             |   |          | L                        | T        | P         | Total     |             | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | EE23AES101  | Basic Electrical & Electronics Engineering    | ES       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 2            | CH23ABS101  | Chemistry                                     | BS       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 3            | EG23AHS101  | Communicative English                         | HS       | 2                        | -        | -         | 2         | 2           | 30                               | 70         | 100         |
| 4            | CS23AES101  | Introduction to Programming                   | ES       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 5            | MA23ABS101  | Linear Algebra & Calculus                     | BS       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 6            | CH23ABS102  | Chemistry Lab                                 | BS       | -                        | -        | 2         | 2         | 1           | 30                               | 70         | 100         |
| 7            | EG23AHS102  | Communicative English Lab                     | HS       | -                        | -        | 2         | 2         | 1           | 30                               | 70         | 100         |
| 8            | CS23AES102  | Computer Programming Lab                      | ES       | -                        | -        | 3         | 3         | 1.5         | 30                               | 70         | 100         |
| 9            | EE23AES102  | Electrical & Electronics Engineering Workshop | ES       | -                        | -        | 3         | 3         | 1.5         | 30                               | 70         | 100         |
| 10           | CH23ABS106  | NSS/NCC/Scouts & Guides/Community Service     | BS       | -                        | -        | 1         | 1         | 0.5         | 100                              | --         | 100         |
| <b>Total</b> |             |   |          | <b>14</b>                | <b>-</b> | <b>11</b> | <b>25</b> | <b>19.5</b> | <b>370</b>                       | <b>630</b> | <b>1000</b> |

### **B.Tech. – I Year II Semester**

| S. No        | Course Code | Course Name                                | Category | Contact Periods per Week |          |           |           | Credits     | Scheme of Examination Max. Marks |            |             |
|--------------|-------------|--|----------|--------------------------|----------|-----------|-----------|-------------|----------------------------------|------------|-------------|
|              |             |  |          | L                        | T        | P         | Total     |             | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | ME23AES101  | Basic Civil and Mechanical Engineering     | ES       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 2            | MA23ABS201  | Differential Equations & Vector Calculus   | BS       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 3            | ME23AES102  | Engineering Graphics                       | ES       | 1                        | -        | 4         | 3         | 3           | 30                               | 70         | 100         |
| 4            | PH23ABS101  | Engineering Physics                        | BS       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 5            | EC23APC201  | Network Analysis                           | PC       | 3                        | -        | -         | 3         | 3           | 30                               | 70         | 100         |
| 6            | PH23ABS102  | Engineering Physics Lab                    | BS       | -                        | -        | 2         | 2         | 1           | 30                               | 70         | 100         |
| 7            | ME23AES103  | Engineering Workshop                       | ES       | -                        | -        | 3         | 3         | 1.5         | 30                               | 70         | 100         |
| 8            | CS23AES103  | IT Workshop                                | ES       | -                        | -        | 2         | 2         | 1           | 30                               | 70         | 100         |
| 9            | EC23APC202  | Network Analysis and Simulation Laboratory | PC       | -                        | -        | 3         | 3         | 1.5         | 30                               | 70         | 100         |
| 10           | CH23ABS105  | Health and Wellness, Yoga and Sports       | BS       | -                        | -        | 1         | 1         | 0.5         | 100                              | --         | 100         |
| <b>Total</b> |             |  |          | <b>13</b>                | <b>-</b> | <b>15</b> | <b>26</b> | <b>20.5</b> | <b>370</b>                       | <b>630</b> | <b>1000</b> |

### B.Tech. – II Year I Semester

| S. No        | Course Code | Course Name                                | Category | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--------------|-------------|--|----------|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|              |             |  |          | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | MA23ABS305  | Probability and Complex Variables          | BS       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 2            | BA23AHS302  | Universal Human Values                     | HS       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3            | EC23APC301  | Digital Circuits Design                    | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 4            | EC23APC302  | Electronic Devices and Circuits            | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 5            | EC23APC303  | Signals, Systems and Stochastic Processes  | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 6            | EC23APC304  | Digital Circuits and Signal Simulation Lab | PC       | -                        | -        | 3        | 3         | 1.5       | 30                               | 70         | 100         |
| 7            | EC23APC305  | Electronic Devices and Circuits Lab        | PC       | -                        | -        | 3        | 3         | 1.5       | 30                               | 70         | 100         |
| 8            | CS23ASC302  | Python Programming                         | SC       | -                        | 1        | 2        | 3         | 2         | 30                               | 70         | 100         |
| 9            | CH23AMC301  | Environmental Science                      | MC       | 2                        | -        | -        | 2         | -         | 30                               | --         | 30          |
| <b>Total</b> |             |  |          | <b>17</b>                | <b>1</b> | <b>8</b> | <b>26</b> | <b>20</b> | <b>270</b>                       | <b>560</b> | <b>830</b>  |

### B.Tech. – II Year II Semester

| S. No   | Course Code | Course Name                                 | Category | Contact Periods per Week |          |           |           | Credits   | Scheme of Examination Max. Marks |            |             |
|---|-------------|---|----------|--------------------------|----------|-----------|-----------|-----------|----------------------------------|------------|-------------|
|   |             |   |          | L                        | T        | P         | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1   | EE23AES401  | Linear Control Systems                      | ES       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 2   | BA23AHS403  | Managerial Economics and Financial Analysis | HS       | 2                        | -        | -         | 2         | 2         | 30                               | 70         | 100         |
| 3   | EC23APC401  | Analog and Digital Communications           | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 4   | EC23APC402  | Electronic Circuit Analysis                 | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 5   | EC23APC403  | EM Waves and Transmission Lines             | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 6   | CS23AES301  | Design Thinking and Innovation              | ES       | 1                        | -        | 2         | 3         | 2         | 30                               | 70         | 100         |
| 7   | EC23APC404  | Analog and Digital Communications Lab       | PC       | -                        | -        | 3         | 3         | 1.5       | 30                               | 70         | 100         |
| 8   | EC23APC405  | Electronic Circuit Analysis Lab             | PC       | -                        | -        | 3         | 3         | 1.5       | 30                               | 70         | 100         |
| 9   | EG23ASC401  | Soft Skills                                 | SC       | -                        | 1        | 2         | 3         | 2         | 30                               | 70         | 100         |
| <b>Total</b>  |             |   |          | <b>15</b>                | <b>1</b> | <b>10</b> | <b>26</b> | <b>21</b> | <b>270</b>                       | <b>630</b> | <b>900</b>  |
| <b>Mandatory Community Service Project Internship of 08 Weeks Duration during Summer Vacation</b> |             |   |          |                          |          |           |           |           |                                  |            |             |

### B.Tech. – III Year I Semester

| S. No  | Course Code | Course Name  | Category | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--|-------------|--|----------|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|  |             |  |          | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1  | CS23AES501  | Introduction to Quantum Technology and Applications                      | ES       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 2  | EC23APC501  | Analog and Digital IC Applications                                       | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3  | EC23APC502  | Antennas and Wave Propagation  | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 4  | EC23APC504  | Microprocessors and Microcontrollers                                     | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 5  | EC23APE501  | <b>Professional Elective-I</b><br>Computer Architecture and Organization | PE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
|  | EC23APE502  | Detection and Estimation Theory  |          |                          |          |          |           |           |                                  |            |             |
|  | EC23APE503  | Information Theory and Coding  |          |                          |          |          |           |           |                                  |            |             |
| 6  |             | <b>Open Elective-I</b>   | OE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 7  | EC23APC506  | Analog and Digital IC Applications Lab                                   | PC       | -                        | -        | 3        | 3         | 1.5       | 30                               | 70         | 100         |
| 8  | EC23APC507  | Microprocessors and Microcontrollers Lab                                 | PC       | -                        | -        | 3        | 3         | 1.5       | 30                               | 70         | 100         |
| 9  | EC23ASC501  | PCB Design and Prototype Development                                     | SC       | -                        | 1        | 2        | 3         | 2         | 30                               | 70         | 100         |
| 10   | EC23ACS501  | Community Service Project  | CS       | -                        | -        | -        | -         | 2         | --                               | 100        | 100         |
| <b>Total</b>   |             |  |          | <b>18</b>                | <b>1</b> | <b>8</b> | <b>27</b> | <b>25</b> | <b>270</b>                       | <b>730</b> | <b>1000</b> |
| <b>Note:</b> One Domain Specific Expert Lecture and One Industrial Visit are mandatory requirements for the Semester |             |  |          |                          |          |          |           |           |                                  |            |             |

### B.Tech. III Year II Semester

| S. No  | Course Code | Course Name   | Category | Contact Periods per Week |          |           |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--|-------------|---|----------|--------------------------|----------|-----------|-----------|-----------|----------------------------------|------------|-------------|
|  |             |   |          | L                        | T        | P         | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1  | EC23APC601  | Digital Signal Processing   | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 2  | EC23APC602  | Microwave and Optical Communications                                  | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 3  | EC23APC603  | VLSI Design   | PC       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 4  | EC23APE601  | <b>Professional Elective-II</b><br>Cellular and Mobile Communications | PE       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
|  | EC23APE602  | Electronic Measurements and Instrumentation                           |          |                          |          |           |           |           |                                  |            |             |
|  | EC23APE604  | Speech Processing   |          |                          |          |           |           |           |                                  |            |             |
| 5  | EC23APE606  | <b>Professional Elective-III</b><br>Embedded Systems and IoT          | PE       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
|  | EC23APE607  | Nanoelectronics   |          |                          |          |           |           |           |                                  |            |             |
|  | EC23APE608  | Satellite Communications  |          |                          |          |           |           |           |                                  |            |             |
| 6  |             | <b>Open Elective-II</b>   | OE       | 3                        | -        | -         | 3         | 3         | 30                               | 70         | 100         |
| 7  | EC23APC604  | Microwave and Optical Communications Lab                              | PC       | -                        | -        | 3         | 3         | 1.5       | 30                               | 70         | 100         |
| 8  | EC23APC605  | VLSI Design Lab   | PC       | -                        | -        | 3         | 3         | 1.5       | 30                               | 70         | 100         |
| 9  | EC23AES501  | Tinkering Lab   | ES       | -                        | -        | 2         | 2         | 1         | 30                               | 70         | 100         |
| 10   | EC23ASC601  | Machine Learning and DSP  | SC       | -                        | 1        | 2         | 3         | 2         | 30                               | 70         | 100         |
| 11   | CS23AMC601  | Technical Paper Writing and IPR                                       | MC       | 2                        | -        | -         | 2         | -         | 30                               | --         | 30          |
| <b>Total</b>   |             |   |          | <b>20</b>                | <b>1</b> | <b>10</b> | <b>31</b> | <b>24</b> | <b>330</b>                       | <b>700</b> | <b>1030</b> |
| <b>Mandatory Industry Internship of 08 Weeks Duration during Summer Vacation</b><br><b>Note:</b> One Domain Specific Expert Lecture and One Domain Specific Workshop are mandatory requirements for the Semester |             |   |          |                          |          |           |           |           |                                  |            |             |

### B.Tech. – IV Year I Semester

| S. No   | Course Code | Course Name  | Category | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|---|-------------|--|----------|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|   |             |  |          | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1   | BA23AHS701  | <b>Management Course</b><br>Business Ethics and Corporate Governance | HS       | 2                        | -        | -        | 2         | 2         | 30                               | 70         | 100         |
|   | BA23AHS702  | E-Business   |          |                          |          |          |           |           |                                  |            |             |
|   | BA23AHS703  | Management Science   |          |                          |          |          |           |           |                                  |            |             |
| 2   | EC23APC701  | Data Communications and Networking                                   | PC       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3   | EC23APE701  | <b>Professional Elective-IV</b><br>Digital Image Processing          | PE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
|   | EC23APE702  | DSP Processors and Architectures                                     |          |                          |          |          |           |           |                                  |            |             |
|   | EC23APE703  | Radar Engineering  |          |                          |          |          |           |           |                                  |            |             |
| 4   | EC23APE704  | <b>Professional Elective-V</b><br>5G Communications                  | PE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
|   | EC23APE705  | Low Power VLSI Design  |          |                          |          |          |           |           |                                  |            |             |
|   | EC23APE706  | Wireless Sensor Networks   |          |                          |          |          |           |           |                                  |            |             |
| 5   |             | <b>Open Elective-III</b>   | OE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 6   |             | <b>Open Elective-IV</b>  | OE       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 7   | EC23ASC701  | <b>Skill Course</b><br>RF System Design Tools                        | SC       | -                        | 1        | 2        | 2         | 2         | 30                               | 70         | 100         |
|   | EC23ASC702  | Industrial IoT and Automation  |          |                          |          |          |           |           |                                  |            |             |
| 8   | BA23AAC701  | Gender Sensitization   | AC       | 2                        | -        | -        | 2         | -         | --                               | --         | --          |
| 9   | EC23AIP701  | Industry Internship  | IP       | -                        | -        | -        | -         | 2         | --                               | 50         | 50          |
| <b>Total</b>  |             |  |          | <b>19</b>                | <b>1</b> | <b>2</b> | <b>21</b> | <b>21</b> | <b>210</b>                       | <b>540</b> | <b>750</b>  |
| <b>Note:</b> One Domain Specific Expert Lecture is mandatory requirement for the Semester |             |  |          |                          |          |          |           |           |                                  |            |             |

### B.Tech. – IV Year II Semester

| S. No        | Course Code | Course Name | Category | Contact Periods per Week |          |          |          | Credits   | Scheme of Examination Max. Marks |            |             |
|--------------|-------------|-------------|----------|--------------------------|----------|----------|----------|-----------|----------------------------------|------------|-------------|
|              |             |             |          | L                        | T        | P        | Total    |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | EC23AIP801  | Internship  | IP       | -                        | -        | -        | -        | 4         | --                               | 100        | 100         |
| 2            | EC23APW801  | Project     | PW       | -                        | -        | -        | -        | 8         | 60                               | 140        | 200         |
| <b>Total</b> |             |             |          | <b>-</b>                 | <b>-</b> | <b>-</b> | <b>-</b> | <b>12</b> | <b>60</b>                        | <b>240</b> | <b>300</b>  |

**LIST OF OPEN ELECTIVE COURSES****Open Elective-I**

| Course Code | Course Name                                  | Offering Dept. |
|-------------|--|----------------|
| CE23AOE501  | Construction Technology and Management       | CE             |
| CE23AOE502  | Green Buildings                              | CE             |
| CS23AOE501  | Principles of Operating Systems              | CSE            |
| AM23AOE501  | Artificial Intelligence Tools and Techniques | CSM            |
| AM23AOE502  | Introduction to Artificial Intelligence      | CSM            |
| CY23APC301  | Computer Networks                            | CSC            |
| DS23AOE501  | Data Analysis with R Programming             | CSD            |
| IT23AOE501  | Web Programming Concepts                     | IT             |
| EC23AOE501  | Electronic Circuits                          | ECE            |
| EE23AOE501  | Electrical Safety Practices and Standards    | EEE            |
| ME23AOE501  | Sustainable Energy Technologies              | ME             |
| BA23AOE501  | Entrepreneurship and Venture Creation        | MBA            |
| EG23AOE501  | Academic Writing and Public Speaking         | English        |
| MA23AOE501  | Mathematics for Machine Learning and AI      | Mathematics    |
| PH23AOE501  | Materials Characterization Techniques        | Physics        |
| CH23AOE501  | Chemistry of Energy Systems                  | Chemistry      |

**Open Elective-II**

| Course Code | Course Name   | Offering Dept. |
|-------------|---|----------------|
| CE23AOE601  | Disaster Management                                 | CE             |
| CE23AOE602  | Sustainability in Civil Engineering Practice        | CE             |
| CS23AOE601  | Fundamentals of Object Oriented Analysis and Design | CSE            |
| CS23AOE602  | Java Programming                                    | CSE            |
| AM23AOE601  | Machine Learning Concepts                           | CSM            |
| CY23AOE601  | Introduction to Cryptography and Network Security   | CSC            |
| DS23AOE601  | Introduction to Social Media Mining                 | CSD            |
| IT23APC401  | Software Engineering                                | IT             |
| EC23AOE601  | Digital Electronics                                 | ECE            |
| EE23AOE601  | Renewable Energy Sources                            | EEE            |
| ME23AOE601  | Drone Technology                                    | ME             |
| ME23AOE602  | System Design for Sustainability                    | ME             |
| BA23AOE601  | Business Communication Skills                       | MBA            |
| EG23AOE601  | English for Competitive Examinations                | English        |
| MA23AOE601  | Mathematical Foundation of Quantum Technologies     | Mathematics    |
| MA23ABS403  | Optimization Techniques                             | Mathematics    |
| PH23AOE601  | Physics of Electronic Materials and Devices         | Physics        |
| CH23AOE601  | Chemistry of Polymers and Applications              | Chemistry      |

**Open Elective-III and IV**

| Course Code | Course Name   | Offering Dept. |
|-------------|---|----------------|
| CE23AOE701  | Building Materials and Services                           | CE             |
| CE23APE502  | Environmental Impact Assessment                           | CE             |
| CE23AOE702  | Geospatial Technologies                                   | CE             |
| CE23AOE703  | Smart Cities  | CE             |
| CE23AOE704  | Solid Waste Management                                    | CE             |
| CS23AOE701  | Introduction to Data Base Management Systems              | CSE            |
| CS23APE604  | Quantum Computing   | CSE            |
| AM23AOE701  | AI Prompt Engineering                                     | CSM            |
| AM23AOE702  | Artificial Intelligence and Machine Learning              | CSM            |
| AM23AOE703  | Introduction to Deep Learning                             | CSM            |
| CY23AOE701  | Fundamentals of Blockchain Technology                     | CSC            |
| CY23AOE702  | Fundamentals of Cyber Security                            | CSC            |
| CY23AOE703  | Fundamentals of Ethical Hacking                           | CSC            |
| DS23AOE701  | Data Analysis and Visualization                           | CSD            |
| DS23AOE702  | Fundamentals of Data Science                              | CSD            |
| IT23APC501  | Cloud Computing   | IT             |
| IT23APE501  | Internet of Things  | IT             |
| EC23AOE701  | Fundamentals of Digital Image Processing                  | ECE            |
| EC23APC504  | Microprocessors and Microcontrollers                      | ECE            |
| EC23AOE702  | Transducers and Sensors                                   | ECE            |
| EE23AOE701  | Electric Vehicles   | EEE            |
| EE23AOE702  | Energy Audit, Conservation and Management                 | EEE            |
| EE23AOE703  | Smart Grid Technologies                                   | EEE            |
| ME23AOE701  | 3D Printing Technologies                                  | ME             |
| ME23APE706  | Automation and Robotics                                   | ME             |
| ME23APE710  | Total Quality Management                                  | ME             |
| BA23AOE701  | Business Development                                      | MBA            |
| BA23AOE702  | Techno Marketing  | MBA            |
| EG23AOE701  | Employability Skills                                      | English        |
| EG23AOE702  | Life Skills   | English        |
| EG23AOE703  | Literary Vibes  | English        |
| MA23AOE701  | Financial Mathematics                                     | Mathematics    |
| MA23AOE702  | Wavelet Transforms: Theory and Applications               | Mathematics    |
| PH23AOE701  | Introduction to Quantum Mechanics                         | Physics        |
| PH23AOE702  | Sensors and Actuators for Engineering Applications        | Physics        |
| PH23AOE703  | Smart Materials and Devices                               | Physics        |
| CH23AOE701  | Biology for Engineers                                     | Chemistry      |
| CH23AOE702  | Chemistry of Nanomaterials and Applications               | Chemistry      |
| CH23AOE703  | Green Chemistry and Catalysis for Sustainable Environment | Chemistry      |

**HONORS DEGREE and MINOR DEGREE**

In addition to the Major Degree, Students have an opportunity to pursue either Minor or Honors Degrees, subject to the eligibility criteria specified in Academic Regulations, Point No.: 22 & 23.

**Honors Degree:** An Honors degree is awarded to students who complete an additional 18 credits of coursework within the same discipline, reflecting extended learning and academic depth.

**Honors in Electronics and Communication Engineering**

| S. No        | Year & Sem.          | Course Code | Course Name                             | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--------------|----------------------|-------------|---|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|              |                      |             |   | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | III-I<br>(2 Theory)  | EC23AHN501  | Adaptive Signal Processing              | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 2            |                      | EC23AHN502  | Digital Design Through Verilog          | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3            |                      | EC23AHN503  | Intelligent Communication Systems       | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 5            | III-II<br>(2 Theory) | EC23AHN601  | FPGA Architectures                      | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 6            |                      | EC23AHN602  | Real Time Embedded Systems              | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 7            |                      | EC23AHN603  | Testing and Verification                | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 9            | IV-I<br>(1 Theory)   | EC23AHN701  | System Design using Embedded Processors | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 10           |                      | EC23AHN702  | Under Water Communications              | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 12           | IV-I                 | EC23AHN703  | Honor Capstone Project                  | -                        | -        | -        | -         | 3         | 50                               | 50         | 100         |
| <b>Total</b> |                      |             |   | <b>15</b>                | <b>-</b> | <b>-</b> | <b>15</b> | <b>18</b> | <b>200</b>                       | <b>400</b> | <b>600</b>  |

**Minor Degree:** A Minor degree is awarded to students who complete an additional 18 credits of coursework in a discipline other than their parent discipline, demonstrating interdisciplinary learning.

**Award of Degree:**

*B.Tech. in [Major Discipline] with Minor in [Other than Major Discipline/Emerging Technology Area]*

**MINOR DEGREES OFFERED UNDER SVCE R23 REGULATIONS**

| S. No | Host Department    | Title of the Minor                            | Eligible Branches       |
|-------|--------------------|---|-------------------------|
| 1     | CE                 | Civil Engineering                             | All branches except CE  |
| 2     |                    | Building Planning and Construction Technology | All branches except CE  |
| 3     | CSE                | Computer Science and Engineering              | EEE, ECE, CE, ME        |
| 4     |                    | Programming and Computational Intelligence    | All branches except CSE |
| 5     |                    | Quantum Computing                             | All branches            |
| 6     |                    | Quantum Technologies                          | All branches            |
| 7     | CSM                | Artificial Intelligence and Machine Learning  | All branches except CSM |
| 8     |                    | AI Applications and Emerging Technologies     | All branches except CSM |
| 9     | CSC                | Cyber Security                                | All branches except CSC |
| 10    | CSD                | Data Science                                  | All branches except CSD |
| 11    |                    | Data Analytics                                | All branches except CSD |
| 12    |                    | Data Science and Analytics                    | All branches except CSD |
| 13    | ECE                | Electronics and Communication Engineering     | All branches except ECE |
| 14    |                    | Embedded Systems and IoT                      | All branches except ECE |
| 15    |                    | Electronic Systems                            | All branches except ECE |
| 16    | EEE                | Electrical and Electronics Engineering        | All branches except EEE |
| 17    |                    | Energy Systems and Microgrid Technologies     | All branches except EEE |
| 18    | IT                 | Information Technology                        | EEE, ECE, CE, ME        |
| 19    |                    | Internet of Things                            | All branches            |
| 20    | ME                 | Mechanical Engineering                        | All branches except ME  |
| 21    |                    | 3D Printing                                   | All branches except ME  |
| 22    |                    | Industrial Engineering                        | All branches except ME  |
| 23    | Management Studies | Business Management and Entrepreneurship      | All branches            |

**MINOR DEGREE IN  
ELECTRONICS AND COMMUNICATION ENGINEERING**

**Host Department:** Electronics and Communication Engineering

**Eligible Branches:** CE; CSE; CSM; CSC; CSD; EEE; IT and ME

**COURSE STRUCTURE**

| S. No        | Year & Sem.          | Course Code | Course Name   | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--------------|----------------------|-------------|---|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|              |                      |             |   | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | III-I<br>(2 Theory)  | EC23AMN501  | Analog Communication  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 2            |                      | EC23AMN502  | Digital System Design   | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3            |                      | EC23AMN503  | Microelectronics: Devices to Circuits                               | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 4            |                      | EC23AMN504  | Principles of Signals and Systems                                   | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 5            | III-II<br>(2 Theory) | EC23AMN601  | Digital VLSI Testing  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 6            |                      | EC23AMN602  | Microprocessors and Interfacing                                     | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 7            |                      | EC23AMN603  | Principles of Communication Systems                                 | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 8            |                      | EC23AMN604  | Sensors and Actuators   | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 9            | IV-I<br>(1 Theory)   | EC23AMN701  | Embedded System Design  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 10           |                      | EC23AMN702  | Optical Wireless Communications for Beyond 5G Networks and IoT      | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 11           |                      | EC23AMN703  | VLSI Design Flow: RTL to GDS  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 12           | IV-I                 | Ec23AMN704  | Minor Capstone Project in Electronics and Communication Engineering | -                        | -        | -        | -         | 3         | 50                               | 50         | 100         |
| <b>Total</b> |                      |             |   | <b>15</b>                | <b>-</b> | <b>-</b> | <b>15</b> | <b>18</b> | <b>200</b>                       | <b>400</b> | <b>600</b>  |

**MINOR DEGREE IN  
EMBEDDED SYSTEMS AND IoT**

**Host Department:** Electronics and Communication Engineering

**Eligible Branches:** CE; CSE; CSM; CSC; CSD; EEE; IT and ME

**COURSE STRUCTURE**

| S. No        | Year & Sem.          | Course Code | Course Name  | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination Max. Marks |            |             |
|--------------|----------------------|-------------|--|--------------------------|----------|----------|-----------|-----------|----------------------------------|------------|-------------|
|              |                      |             |  | L                        | T        | P        | Total     |           | Int. Marks                       | Ext. Marks | Total Marks |
| 1            | III-I<br>(2 Theory)  | EC23AMN505  | Embedded Systems Technology                        | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 2            |                      | EC23AMN506  | Microprocessors and Microcontrollers               | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 3            |                      | EC23AMN507  | Real Time Embedded Systems Design and Analysis     | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 4            |                      | EC23AMN508  | Sensors and Transducers Technology                 | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 5            | III-II<br>(2 Theory) | EC23AMN605  | Embedded System Design using Arduino               | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 6            |                      | EC23AMN606  | IoT Protocols                                      | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 7            |                      | EC23AMN607  | Principles of IoT                                  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 8            |                      | EC23AMN608  | Wireless Sensor Networks                           | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 9            | IV-I<br>(1 Theory)   | EC23AMN705  | Embedded System Design using Raspberry Pi          | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 10           |                      | EC23AMN706  | Industrial Internet of Things                      | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 11           |                      | EC23AMN707  | IoT System Design                                  | 3                        | -        | -        | 3         | 3         | 30                               | 70         | 100         |
| 12           | IV-I                 | EC23AMN708  | Minor Capstone Project in Embedded Systems and IoT | -                        | -        | -        | -         | 3         | 50                               | 50         | 100         |
| <b>Total</b> |                      |             |  | <b>15</b>                | <b>-</b> | <b>-</b> | <b>15</b> | <b>18</b> | <b>200</b>                       | <b>400</b> | <b>600</b>  |

## **MINOR DEGREE IN ELECTRONIC SYSTEMS**

**Host Department:** Electronics and Communication Engineering

**Eligible Branches:** CE; CSE; CSM; CSC; CSD; EEE; IT and ME

### **COURSE STRUCTURE**

| S. No        | Year & Sem.          | Course Code | Course Name                                  | Contact Periods per Week |          |          |           | Credits   | Scheme of Examination |            |             |
|--------------|----------------------|-------------|--|--------------------------|----------|----------|-----------|-----------|-----------------------|------------|-------------|
|              |                      |             |  | L                        | T        | P        | Total     |           | Max. Marks            |            |             |
|              |                      |             |  |                          |          |          |           |           | Int. Marks            | Ext. Marks | Total Marks |
| 1            | III-I<br>(2 Theory)  | EC23AMN509  | Digital Electronics                          | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 2            |                      | EC23AMN510  | Electronic Circuits                          | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 3            |                      | EC23AMN511  | Operational Amplifiers and Linear ICs        | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 4            |                      | EC23AMN512  | PCB Design and Manufacturing                 | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 5            | III-II<br>(2 Theory) | EC23AMN609  | Basic VLSI Design                            | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 6            |                      | EC23AMN610  | Digital Integrated Circuits                  | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 7            |                      | EC23AMN611  | Electronic Instrumentation                   | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 8            |                      | EC23AMN612  | Principles of Communication Engineering      | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 9            | IV-I<br>(1 Theory)   | EC23AMN709  | CMOS Analog IC Design                        | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 10           |                      | EC23AMN701  | Embedded System Design                       | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 11           |                      | EC23AMN506  | Microprocessors and Microcontrollers         | 3                        | -        | -        | 3         | 3         | 30                    | 70         | 100         |
| 12           | IV-I                 | EC23AMN710  | Minor Capstone Project in Electronic Systems | -                        | -        | -        | -         | 3         | 50                    | 50         | 100         |
| <b>Total</b> |                      |             |  | <b>15</b>                | <b>-</b> | <b>-</b> | <b>15</b> | <b>18</b> | <b>200</b>            | <b>400</b> | <b>600</b>  |

I Year B.Tech. – I Semester

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**(EE23AES101) BASIC ELECTRICAL & ELECTRONICS ENGINEERING****PART A: BASIC ELECTRICAL ENGINEERING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Gain the knowledge about various laws, simplification techniques and principles associated with electrical circuits.
- Acquire basic knowledge about the Electric machines, their principle of operation and the concept of measuring instruments.
- Understand the concept of Power Generation, Electricity Bill and Safety Measures.

**COURSE OUTCOMES:**

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

- CO 1:** Apply the knowledge of theorems/laws to analyze the simple AC and DC circuits.
- CO 2:** Illustrate the operating principles of various electrical machines and electrical measuring equipment's.
- CO 3:** Understand the basic concepts of electrical power generation, Electricity Bill and Safety Measures.

**UNIT I:****(8 Periods)**

**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:****(7 Periods)**

**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:****(7 Periods)**

**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.

**TEXT BOOKS:**

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

**REFERENCES:**

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

**PART B: BASIC ELECTRONICS ENGINEERING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the working principle of various electronic devices.
- Acquire knowledge on the operating conditions of a DC power supply system, amplifiers and general electronic instrumentation system.
- Learn basic techniques in the design of a logic circuit.

**COURSE OUTCOMES:**

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

- CO 1:** Apply the concept of science and mathematics to understand the working principles of electronic devices.
- CO 2:** Analyze the working principle of a DC power supply system and Amplifiers.
- CO 3:** Solve digital logic circuits and implement using different logic gates.

**UNIT I:****(7 Periods)**

**Semiconductor Devices:** Introduction - Evolution of 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:****(8 Periods)**

**Basic Electronic Circuits and Instrumentation:** 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:****(8 Periods)**

**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 Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only).

**Total Periods: 45****TEXT BOOKS:**

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

**REFERENCES:**

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.

I Year B.Tech. ECE – I Semester

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## (CH23ABS101) CHEMISTRY

### COURSE OBJECTIVES:

The objectives of this course are to:

- Familiarize engineering chemistry and its applications.
- Train the students on the principles and applications of electrochemistry and polymers.
- Introduce instrumental methods

### COURSE OUTCOMES:

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

- CO 1:** Understand Schrodinger Wave equation, MOT, energy level diagrams Apply the knowledge of linear differential equations related to various engineering fields.
- CO 2:** Apply the principle of Band diagrams in the application of conductors and semiconductors.
- CO 3:** Compare the materials for construction of a battery and electrochemical sensors.
- CO 4:** Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers.
- CO 5:** Explain the principles of spectrometry and separation of solid and liquid mixtures by chromatography

### UNIT I:

(8 Periods)

**Structure and Bonding Models:** Fundamentals of Quantum Mechanics-Plank's quantum theory, de-Broglie's hypothesis, Heisenberg uncertainty principle, Schrodinger Wave equation, significance of  $\Psi$  and  $\Psi^2$ , molecular orbital theory – bonding in homo- and hetero nuclear diatomic molecules – energy level diagrams of O<sub>2</sub> and CO, etc. n-molecular orbitals of butadiene and benzene, calculation of bond order.

### UNIT II:

(10 Periods)

**Modern Engineering materials:** Crystal field theory, d- orbital's splitting in tetra hedral and octa hedral complexes, Semiconductors – Introduction, doping concept, application, Super Conductors- Introduction basic concept, applications. Super capacitors-: Introduction, Basic Concept-Classification – applications. Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon Nano tubes and Graphenes

### UNIT III:

(10 Periods)

**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-oxygen fuel cell- working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

### UNIT IV:

(8 Periods)

**Polymer Chemistry:** Introduction to polymers, functionality of monomers, Tactility, chain growth and step growth polymerization, co- 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.

Elastomers–Processing and vulcanization of natural rubber, Buna-S, Buna-N- preparation,

properties and applications.

Conducting polymers – poly acetylene, poly aniline, – mechanism of conduction and applications. Bio-Degradable polymer - Poly Glycolic Acid (PGA).

**UNIT V:****(9 Periods)**

**Instrumental Methods and Applications:** Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV- Visible Spectroscopy- electronic transition, Instrumentation and applications, IR spectroscopy- principle, Instrumentation and applications. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

**Total Periods: 45****TEXT BOOKS:**

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
3. Vogel's quantitative chemical analysis, 6th edition-2009.

**REFERENCES:**

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. J.D. Lee, Concise Inorganic Chemistry, 5<sup>th</sup> Edition, Wiley Publications, Feb. 2008
3. Textbook of Polymer Science, Fred W. Billmeyer Jr, 3rd Edition
4. Chemistry Mc GrawHill, K.N. Jayaveera, G.V. Subba Reddy and C. Rama Chandraiah

## I Year B.Tech. ECE – I Semester

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**(EG23AHS101) COMMUNICATIVE ENGLISH****COURSE OBJECTIVES:**

The objectives of this course are to:

- Facilitate effective listening, Reading, Speaking and Writing skills among the students.
- Enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary.
- Helps the students to make them effective in speaking and writing skills and to make them industry ready.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the context, topic, and pieces of specific information from social or Transactional dialogues.
- CO 2:** Apply grammatical structures to formulate and correct word forms.
- CO 3:** Analyze discourse markers to speak clearly on a specific topic in informal discussions.
- CO 4:** Evaluate reading/listening texts and write summaries based on global comprehension of these texts.
- CO 5:** Create a coherent paragraph, essay, and resume.

**UNIT I:****(6 Periods)**

**Lesson: HUMAN VALUES:** The Gift of the Magi (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.

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

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

**UNIT II:****(7 Periods)**

**Lesson: NATURE:** The Brook by Alfred Tennyson (Poem)

**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.

**UNIT III:****(6 Periods)**

**Lesson: BIOGRAPHY:** Elon Musk

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

**Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed.

**Reading:** Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

**Writing:** Summarizing, Note-making, paraphrasing.

**Grammar:** Verbs - tenses; subject-verb agreement; Compound words, Collocations.

**Vocabulary:** Compound words, Collocation.

#### UNIT IV:

(5 Periods)

**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:

(6 Periods)

**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 contexts

**Reading:** Reading comprehension.

**Grammar:** Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement).

**Vocabulary:** Technical Jargons

**Total Periods: 30**

#### TEXT BOOKS:

1. Pathfinder: Communicative English for Undergraduate Students, 1<sup>st</sup> Edition, Orient Black Swan, 2023 (Units 1,2 & 3).
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5).

#### REFERENCES:

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, 4<sup>th</sup> Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

#### ONLINE RESOURCES:

##### Grammar:

1. [www.bbc.co.uk/learningenglish](http://www.bbc.co.uk/learningenglish)
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. [www.eslpod.com/index.html](http://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](https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA)

## I Year B.Tech. ECE – I Semester

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**(CS23AES101) INTRODUCTION TO PROGRAMMING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn how to solve a given problem.
- Illustrate the basic concepts of C programming language.
- Discuss the concepts of Functions, Arrays, Pointers and Structures.
- Familiarize with dynamic memory allocation concepts.
- Apply concepts of structures and files to solve real word problems.

**COURSE OUTCOMES:**

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

- CO 1:** Solve computational problems.  
**CO 2:** Select the features of C language appropriate for solving a problem.  
**CO 3:** Design computer programs for real world problems.  
**CO 4:** Organize the data which is more appropriated for solving a problem.  
**CO 5:** Understanding the basic concept of structures and file handling.

**UNIT I: (10 Periods)**

**Introduction to Problem Solving:** Problem Solving Aspect, Problem Identification, Problem Understanding, Algorithm Development, Solution Planning, characteristics of algorithm, Top-down approach, Bottom-up approach, Time and space complexities of algorithms, Flowchart.

Overview of C: History of C, C Language Elements, Basic Structure of C Program, C Tokens- Variables and Data Types, Operators, Expressions and Type Conversions.

**UNIT II: (8 Periods)**

**Control Statements:** Selection Statements- if and switch statements.

**Iterative Statements:** for, while and do-while statements.

**Jump Statements:** break, continue, go to statements.

**UNIT III: (8 Periods)**

**Arrays:** Declaration, accessing array elements, Storing values, Operations on arrays, multi-dimensional arrays.

**Functions:** Introduction, Using Functions, Function declaration, Function definition and Function call, Parameter passing, Passing arrays to functions, Recursion, Storage classes.

**UNIT IV: (10 Periods)**

**Pointers:** Declaration and Initialization of pointer variables, Pointer arithmetic, Pointers and arrays, Pointer to pointer, Array of pointers, Pointers and functions, Dynamic Memory Allocation.

**Strings:** Introduction to Strings, String handling functions, Preprocessor Directives.

**UNIT V: (9 Periods)**

**Structures:** Introduction, Nested Structures, Array of Structures, Structures and Functions, Unions.

**Files in C:** Using Files in C, read data from Files, Writing data to Files, Random access to files, Command-line Arguments

**Total Periods: 45**

**TEXT BOOKS:**

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3<sup>rd</sup> Edition, Cengage Learning, 2007.
2. M.T. Somashekara, Problem solving with C, PHI

**REFERENCES:**

1. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson, 5<sup>th</sup> Edition,
2. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Prentice Hall Publication, 2<sup>nd</sup> Edition.
3. Reema Thareja, Programming in C, Oxford University Press, AICTE Edition, 2018.
4. R.G. Dromey, How to Solve it by Computer, Pearson, 2014.

## I Year B.Tech. ECE – I Semester

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**(MA23ABS101) LINEAR ALGEBRA & CALCULUS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Illuminate the students in the concepts of calculus and linear algebra.
- Equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

**COURSE OUTCOMES:**

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

- CO 1:** Understanding the concepts of matrix algebra techniques to solve the system of linear equations.
- CO 2:** Develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- CO 3:** Apply mean value theorems to solve real life problems in engineering.
- CO 4:** Make use of partial differentiation to solve optimization problems.
- CO 5:** Familiarize with double and triple integrals of functions of several variables in two dimensions using Cartesian and polar coordinates and in three dimensions using cylindrical and spherical coordinates.

**UNIT I:****(8 Periods)**

**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, Jacobi and Gauss Seidel Iteration Methods.

**UNIT II:****(10 Periods)**

**Eigenvalues, Eigenvectors and Orthogonal Transformation:** Eigenvalues, Eigenvectors and their properties, 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:****(7 Periods)**

**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:****(10 Periods)**

**Partial differentiation and Applications (Multi variable calculus):** Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

**UNIT V:****(10 Periods)**

**Multiple Integrals (Multi variable Calculus):** Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

**Total Periods: 45**

**TEXT BOOKS:**

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10<sup>th</sup> Edition, 2011.

**REFERENCES:**

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd., 3<sup>rd</sup> Edition, 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, Pearson Publishers, 13<sup>th</sup> Edition, 2013.
3. GlynJames, Advanced Modern Engineering Mathematics, Pearson publishers, 4<sup>th</sup> Edition, 2011.
4. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education
5. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
6. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

## I Year B.Tech. ECE – I Semester

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**(CH23ABS102) CHEMISTRY LAB****COURSE OBJECTIVES:**

The objective of this course is to:

- Verify the fundamental concepts with experiments.

**COURSE OUTCOMES:**

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

- CO 1:** Verify Beer Lambert's law
- CO 2:** Analyse the IR and NMR spectra of some organic compounds
- CO 3:** Apply electro analytical techniques for sample analysis.
- CO 4:** Measure the strength of an acid present in the samples.
- CO 5:** Prepare advanced polymer materials.

**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 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

**REFERENCES:**

1. J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", Pearson Publications, 6<sup>th</sup> Edition

**I Year B.Tech. ECE – I Semester**

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**(EG23AHS102) COMMUNICATIVE ENGLISH LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Expose the students to a variety of self-instructional, learner friendly modes of language learning.
- Get trained in basic communication skills and also make them ready to face job interviews.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the different aspects of the English language proficiency with an emphasis on LSRW skills.
- CO 2:** Apply communication skills through various language learning activities.
- CO 3:** Analyze the English speech sounds, stress, rhythm, intonation, and syllable division for better listening and speaking comprehension.
- CO 4:** Evaluate and exhibit professionalism in participating in debates and group discussions.
- CO 5:** 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

**REFERENCES:**

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, Kindle, 2<sup>nd</sup> Edition, 2013

**ONLINE RESOURCES:****Spoken English:**

1. [www.esl-lab.com](http://www.esl-lab.com)
2. [www.englishmedialab.com](http://www.englishmedialab.com)
3. [www.englishinteractive.net](http://www.englishinteractive.net)
4. <https://www.britishcouncil.in/english/online>
5. <http://www.letstalkpodcast.com/>
6. [https://www.youtube.com/c/mmmEnglish\\_Emma/featured](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\\_cBE0Drdx19qkTMOWNw](https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTMOWNw)

**VOICE AND 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](https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc)
4. [https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp\\_IA](https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA)

## I Year B.Tech. ECE – I Semester

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**(CS23AES102) COMPUTER PROGRAMMING LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Use basic data types, operators, expressions and expression evaluation mechanisms using C Programming Language.
- Implement control flows, construct in C Programming Language and understand the syntax, semantics and usability contexts of these different constructs.
- Develop composite data types in C and constructs available to develop their datatypes, utilize them to model things and dealing with data from and to external files.
- Design programs with different variations of the constructs available for practicing modular programming and understand the pros and cons of using different variants and apply optimization.

**COURSE OUTCOMES:**

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

**CO 1:** Read, understand and trace the execution of programs written in C language.

**CO 2:** Select the right control structure for solving the problem.

**CO 3:** Develop C programs which utilize the memory efficiently using programming constructs like pointers.

**CO 4:** Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

**WEEK 1:**

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

**Activities:**

**Tutorial 1:** Problem-solving using Computers.

Lab1: Familiarization with programming environment

- Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- Exposure to Turbo C, gcc.
- 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.

**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

- Sum and average of 3 numbers
- Conversion of Fahrenheit to Celsius and vice versa
- 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.

**Activities:**

**Tutorial 3:** Variable types and type conversions:

**Lab 2:** Simple computational problems using arithmetic expressions.

- Finding the square root of a given number
- Finding compound interest
- Area of a triangle using heron's formulae
- Distance travelled by an object

**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.

**Activities:**

**Tutorial 4:** Operators and the precedence and as associativity:

**Lab 3:** 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 4:** 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 each of these statements is more appropriate to use.

**Activities:**

**Tutorial 6:** Loops, while and for loops

**Lab 5:** 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.

**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.

**Activities:**

**Tutorial 7:** 1 D Arrays: searching.

Lab 6: 1D Array manipulation, linear search

- i. Find the min and max of a 1-D integer array.
- ii. Perform linear search on 1D 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.

**Activities:**

**Tutorial 8:** 2 D arrays, sorting and Strings.

**Lab 7:** 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

**WEEK 9:**

**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

Activities:

**Tutorial 9:** Functions, call by value, scope and extent,

**Lab 8:** 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 10:**

**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.

Activities:

**Tutorial 10:** Recursion, the structure of recursive calls

**Lab 9:** 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 11:**

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

Activities:

**Tutorial 11:** Call by reference, dangling pointers

**Lab 10:** 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.

**WEEK 12:**

**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 12:** Pointers, structures and dynamic memory allocation

**Lab 11:** 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 13:**

**Objective:** Experiment with C Structures, Unions, bit fields and nested structures

**Activities:**

**Tutorial 13:** Bit fields, Self-Referential Structures, Linked lists

**Lab 12:** Bit fields, linked lists Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

- i. Demonstrate the differences between structures and unions using a C program
- ii. Write a C program to shift/rotate using bitfields.
- iii. Write a C program to copy one structure variable to another structure of the same type.

**WEEK14:**

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

**Activities:**

**Tutorial 14:** File handling

**Lab 13:** 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.

**TEXT BOOKS:**

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

**REFERENCES:**

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 B.Tech. ECE – I Semester

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**(EE23AES102) ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP****PART A: ELECTRICAL ENGINEERING LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Gain the practical knowledge about various laws/theorems for the given circuit.
- Acquire knowledge about various electrical measuring instruments and safety measures.
- Obtain the performance characteristics of DC generator.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the concept of KCL, KVL and Theorems practically for the given circuit.
- CO 2:** Evaluate the resistance, power and power factor of circuit elements by using measuring instruments.
- CO 3:** Obtain the Magnetization Characteristics of DC shunt Generator

**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

**REFERENCES:**

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

**Note:** Minimum Six Experiments to be performed.

**PART B: ELECTRONICS ENGINEERING LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Gain hands on experience in testing various electronic components.
- Acquire knowledge related to the use of electronic measuring instruments for different applications.
- Design and simulate a RC coupled amplifier.
- Verify the operating conditions of combinational and sequential circuits.

**COURSE OUTCOMES:**

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

- CO 1:** Identify and Test various electronic components.
- CO 2:** Employ various electronic measuring instruments for different applications.
- CO 3:** Evaluate the biasing conditions of various diodes and BJTs.
- CO 4:** Examine the operating conditions 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
  - i. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
7. 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, Tata Mc Graw Hill, 4<sup>th</sup> Edition, 2009
3. R. T. Paynter, Introductory Electronic Devices and 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 B.Tech. ECE – I Semester

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**(CH23ABS106) NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE****COURSE OBJECTIVES:**

The objective of this course is to:

- Impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the importance of discipline, character and service motto.
- CO 2:** Solve some societal issues by applying acquired knowledge, facts, and techniques.
- CO 3:** Explore human relationships by analyzing social problems.
- CO 4:** Determine to extend their help for the fellow beings and downtrodden people.
- CO 5:** 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-authorities experts-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.

**REFERENCES:**

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<sup>th</sup> Edition, 2008
4. Masters G. M., Joseph K. and Nagendran R. Introduction to Environmental Engineering and Science, Pearson Education, New Delhi. 2<sup>nd</sup> Edition, 2007
5. Ram Ahuja. Social Problems in India, Rawat Publications, New Delhi.

## I Year B.Tech. ECE – II Semester

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**(ME23AES101) BASIC CIVIL & MECHANICAL ENGINEERING****PART A: BASIC CIVIL ENGINEERING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Get familiarized with basic Construction Materials; the scope and importance of Civil Engineering specializations.
- Introduce the preliminary concepts of Structural and Geotechnical Engineering.
- Acquire preliminary knowledge on Surveying and Transportation Engineering.
- Get familiarized with the importance of Water Resources and Environmental Engineering.

**COURSE OUTCOMES:**

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

- CO 1:** Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society and the basic characteristics of Construction Materials.
- CO 2:** Gain knowledge regarding Structural and Geotechnical Engineering.
- CO 3:** Explain the concepts of surveying and Transportation Engineering, Water Resources and Environmental Engineering.

**UNIT I:****(8 Periods)**

**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.

**Construction Materials** - Cement – Sand - Aggregate - Bricks- Cement concrete – Steel - Timber.

**UNIT II:****(7 Periods)**

**Structural Engineering:** Importance- Types of Structures and structural Members- Building Components –Building Planning principles.

**Geotechnical Engineering:** Types of Foundations-Functions and Requirement of a good foundation

**UNIT III:****(8 Periods)**

**Surveying & Transportation Engineering:** Objectives and Principles of Surveying- Instruments used in Surveying-Importance of Transportation in Nation's economic development- Modes of Transportation- Types of Highway Pavements- Flexible Pavements and Rigid Pavements -Traffic signals and signs.

**Water Resources and Environmental Engineering:** Introduction to Hydrology- hydrological cycle- Sources of water- Quality of water- Specifications- Rainwater Harvesting- Water Storage and Conveyance Structures- Dams and Reservoirs-types and components.

**TEXT BOOKS:**

1. M.S. Palanisamy, Basic Civil Engineering, Tata Mc Graw Hill publications (India) Pvt., Ltd., 4<sup>th</sup> Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers, 2022, 1<sup>st</sup> Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, , 1<sup>st</sup> Edition.

**REFERENCES:**

1. S.K.Duggal, Surveying, Vol – I and Vol - II, Tata McGraw Hill Publishers, 5<sup>th</sup>

- Edition, 2019
2. Santosh Kumar Garg, Hydrology and Water Resources Engineering, Khanna Publishers, Delhi, 2016.
  3. Santosh Kumar Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 38<sup>th</sup>Edition, Delhi 2023,
  4. Highway Engineering, S.K.Khanna, C.E.G.Justo and Veeraraghavan, Nemchand and Brothers Publications, 10<sup>th</sup>Edition, 2019.
  5. Indian Standard DRINKING WATER — SPECIFICATIONIS 10500-2012.

## **PART B: BASIC MECHANICAL ENGINEERING**

### **COURSE OBJECTIVES:**

The objectives of this course are to:

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

### **COURSE OUTCOMES:**

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

- CO 1:** Understand the different manufacturing processes.
- CO 2:** Explain the basics of thermal engineering and its applications.
- CO 3:** Describe the working of different mechanical power transmission systems and power plants and describe the basics of robotics and its applications.

### **UNIT I:**

**(7 Periods)**

**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:**

**(8 Periods)**

**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:**

**(7 Periods)**

**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.

**Total Periods: 45**

### **TEXT BOOKS:**

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

**REFERENCES:**

1. Appu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. L.Jyothish Kumar, Pulak M Pandey, 3D printing & Additive Manufacturing Technology- Springer publications
3. Mahesh M Rathore, Thermal Engineering, 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 B.Tech. ECE – II Semester

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**(MA23ABS201) DIFFERENTIAL EQUATIONS & VECTOR CALCULUS****COURSE OBJECTIVES:**

The objectives of this course are to:

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

**COURSE OUTCOMES:**

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

**CO 1:** Familiarize to solve the first and higher order differential equations.

**CO 2:** Apply the knowledge of linear differential equations related to various engineering fields.

**CO 3:** Identify solution methods for partial differential equations that model physical processes.

**CO 4:** Interpret the physical meaning of different operators such as gradient, curl and divergence.

**CO 5:** Evaluate the work done by force field, circulation and transformation between single, double and triple integrals using vector calculus.

**UNIT I:****(8 Periods)**

**Differential Equations:** 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:****(10 Periods)**

**Linear Differential Equations of Higher Order:** Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

**UNIT III:****(10 Periods)**

**Partial Differential Equations:** Introduction, Formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogenous linear Partial Differential equations with constant coefficients.

**UNIT IV:****(8 Periods)**

**Vector Differentiation:** Scalar and vector point functions, vector operator Del, Del applies to scalar point functions, Gradient, Directional derivative, del applied to vector point functions- Divergence and Curl, vector identities.

**UNIT V:****(9 Periods)**

**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 related problems.

**Total Periods: 45****TEXT BOOKS:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna publishers, 44<sup>th</sup> Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10<sup>th</sup> Edition, 2011.

**REFERENCES:**

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, Pearson, 2<sup>nd</sup> Edition, 2018.
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, Pearson Publishers, 13<sup>th</sup> Edition, 2013.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd., 3<sup>rd</sup> Edition, 2002.
5. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.
6. H. K. Dass, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.
7. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

## I Year B.Tech. ECE – II Semester

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**(ME23AES102) ENGINEERING GRAPHICS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Enable with various concepts like dimensioning, conventions and standards related to engineering drawing.
- Impart knowledge on the projection of points, lines and plane surfaces.
- Improve the visualization skills for better understanding of projection of solids.
- Develop the imaginative skills required to understand section of solids and developments of surfaces.
- Draw the viewing perception of a solid object in isometric and orthographic projections.

**COURSE OUTCOMES:**

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

**CO 1:** Draw various engineering curves, scales.

**CO 2:** Draw and interpret orthographic projections of points, lines, planes.

**CO 3:** Draw the projection of solids in various positions.

**CO 4:** Draw and explore the sections of solids and development of surfaces.

**CO 5:** Draw an isometric and orthographic views of simple solids.

**UNIT I:****(2 Periods and 8 Practical's)**

**Introduction to Engineering Drawing:** Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing Regular Polygons by General Methods.

**Curves:** Construction of Ellipse, Parabola and Hyperbola by General Method, Cycloids, Involute, Normal and Tangent to Curves.

**Scales:** Plain Scales, Diagonal Scales and Vernier Scales.

**UNIT II:****(3 Periods and 12 Practical's)**

**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:****(3 Periods and 12 Practical's)**

**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, Projection of Solids Inclined to both the Reference Planes.

**UNIT IV:****(3 Periods and 12 Practical's)**

**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:**

**(4 Periods and 16 Practical's)**

**Conversion of Views:** Conversion of Isometric Views to Orthographic Views of Simple Solids; Conversion of Orthographic Views to Isometric views of Simple Solids.

**Computer Graphics:** Creating 2D&3D Drawings of Objects Including Domain Specific Engineering Applications using Auto CAD (Not for end examination).

**Total Periods: 15 Periods and 60 Practical's**

**TEXT BOOKS:**

1. K.L. Narayana and P. Kannaiah, Engineering Drawing, Tata McGraw Hill, 2013.
2. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 54<sup>th</sup> Edition, 2023.

**REFERENCES:**

1. M.B.Shah and B.C. Rana, Engineering Drawing, Pearson Education Inc,2009.
2. Dhananjay Jolhe, Engineering Drawing with an Introduction to AutoCAD, Tata McGraw-Hill, 2017.
3. K. Venugopal, Engineering Drawing and Graphics, New Age Publishers, 4<sup>th</sup> Edition, 2004.
4. Basant Agarwal & C.M. Agarwal, Engineering Drawing, Tata McGraw-Hill, 2<sup>nd</sup> Edition, 2013

## I Year B.Tech. ECE – II Semester

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**(PH23ABS101) ENGINEERING PHYSICS****COURSE OBJECTIVES:**

The objective of this course is 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:**

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

- CO 1:** Understand the intensity variation of light due to interference, diffraction and polarization.
- CO 2:** Apply the basic concepts of crystal structures and X-ray diffraction to study the behavior of materials for engineering applications.
- CO 3:** Summarize the fundamental properties of dielectric and magnetic materials for engineering applications.
- CO 4:** Analyze the properties of quantum particles to interpret the energy band formation and classification of solids
- CO 5:** Assess the current flow mechanism to understand the transport phenomenon of charge carriers in semiconductors.

**UNIT I:****(10 Periods)**

**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:****(8 Periods)**

**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:****(10 Periods)**

**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 - 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- Applications of magnetic materials.

**UNIT IV:****(9 Periods)**

**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:****(8 Periods)**

**Semiconductors:** Formation of energy bands – classification of solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers (Qualitative) – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein’s equation – Hall effect and its applications - Direct and indirect bandgap semiconductors and its applications.

**Total Periods: 45****TEXT BOOKS:**

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

**REFERENCES:**

1. B.K. Pandey and S. Chaturvedi, Engineering Physics, 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).

**ONLINE RESOURCES:**

1. <https://www.loc.gov/rr/scitech/selected-ternet/physics.html>

## I Year B.Tech. ECE – II Semester

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**(EC23APC201) NETWORK ANALYSIS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce basic laws, mesh & nodal analysis techniques for solving electrical circuits.
- Impart knowledge on applying appropriate theorem for electrical circuit analysis.
- Explain transient and steady state behavior of different circuits
- Analyze the concepts of resonance and Magnetic circuits
- Understand open circuit, short circuit, transmission, hybrid parameters and their interrelationship.

**Course Outcomes:**

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

- CO 1:** Apply the basic electrical concepts to different circuits along with network simplification Techniques
- CO 2:** Determine the transient response of R-L, R-C, R-L-C circuits for D.C. and A.C excitations
- CO 3:** Analyze steady state response for various Circuits for AC excitation.
- CO 4:** Apply the concept of Resonance & Magnetic principles for different circuits.
- CO 5:** Evaluate network parameters for different two port networks.

**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-homogeneous, 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, basic theorems, 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.

**TEXT BOOKS:**

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

**REFERENCES:**

1. D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013.
2. Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, 7<sup>th</sup> Edition, New Delhi, 2017.
3. Charles K. Alexander and Matthew N.O. Sadiku, Fundamentals of Electric Circuits, McGraw-Hill Education.

## I Year B.Tech. ECE – II Semester

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**(PH23ABS102) ENGINEERING PHYSICS LAB****COURSE OBJECTIVES:**

The objective of this course is to:

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

**COURSE OUTCOMES:**

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

- CO 1:** Compare the wavelengths of different colours using diffraction grating.
- CO 2:** Utilize optical instruments like travelling microscope and spectrometer.
- CO 3:** Analyze the intensity of the magnetic field of circular coil carrying current with distance.
- CO 4:** Evaluate dielectric constant for a dielectric material.
- CO 5:** Estimate the band gap of a given semiconductor and 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. Determination of dielectric constant using charging and discharging method.
4. Study the variation of B versus H by magnetizing the magnetic material (B- H curve).
5. Determination of wavelength of Laser light using diffraction grating.
6. Estimation of Planck's constant using photoelectric effect.
7. Determination of the resistivity of semiconductors by four probe methods.
8. Determination of energy gap of a semiconductor using p-n junction diode.
9. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
10. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
11. Determination of temperature coefficients of a thermistor.
12. Sonometer: Verification of laws of stretched string.

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

**REFERENCES:**

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

**ONLINE RESOURCES:**

1. [www.vlab.co.inhttps://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html](https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html), prototype

## I Year B.Tech. ECE – II Semester

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**(ME23AES103) ENGINEERING WORKSHOP****COURSE OBJECTIVES:**

The objectives of this course are to:

- Identify and explain safety practices and precautions relevant to workshop activities.
- Recognize and differentiate various types of woods and tools used in woodwork.
- Demonstrate the ability to create different wood joints, including half-lap, mortise and tenon, and dovetail joints.
- Familiarize students with sheet metal working tools and techniques.
- Enable students to develop sheet metal projects such as tapered trays, conical funnels, elbow pipes and brazing.

**COURSE OUTCOMES:**

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

**CO 1:** Fabricate sheet metal components manually.

**CO 2:** Construct wood joints such as half-lap, mortise, and tenon.

**CO 3:** Assemble the components to create joints like a V-fit.

**CO 4:** Demonstrate the plumbing, welding, foundry, and fitting jobs to form the components.

**CO 5:** Connect & check the basic house wiring circuit connections for various applications.

1. **Demonstration:** Safety Practices and Precautions to be Observed in the Workshop.
2. **Wood Working:** Familiarity with Different Types of Woods and Tools used in Wood Working and Making Following Joints.
  - b) Half – Lap Joint
  - c) Mortise and Tenon Joint
  - d) 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.
  - b) Tapered Tray
  - c) Conical Funnel
  - d) Elbow Pipe
  - e) Brazing
4. **Fitting:** Familiarity with Different Types of Tools used in Fitting and do the Following Fitting Exercises.
  - b) V-Fit
  - c) Dovetail Fit
  - d) Semi-Circular Fit
  - e) 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.

**TEXT BOOKS:**

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

**REFERENCES:**

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

## I Year B.Tech. ECE – II Semester

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**(CS23AES103) IT WORKSHOP****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the internal parts of a computer, peripherals, I/O ports, connecting cables.
- Teach basic command line interface commands on Linux.
- Teach the usage of Internet for productivity and self-paced life-long learning
- Introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

**COURSE OUTCOMES:**

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

- CO 1:** Perform Hardware troubleshooting.
- CO 2:** Understand Hardware components and inter dependencies.
- CO 3:** Safeguard computer systems from viruses/worms.
- CO 4:** Document/ Presentation preparation.
- CO 5:** Perform calculations using spreadsheets

**Hardware:**

**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 with both Windows and Linux. 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 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 TeX and 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:** Code Generation: Test the model's ability to generate code by giving it partial code snippets and asking it to complete them. You can also ask the model to explain programming concepts or help you debug code.

**Ex:** Prompt: "Complete the following Python code to swap the values of two variables:\npython\na = 5\nb = 10\ntemp = a\na = b\nb = temp\n"

**Task 4:** 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?'"

**Task 5:** Summarization: Provide a long piece of text, such as an article or a blog post, and

ask the model to summarize it. Compare the model's summary with the original text to assess its ability to condense information effectively.

**Ex:** Prompt: "Summarize the article titled 'Ramayanam' in 3-4 sentences."

**Task 6:** Futuristic Predictions: Have fun by asking the model to predict future technological advancements, societal changes, or even hypothetical scenarios. Compare its responses with your own ideas.

**Ex:** Prompt: "Predict how artificial intelligence will transform everyday life in the next 20 years."

**Task 7:** Technical Explanations: Challenge the model with technical questions from different domains. Ask it to explain scientific concepts, mathematical theorems, or complex algorithms in simple terms.

**Ex:** Prompt: "Explain the concept of neural networks in machine learning, including their layers and the process of backpropagation."

#### **REFERENCES:**

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

## (EC23APC202) NETWORK ANALYSIS AND SIMULATION LABORATORY

### COURSE OBJECTIVES:

The objectives of this course are to:

- Gain Hands on Experience in Verifying Kirchhoff's Laws and network Theorems
- Analyze transient and steady state behavior of circuits
- Study resonance characteristics
- Determine two-port network Parameters

### COURSE OUTCOMES:

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

- CO 1:** Verify Kirchhoff's Laws and network Theorems
- CO 2:** Analyze time domain and frequency response of RL & RC circuits
- CO 3:** Analyze behavior of RLC circuit for different excitations
- CO 4:** Design resonant circuit for given Specifications
- CO 5:** 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<sup>st</sup> order RL & RC networks.
8. To study the transient and steady state response of a 2<sup>nd</sup> 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. ME Van Valkenburg, Network Analysis –Prentice Hall of India, revised 3<sup>rd</sup> Edition, 2019.
2. William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, Engineering Circuit Analysis, 9<sup>th</sup> Edition 2020.

I Year B.Tech. ECE – II Semester  
I Year B.Tech. ECE – II Semester

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## (CH23ABS105) HEALTH AND WELLNESS, YOGA AND SPORTS

### COURSE OBJECTIVES:

The objective of 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 successful completion of the course, students will be able to:

- CO 1:** Understand the importance of yoga and sports for Physical fitness and sound health.
- CO 2:** Demonstrate an understanding of health-related fitness components.
- CO 3:** Compare and contrast various activities that help enhance their health.
- CO 4:** Assess current personal fitness levels.
- CO 5:** 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:

- ii) Organizing health awareness programs in community.
- iii) Preparation of health profile.
- iv) 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.

### REFERENCES:

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

## II Year B.Tech. ECE – I Semester

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**(MA23ABS305) PROBABILITY AND COMPLEX VARIABLES****COURSE OBJECTIVES:**

The objectives of this course are to:

- Describe continuity/differentiability/analyticity of a function and find the derivative of a function.
- Classify and explain complex power series, singularities, calculus of residues and its applications in the evaluation of integrals.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the concepts of Probability, Random Variables and their characteristics.
- CO 2:** Learn how to deal with multiple random variables, conditional probability, joint distribution and statistical independence.
- CO 3:** Formulate and solve engineering problems involving random variables.
- CO 4:** Analyze the behavior of a complex function and understand Cauchy-Riemann equation in testing the analytic functions.
- CO 5:** Apply Cauchy integral theorem, formula and residue theorem to evaluating the complex integrals.

**UNIT I:****(10 periods)**

**Probability & Random Variable:** Probability through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events. Random variables (discrete and continuous), mathematical expectation, Distribution and Density functions, Properties, Binomial, Poisson, Gaussian, Uniform, Exponential and Rayleigh distributions.

**UNIT II:****(10 Periods)**

**Operations on Random variable:** Moments-moments about the origin, Central moments, Variance and Skew, Chebyshev's inequality, moment generating function, characteristic function.

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence.

**UNIT III:****(09 Periods)**

**Operations on Multiple Random variables:** Operations on Multiple Random Variables: Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties of Gaussian random variables.

**UNIT IV:****(08 Periods)**

**Complex Variable–Differentiation:** Introduction to functions of complex variable-concept of Limit & continuity - Differentiation, Cauchy-Riemann equations, analytic functions harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method.

**UNIT V:****(08 Periods)**

**Complex Variable–Integration:** Line integral-Contour integration, Cauchy's integral theorem (without proof), Cauchy Integral formula, Power series expansions: Taylor's series and Maclaurin's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proof). Evaluation of definite Integral involving sine and cosine.

**Total Periods: 45**

**TEXT BOOKS:**

1. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, TMH, 4<sup>th</sup> Edition, 2002.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> Edition, 2017,

**REFERENCES:**

1. Athanasios Papoulis and S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, PHI, 4<sup>th</sup> Edition, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India.
3. Henry Stark and John W. Woods, Probability and Random Processes with Application to Signal Processing, Pearson Education, 3<sup>rd</sup> Edition, 2002.
4. B.V.Ramana, Higher Engineering Mathematics, McGraw Hill publishers.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_ma50/preview](https://onlinecourses.nptel.ac.in/noc20_ma50/preview)
2. [https://onlinecourses.nptel.ac.in/noc21\\_ma66/preview#:~:text=This%20course%20provides%20random%20variable,and%20simple%20Markovian%20queueing%20models.](https://onlinecourses.nptel.ac.in/noc21_ma66/preview#:~:text=This%20course%20provides%20random%20variable,and%20simple%20Markovian%20queueing%20models.)

**II Year B.Tech. ECE – I Semester**

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**(BA23AHS302) UNIVERSAL HUMAN VALUES****COURSE OBJECTIVES:**

The objectives of this course are 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.
- 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.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**COURSE OUTCOMES:**

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

**CO 1:** Define the terms like Natural Acceptance, Happiness and Prosperity ..

**CO 2:** Identify one's self, and one's surroundings (family, society nature).

**CO 3:** Apply what they have learnt to their own self in different day-to-day settings in real life.

**CO 4:** Relate human values with human relationship and human society.

**CO 5:** Justify the need for universal human values and harmonious existence.

**CO 6:** Develop as socially and ecologically responsible engineers

**UNIT I:****(7 Periods)**

**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) – Understanding Value Education; Practice Session - Sharing about Oneself; Self-Exploration as the Process for Value Education - Continuous Happiness and Prosperity - the Basic Human Aspirations; Practice Session - Exploring Human Consciousness; Happiness and Prosperity – Current Scenario - Method to Fulfill the Basic Human Aspirations; Practice Session - Exploring Natural Acceptance.

**UNIT II:****(6 Periods)**

**Harmony in the Human Being:** Understanding Human Being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body; Practice Session - Exploring the difference of Needs of self and body; The Body as an Instrument of the Self - Understanding Harmony in the Self; Practice Session - Exploring Sources of Imagination in the Self; Harmony of the Self with the Body - Programme to ensure Self-regulation and Health; Practice Session - Exploring Harmony of Self with the Body.

**UNIT III:****(6 Periods)**

**Harmony in the Family and Society:** Harmony in the Family – The Basic Unit of Human Interaction - 'Trust' – The Foundational Value in Relationship; Practice Session - Exploring the Feeling of Trust; 'Respect' – as the Right Evaluation; Practice Session - Exploring the Feeling of Respect; Other Feelings, Justice in Human-to-Human Relationship - Understanding Harmony in the Society - Vision for the Universal Human Order; Practice Session; Exploring Systems to fulfill Human Goal.

**UNIT IV:****(5 Periods)**

**Harmony in the Nature / Existence:** Understanding Harmony in the Nature - Interconnectedness, Self-regulation and Mutual fulfillment among the Four Orders of Nature; Practice Session - Exploring the Four Orders of Nature; Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence; Practice Session - Exploring Co-existence in Existence.

**UNIT V:****(6 Periods)**

**Implications of the Holistic Understanding** – a Look at Professional Ethics: Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct; Practice Session - Exploring Ethical Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics; Practice Session - Exploring Humanistic Models in Education; Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession; Practice Session - Exploring Steps of Transition towards Universal Human Order.

**Total Periods: 30****TEXT BOOKS:**

1. R.R Gaur, R. Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2<sup>nd</sup> Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

**REFERENCES:**

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathy, 2003, Human Values, New Age International Publishers. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
3. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
4. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
5. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted 2008.

**ONLINE RESOURCES:**

1. <https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385>
2. [https://onlinecourses.swayam2.ac.in/aic22\\_ge23/preview](https://onlinecourses.swayam2.ac.in/aic22_ge23/preview)

## II Year B.Tech. ECE – I Semester

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**(EC23APC301) DIGITAL CIRCUITS DESIGN****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the properties of Boolean algebra, logic operations, and minimization of Boolean functions.
- Analyze combinational and analyze sequential logic circuits.
- Understand the concepts of FSM and compare various Programmable logic devices.
- Model combinational and sequential circuits using HDLs.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the properties of Boolean algebra, logic operations and apply techniques for minimization of Boolean functions
- CO 2:** Analyze and Design Combinational Circuits
- CO 3:** Design and Model combinational circuits using HDLs
- CO 4:** Design and Model Sequential circuits using HDLs
- CO 5:** Design of FSM and Compare various Programmable logic devices.

**UNIT I: (10 Periods)**

**Boolean algebra, logic operations, and minimization of Boolean functions:** Review of Number Systems and Codes, Representation of unsigned and signed integers, 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.

**UNIT II: (9 Periods)**

**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, binary multiplier, magnitude comparator, priority encoders, decoders, multiplexers, demultiplexers.

**UNIT III: (8 Periods)**

**Hardware Description Language:** Introduction to Verilog - structural specification of logic circuits, behavioral specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop using sequential circuits with CAD tools.

**UNIT IV: (8 Periods)**

**Sequential Logic Circuits:** Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, conversion of flip- flops, design of counters, ripple counters, synchronous counters, ring counter, Johnson counter, registers, shift registers, universal shift register. Verilog constructs for sequential circuits, flip-flop with clear capability, using Verilog constructs for registers and counters.

**UNIT V: (10 Periods)**

**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. Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGAs.

**Total Periods: 45**

**TEXT BOOKS:**

1. M. Morris Mano, Digital Design, 3<sup>rd</sup> edition, PHI.
2. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 3<sup>rd</sup> Edition, McGraw-Hill.

**REFERENCES:**

1. Charles H. Roth, Jr, Fundamentals of Logic Design, 4<sup>th</sup> Edition, Jaico Publishers.
2. Zvi Kohavi and Niraj K. Jha, Switching and Finite Automata Theory, 3<sup>rd</sup> Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, 2<sup>nd</sup> Edition Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, Digital Principles and Applications, TMH, 7<sup>th</sup> Edition.

## (EC23APC302) ELECTRONIC DEVICES AND CIRCUITS

### COURSE OBJECTIVES:

The objectives of this course are to:

- Understand the basic principles of all semiconductor devices.
- Analyze diode circuits, various biasing and small signal equivalent circuitsof amplifiers, compare the performance of BJTs and MOSFETs
- Design rectifier circuits and various amplifier circuits using BJTs andMOSFETs.

### COURSE OUTCOMES:

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

- CO 1:** Design a Bridge rectifier using C-filter.
- CO 2:** Compare the performance of various BJT biasing circuits.
- CO 3:** Evaluate the various important specifications of three amplifier configurations.
- CO 4:** Analyze a MOSFET biasing circuit.
- CO 5:** Design a practical amplifier circuit using MOSFETS and discrete components.

### UNIT I:

(10 Periods)

**PN junction diode:** Review, diode current equation, Diode resistance, Transition and Diffusion Capacitance, effect of temperature on PN junction diode, Quantitative analysis of center-tap Full-wave and Bridge Rectifiers with C-filter, Ripple Factor and Regulation Characteristics, Clipping and Clamping circuits, Illustrative problems.

**Special Diodes:** Construction, operation and VI characteristics of Tunnel Diode, Varactor Diode, LED, LCD, Photo Diode, SCR and UJT.

### UNIT II:

(8 Periods)

Review of Bipolar Junction Transistors, Limits of Operation, BJT Specifications.

**Biasing and Stabilization:** Operating Point, DC and AC Load Lines, Importance of Biasing, Fixed Bias, Collector to Base Bias, Self-Bias, Bias Stability, Thermal Runaway, Thermal Stability, Illustrative problems.

### UNIT III:

(8 Periods)

**BJT Small Signal Operation and Models:** The transconductance, input resistance at the base, input resistance at the emitter, Voltage gain, separating the Signal and the DC Quantities, The Hybrid  $\pi$  Model, the T Model.

Single Stage BJT Amplifiers - Common-Emitter (CE) amplifier without and with emitter resistance, Common-Base (CB) amplifier, Common- Collector (CC) amplifier or Emitter Follower, Problem solving.

### UNIT IV:

(9 Periods)

**Junction Field Effect Transistor (FET):** Construction, Principle of Operation, V-I Characteristics, Comparison of BJT and FET, FET as Voltage Variable Resistor.

**MOS Field Effect Transistors:** Introduction, Device Structure and Physical Operation, CMOS, V - I Characteristics, MOSFET Circuits at DC, MOSFET as an Amplifier and as a Switch. Biasing in MOS Amplifier circuits - biasing by fixing VGS with and without source resistance, biasing using drain to gate feedback resistor, biasing using constant current source, body effect, Problem solving.

### UNIT V:

(10 Periods)

**MOSFET Small Signal Operation Models:** The dc bias, separating the DC analysis and the signal analysis, Small signal equivalent circuit models, the trans-conductance, the T-equivalent circuit model, Single stage MOS Amplifiers – common source (CS) amplifier without and with source resistance, common gate (CG) amplifier, source follower, Problem Solving.

**Total Periods: 45**

**TEXT BOOKS:**

1. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits – Theory and Applications, 6<sup>th</sup> Edition, Oxford Press, 2013.
2. J. Milliman and C Halkias, Integrated electronics, 2<sup>nd</sup> Edition, Tata McGraw Hill, 1991.

**REFERENCES:**

1. Donald A Neamen, Electronic Circuits – analysis and design, 3<sup>rd</sup> Edition, McGraw Hill (India), 2019.
2. Behzad Razavi, Microelectronics, 2<sup>nd</sup> Edition, Wiley, 2013.
3. R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, 9<sup>th</sup> Edition, Pearson, 2006.
4. Jimmie J Cathey, Electronic Devices and Circuits, Schaum’s outlines series, 3<sup>rd</sup> Edition, McGraw-Hill (India), 2010.

**(EC23APC303) SIGNALS, SYSTEMS AND STOCHASTIC PROCESSES****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basics of signals and systems required for ECE courses.
- Learn concepts of signals and systems and its analysis using different transform techniques.
- Understand random processes which are essential for the random signals and systems encountered in communications and signal processing areas.

**COURSE OUTCOMES:**

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

- CO 1:** Classify Signals and Systems (Continuous and Discrete) in time domain and apply Fourier series to represent signals in frequency domain.
- CO 2:** Apply Continuous time Fourier Transform to Continuous time Signals and convert Continuous time signals to discrete time Signals using Sampling Theorem.
- CO 3:** Analyze Signal Transmission to LTI Systems
- CO 4:** Analyze Temporal Characteristics and its Properties.
- CO 5:** Analyze Spectral Characteristics and its Properties.

**UNIT I:****(9 Periods)**

**Signals & Systems:** Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error.

**Fourier series:** Trigonometric & Exponential forms of Fourier series, Properties, Concept of discrete spectrum, Illustrative Problems.

**UNIT II:****(9 Periods)**

**Fourier Transform:** Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Sampling: Sampling theorem – Statement and Proof of sampling theorem of low pass signals Illustrative Problems.

**Laplace Transform:** Definition, ROC, Properties, Inverse Laplace transforms, the s-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions, Illustrative Problems.

**UNIT III:****(10 Periods)**

**Signal Transmission through Linear Systems:** Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems.

**UNIT IV:****(9 Periods)**

**Random Processes – Temporal Characteristics:** The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First -Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-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:**

**(8 Periods)**

**Random Processes – Spectral Characteristics:** The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross correlation Function.

**Total Periods: 45**

**TEXTBOOKS:**

1. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, TMH, 4<sup>th</sup> Edition, 2002.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, Signals and Systems, 2<sup>nd</sup> Edition, PHI, 2009.

**REFERENCES:**

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Athanasios Papoulis and S. Unni Krishna Pillai, Probability, Random Variables and Stochastic Processes, PHI, 4<sup>th</sup> Edition, 2002
3. Simon Haykin and Van Veen, Signals and Systems, Wiley, 2<sup>nd</sup> Edition, 2005.
4. Matthew Sadiku and Warsame H. Ali, Signals and Systems A primer with MATLAB, CRC Press, 2016.
5. Hwei Hsu, Schaum's Outline of Signals and Systems, TMH, 4<sup>th</sup> Edition, 2019.

### (EC23APC304) DIGITAL CIRCUITS AND SIGNAL SIMULATION LAB

#### COURSE OBJECTIVES:

The objectives of this course are to:

- 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.

#### COURSE OUTCOMES:

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

- CO 1:** Verify the truth tables of various logic circuits.
- CO 2:** Understand how to simulate different types of signals and system response.
- CO 3:** Design sequential and combinational logic circuits and verify their functionality.
- CO 4:** Analyze the response of different systems when they are excited by different signals and plot power spectral density of signals.
- CO 5:** Generate different random signals for the given specifications.

#### LIST OF EXPERIMENTS:

##### PART A

1. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit.
2. Verification of functional table of 3 to 8-line Decoder /De-multiplexer
3. 4 variable logic function verification using 8 to1 multiplexer.
4. Design full adder circuit and verify its functional table.
5. Design a four-bit ring counter using D Flip-Flops/JK Flip Flop and verify output.
6. Design a four-bit Johnson's counter using D Flip-Flops/JK Flip Flops and verify output
7. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
8. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip-Flops and Test It with a low frequency clock and sketch the output waveforms.
9. Design MOD-8 synchronous counter using T Flip-Flop and verify the result and sketch the output waveforms.
10. (a) Draw the circuit diagram of a single bit comparator and test the output  
(b) Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.

#### Note:

1. Design and verify combinational and sequential circuits using Hardware Description Language
2. Verify the design with test bench for at least one experiment.

#### REFERENCES:

1. M. Morris Mano, Digital Design, 3<sup>rd</sup> Edition, PHI

##### PART B

1. Write a program to generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Perform 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 find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
11. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.
12. To plot pole-zero diagram in S-plane of given signal/sequence and verify its stability.

**Note:** Any **TEN** experiments. All the experiments are to be simulated using MATLAB or equivalent software.

**REFERENCES:**

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

II Year B.Tech. ECE – I Semester

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**(EC23APC305) ELECTRONIC DEVICES AND CIRCUITS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Verify the theoretical concepts practically from all the experiments.
- Analyze the characteristics of Diodes, BJT, MOSFET, and UJT.
- Design the amplifier circuits from the given specifications.
- Model the electronic circuits using tools such as PSPICE/Multisim.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the basic characteristics and applications of basic electronic devices.
- CO 2:** Observe the characteristics of electronic devices by plotting graphs.
- CO 3:** Analyze the V-I characteristics of various diodes, BJT, JFET and MOSFET.
- CO 4:** Design MOSFET / BJT based amplifiers for the given specifications.
- CO 5:** Simulate all circuits in PSPICE / Multisim.

**LIST OF EXPERIMENTS:**

1. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
2. Study and draw the Volt Ampere characteristics of UJT and determine  $\eta$ ,  $I_P$ ,  $I_v$ ,  $V_P$ , &  $V_v$  from the experiment.
3. Verification of the input and output characteristics of BJT in Common Emitter configuration experimentally and find required parameters from the graphs.
4. Study and draw the input and output characteristics of BJT in Common Base configuration experimentally and determine required parameters from the graphs.
5. Verification of the input and output characteristics of BJT in Common Collector configuration experimentally and find required parameters from the graphs. Study and draw the V- I characteristics of JFET experimentally.
6. Study and draw the **output** and **transfer** characteristics of MOSFET (Enhance mode) in Common Source Configuration experimentally. Find **Threshold voltage (VT), gm, & K** from the graphs.
7. Study and draw the **output** and **transfer** characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find **IDSS, gm, & VP** from the graphs.
8. Design and analysis of voltage- divider bias/self-bias circuit using BJT.
9. Design and analysis of self-bias circuit using MOSFET.
10. Design a suitable circuit for switch using MOSFET/BJT.
11. Design a small signal amplifier using MOSFET (common source) for the given specifications. Draw the frequency response and find the bandwidth.
12. Design a small signal amplifier using BJT (common emitter) for the given specifications. Draw the frequency response and find the bandwidth.

**TOOLS / EQUIPMENT REQUIRED:**

Software Toollike Multisim/ Pspice or Equivalent, DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

**NOTE:** (Implement / Execute any **TEN** Experiments).

## II Year B.Tech. ECE – I Semester

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**(CS23ASC302) PYTHON PROGRAMMING****COURSE OBJECTIVES:**

The objectives of this 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 successful completion of the course, students will be able to:

- CO 1:** Classify data structures of Python.
- CO 2:** Apply Python programming concepts to solve a variety of computational problems.
- CO 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.
- CO 4:** Become proficient in using commonly used Python libraries and frameworks such as JSON, XML, NumPy, pandas.
- CO 5:** Exhibit competence in implementing and manipulating fundamental data structures such as lists, tuples, sets, dictionaries.
- CO 6:** Propose new solutions to computational problems

**UNIT I**

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupiter 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.
  - Arithmetic Operators
  - Relational Operators
  - Assignment Operators
  - Logical Operators
  - Bit wise Operators Ternary Operator
  - Membership Operators Identity Operators
5. 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.

**SAMPLE EXPERIMENTS:**

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:
  - i. Addition
  - ii. Insertion
  - iii. slicing
6. 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.

**Sample Experiments:**

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. 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, Python os and os.path Modules.

**Object-Oriented Programming:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, method overloading, constructor overloading, classes with Multiple Objects, Inheritance, Polymorphism.

**Sample Experiments:**

1. Write a program to create Classes and Objects in Python
2. Write a program to implement inheritance concept
3. Write a Python program to implement method overloading, constructor overloading

**UNIT V**

**Introduction to Data Science:** NumPy, Pandas, Matplotlib libraries.

**Sample Experiments:**

1. Python Program to demonstrate NumPy arrays creation using array () function.
2. Python program to demonstrate use of ndim, shape, size, dtype.
3. Python programs to demonstrate different ways to create Pandas Dataframe
4. Python programs to demonstrate various plots in matplotlib.

**REAL TIME PROJECT:**

Dice Rolling Simulator in Python

**REFERENCES:**

1. Gowrishankar S, Veena A, Introduction to Python Programming, CRC Press 1<sup>st</sup> Edition, 2018
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2<sup>nd</sup> Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson 1<sup>st</sup> Edition 2017.

**ONLINE RESOURCES:**

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

## II Year B.Tech. ECE – I Semester

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**(CH23AMC301) ENVIRONMENTAL SCIENCE****COURSE OBJECTIVES:**

The objectives of this course are to:

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

**COURSE OUTCOMES:**

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

- CO 1:** Exploring different types of renewable and non-renewable energy sources.
- CO 2:** Students will learn about the structure and function of different ecosystems.
- CO 3:** Students will learn about different types of pollution and their sources, effects and control measures.
- CO 4:** Exploring the science behind climate change, its evidence, and its impacts on ecosystems and human societies.
- CO 5:** Understanding demographic factors and their environmental implications.

**UNIT I:****(6 Periods)**

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

**Natural Resources:** Energy 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.

**UNIT II:****(7 Periods)**

**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 Ecosystems:

- Forest Ecosystem.
- Grassland Ecosystem
- Desert Ecosystem.
- Aquatic Ecosystems (Freshwater - Ponds, Streams, Lakes, Rivers, Marine Ecosystem- Oceans, Estuaries)

**Biodiversity and its Conservation :** Introduction, Definition: Genetic, Species and Ecosystem Diversity – Bio-Geographical Classification of India – Value of Biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – Endangered and Endemic Species of India – Conservation of Biodiversity: In-situ and Ex-situ Conservation of Biodiversity. Specific Case Studies.

**UNIT III:****(6 Periods)**

**Environmental Pollution:** Definition, Cause, Effects, and Control measures of: Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution,

Nuclear Hazards - Pollution Case Studies - Role of an Individual in the Prevention of Pollution - Solid Waste Management- Causes, Effects and Control Measures of Urban and Industrial Wastes - Disaster Management-Floods, Earthquakes, Cyclones and Landslides.

**UNIT IV: (5 Periods)**

**Social Issues and the Environment:** Sustainable Development Goals, From Unsustainable to Sustainable Development–Urban Problems related to Energy – Water Conservation, Rainwater 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: (6 Periods)**

**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 a Local Area to Document Environmental Assets River / Forest Grassland / Hill / Mountain – Polluted Site – Urban / Rural / Industrial / Agricultural - Study of Common Plants, Insects and Birds – River, Hill Slopes.

**Total Periods: 30**

**TEXT BOOKS:**

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press, Third Edition, 2021.
2. K. Raghavan Nambiar, Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus, Scitech Publications (India), Pvt. Ltd. 2<sup>nd</sup> Edition, 2008.
3. Palaniswamy, Environmental Studies, Pearson Education, 2<sup>nd</sup> Edition, 2014.
4. S. Azeem Unnisa, Environmental Studies Academic Publishing Company
5. A. Koushik & C. P. Koushik, Perspectives in Environmental Studies, New Age International, 4<sup>th</sup> Edition, 2006.

**REFERENCES:**

1. Deeksha Dave and E. Sai Baba Reddy, Textbook of Environmental Science, Cengage Publications, 2<sup>nd</sup> Edition, 2012.
2. M. Anji Reddy, Textbook of Environmental Sciences and Technology, BS Publication, Second Edition, 2023.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 3<sup>rd</sup> Edition, 2009.
4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private Limited, 2<sup>nd</sup> Edition, 2004.
5. G.R. Chatwal, A Text Book of Environmental Studies Himalaya Publishing House, 4<sup>th</sup> Edition, 2014.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, Prentice Hall of India Private Limited, 3<sup>rd</sup> Edition, 2007.

## II Year B.Tech. ECE – II Semester

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**(EE23AES401) LINEAR CONTROL SYSTEMS****COURSE OBJECTIVES:**

The objectives of this course are to:

- 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.

**COURSE OUTCOMES:**

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

- CO 1:** Analyze and model various control systems transfer functions using differential equations, block diagram reduction techniques and signal flow graphs.
- CO 2:** Evaluate the transient and steady-state response of control systems and the effects of different controllers.
- CO 3:** Apply stability criteria and root locus methods to determine and analyze system stability.
- CO 4:** Analyze frequency response using Bode, Polar, and Nyquist plots to assess system stability and performance.
- CO 5:** Construct and solve state space models of continuous systems and evaluate their controllability and observability.

**UNIT I:****(9 periods)**

**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 Servo motor their transfer functions, Synchronos.

**UNIT II:****(9 periods)**

**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 of P, PI, PD and PID Controllers on second order system.

**UNIT III:****(9 periods)**

**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:****(9 periods)**

**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 of Lag, Lead, Lag-Lead Compensators on a second order system.

**UNIT V:**

**(9 periods)**

**State Space Analysis of Continuous Systems:** Concepts of state, state variables and state model - differential equations and 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.

**Total Periods: 45**

**TEXT BOOKS:**

- 1 Katsuhiko Ogata, Modern Control Engineering, Prentice Hall of India Pvt. Ltd., 5<sup>th</sup> Edition, 2010.
- 2 I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International (P) Limited Publishers, 5<sup>th</sup> Edition, 2007.
- 3 Control Systems by A. Nagoor Kani, RBA Publications, 3<sup>rd</sup> Edition, 2017.

**REFERENCES:**

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

**II Year B.Tech. ECE – II Semester**

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**(BA23AHS403) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Inculcate the basic knowledge of micro economics and financial accounting.
- Make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost.
- Know the Various types of market structure and pricing methods and strategy.
- Give an over view on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- Provide fundamental skills on accounting and to explain the process of preparing financial statements.

**COURSE OUTCOMES:**

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

- CO 1:** Define the concepts related to Managerial Economics, financial accounting and management.
- CO 2:** Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets.
- CO 3:** Apply the Concept of Production cost and revenues for effective Business decision.
- CO 4:** Analyze how to invest their capital and maximize returns and evaluate the capital budgeting techniques.
- CO 5:** Develop the accounting statements and evaluate the financial performance of business entity.

**UNIT I:****(6 Periods)**

**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:****(6 Periods)**

**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:****(6 Periods)**

**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:****(6 Periods)**

**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:**

**(6 Periods)**

**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.

**Total Periods: 30**

**TEXT BOOKS:**

1. Varshney & Maheswari: Managerial Economics, Sultan Chand.
2. Aryasri: Business Economics and Financial Analysis, 4<sup>th</sup> Edition, MGH.

**REFERENCES:**

1. Ahuja HI Managerial economics, S chand.
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<sup>nd</sup> Edition, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage.

**ONLINE RESOURCES:**

1. <https://www.slideshare.net/123ps/managerial-economics-ppt>
2. <https://www.slideshare.net/rossanz/production-and-cost-45827016>
3. <https://www.slideshare.net/darkyla/business-organizations-19917607>
4. <https://www.slideshare.net/balarajbl/market-and-classification-of-market>
5. <https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>
6. <https://www.slideshare.net/ashu1983/financial-accounting>

**II Year B.Tech. ECE – II Semester**

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**(EC23APC401) ANALOG AND DIGITAL COMMUNICATIONS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce various modulation and demodulation techniques of analog and digital communication systems.
- Analyze different parameters of analog and digital communication techniques.
- Understand function of various stages of AM, FM transmitters and Know characteristics of AM & FM receivers.
- Analyze the performance of various digital modulation techniques in the presence of AWGN.

**COURSE OUTCOMES:**

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

- CO 1:** Recognize the basic terminology used in analog and digital communication technique for transmission of information/data.
- CO 2:** Explain the basic operation of different analog and digital communication systems at Base band and passband level.
- CO 3:** Compute various parameters of baseband and passband transmission schemes by applying basic engineering knowledge.
- CO 4:** Analyze the performance of different modulation & demodulation techniques to solve complex problems in the presence of noise.
- CO 5:** Evaluate the performance of analog and digital modulation techniques to know merits and demerits of each one in terms of bandwidth and power efficiency.

**UNIT I:****(10 Periods)**

**Amplitude Modulation:** Need for modulation, Amplitude Modulation - Time and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves - Switching modulator, Detection of AM Waves - Envelope detector, DSBSC modulation - time and frequency domain description, Generation of DSBSC Waves - Balanced Modulators, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, SSB modulation - time and frequency domain description, frequency discrimination and Phase discrimination methods for generating SSB, Demodulation of SSB Waves, principle of Vestigial side band modulation.

**UNIT II:****(9 Periods)**

**Angle Modulation:** Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave using Bessel functions, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Comparison of FM and AM., Concept of Pre-emphasis and de-emphasis

**UNIT III:****(8 Periods)**

**Transmitters:** Classification of Transmitters, AM Transmitters, FM Transmitters Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Superheterodyne 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:****(9 Periods)**

**Introduction to Noise:** Types of Noise, Receiver Model, Noise in AM, DSB, SSB, and FM Receivers.

**Pulse Modulation:** Types of Pulse modulation- PAM, PWM and PPM. Comparison of FDM and TDM. Pulse Code Modulation: PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, Delta Modulation, DPCM, Noise in PCM and DM.

**UNIT V:**

**(9 Periods)**

**Digital Modulation Techniques:** Coherent Digital Modulation Schemes – ASK, BPSK, BFSK, QPSK, Non-coherent BFSK, DPSK. M-ary Modulation Techniques, Power Spectra, Bandwidth Efficiency.

**Baseband Transmission and Optimal Reception of Digital Signal:** A Baseband Signal Receiver, Probability of Error, Optimum Receiver, Coherent Reception, ISI, Eye Diagrams.

**Total Periods: 45**

**TEXTBOOKS:**

1. Simon Haykin, Communication Systems, John Wiley & Sons, 4<sup>th</sup> Edition, 2004.
2. Wayne Tomasi – Electronics Communication Systems – Fundamentals through Advanced, PHI, 5<sup>th</sup> Edition., 2009
3. B. P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford press, 2011.

**REFERENCES:**

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

**II Year B.Tech. ECE – II Semester**

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**(EC23APC402) ELECTRONIC CIRCUIT ANALYSIS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the characteristics of Differential amplifiers, feedback and power amplifiers.
- Analyze the response of tuned amplifiers
- Categorize different oscillator circuits based on the application
- Design the electronic circuits for the given specifications and for a given application.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the working principle and characteristics of Multistage amplifiers, differential amplifiers.
- CO 2:** Analyze the frequency response of multistage and differential amplifier circuits using BJT & MOSFETs at low and high frequencies.
- CO 3:** Apply basic principles to solve the problems related to oscillators and feedback amplifiers.
- CO 4:** Design different feedback amplifiers and power amplifier circuits based on the application.
- CO 5:** Evaluate the performance of different tuned amplifiers and multivibrators.

**UNIT I:****(9 Periods)**

**Multistage & Differential Amplifiers:** Introduction, Classification of Amplifiers, Distortion in amplifiers, Coupling Schemes, RC Coupled Amplifier using BJT, Cascaded RC Coupled BJT Amplifiers, Cascode amplifier, Darlington pair, the MOS Differential Pair, Small-Signal Operation of the MOS Differential Pair, the BJT Differential Pair.

**UNIT II:****(8 Periods)**

**Frequency Response:** Low-Frequency Response of the CS and CE Amplifiers, Internal Capacitive Effects and the High-Frequency Model of the MOSFET and the BJT, High-Frequency Response of the CE, Emitter follower, CS, CD,  $f_{\beta}$ ,  $f_T$  and gain bandwidth product.

**UNIT III:****(10 Periods)**

**Feedback Amplifiers:** Introduction, The General Feedback Structure, Some Properties of Negative Feedback, The Four Basic Feedback Topologies, Series—Shunt, Series—Series, Shunt—Shunt, Shunt—Series.

**Oscillators:** General Considerations, Phase Shift Oscillator, Wien-Bridge Oscillator, LC Oscillators, Relaxation Oscillator, Crystal Oscillators, Illustrative Problems.

**UNIT IV:****(8 Periods)**

**Power Amplifiers:** Introduction, Class A amplifiers (Series fed, Transformer coupled, Push pull), Second Harmonic distortion, Class B amplifiers (Push pull, Complementary symmetry), Crossover distortion and Class AB operation, Class C amplifiers.

**UNIT V:****(10 Periods)**

**Tuned Amplifiers:** Introduction, single Tuned Amplifiers – Q-factor, frequency response, Double Tuned Amplifiers – Q-factor, frequency response, Concept of stagger tuning.

**Multivibrators:** Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors.

**Total Periods: 45**

**TEXT BOOKS:**

1. Adel. S. Sedra and Kenneth C. Smith, Micro Electronic Circuits, Oxford University Press, 6<sup>th</sup> Edition, 2011.
2. J. Millman, H. Taub and Mothiki S. PrakashRao - Pulse, Digital and Switching Waveforms, TMH, 2<sup>nd</sup> Edition., 2008.
3. Millman, C Chalkias, Integrated Electronics, McGraw Hill Education (India) Private Ltd., 4<sup>th</sup> Edition, 2015.

**REFERENCES:**

1. Behzad Razavi, Fundamentals of Micro Electronics, Wiley, 2010.
2. Donald A Neamen, Electronic Circuits – Analysis and Design, 3<sup>rd</sup> Edition, McGraw Hill (India), 2019.
3. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson/Prentice Hall, 9<sup>th</sup> Edition, 2006.

## II Year B.Tech. ECE – II Semester

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**(EC23APC403) EM WAVES AND TRANSMISSION LINES****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand and analyze different laws and theorems of electrostatic fields.
- Study and analyze different laws and theorems of magneto-static fields.
- Analyzing Maxwell's equations in different forms.
- Learn the concepts of wave theory and its propagation through various mediums.
- Get exposure to the properties of transmission lines.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the concepts of wave theory and its propagation through various mediums.
- CO 2:** Understand the properties of transmission lines and their applications.
- CO 3:** Apply the laws & theorems of electrostatic fields to solve the related problems.
- CO 4:** Gain proficiency in the analysis and applications of magnetostatic laws and theorems.
- CO 5:** Analyze Maxwell's equations in different forms.

**UNIT I:****(10 Periods)**

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:****(10 Periods)**

**Magneto-statics:** 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 Different Final Forms and Word Statements, Conditions at a Boundary Surface, Illustrative Problems.

**UNIT III:****(9 Periods)**

**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:****(8 Periods)**

**Transmission Lines - I:** Types, Parameters, T & n 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:**

**(8 Periods)**

**Transmission Lines – II:** Input Impedance Relations, Reflection Coefficient, VSWR, Average Power, Shorted Lines, Open Circuited Lines, and Matched Lines, Smith Chart – Construction and Applications, Quarter wave transformer, Single Stub Matching, Illustrative Problems.

**Total Periods: 45**

**TEXT BOOKS:**

1. Matthew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 4<sup>th</sup> Edition, 2008.
2. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, PHI, 2<sup>nd</sup> Edition, 2000

**REFERENCES:**

1. G. S. N. Raju, Electromagnetic Field Theory and Transmission Lines, Pearson Education, 2<sup>nd</sup> Edition, 013.
2. William H. Hayt Jr. and John A. Buck, Engineering Electromagnetics, Tata McGraw Hill, 7<sup>th</sup> Edition, 2006.
3. John D. Krauss, Electromagnetics, McGraw Hill, 3<sup>rd</sup> Edition, 1988.
4. John D. Ryder, Networks, Lines, and Fields, PHI publications, 2<sup>nd</sup> Edition, 2012.

## II Year B.Tech. ECE – II Semester

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**(CS23AES301) DESIGN THINKING AND INNOVATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Familiarize students with design thinking process as a tool for breakthrough innovation.
- Equip students with design thinking skills and ignite their minds to create innovative ideas, develop solutions for real-time problems.

**COURSE OUTCOMES:**

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

- CO 1:** Define the concepts related to design thinking.
- CO 2:** Explain the fundamentals of Design Thinking and innovation.
- CO 3:** Apply the design thinking techniques for solving problems in various sectors.
- CO 4:** Analyze to work in a multidisciplinary environment.
- CO 5:** Evaluate the value of creativity.
- CO 6:** Formulate specific problem statements of real-time issues.

**UNIT I:****(2 Periods)**

**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:****(2 Periods)**

**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, customer, journey map, brainstorming, product development.

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

**UNIT III:****(4 Periods)**

**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:****(3 Periods)**

**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 modeling, how to set specifications, explaining their own product design.

**UNIT V:****(4 Periods)**

**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.

**Total Periods: 15**

**TEXT BOOKS:**

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

**REFERENCES:**

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

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/110/106/110106124/>
2. <https://nptel.ac.in/courses/109/104/109104109/>
3. [https://swayam.gov.in/nd1\\_noc19\\_mg60/preview](https://swayam.gov.in/nd1_noc19_mg60/preview)

## II Year B.Tech. ECE – II Semester

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**(EC23APC404) ANALOG AND DIGITAL COMMUNICATIONS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- 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.

**COURSE OUTCOMES:**

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

- CO 1:** Know about the usage of equipment/components/software tools used to conduct experiments in analog and digital modulation techniques.
- CO 2:** 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.
- CO 3:** Analyze the performance of a given modulation scheme to find the important metrics of the system theoretically.
- CO 4:** Compare the experimental results with that of theoretical ones and infer the conclusions.

**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. Frequency Division Multiplexing
4. FM Modulation and Demodulation
5. Radio receiver measurements
6. PAM Modulation and Demodulation
7. PWM Modulation and Demodulation
8. PPM Modulation and Demodulation

**Section-B**

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

## II Year B.Tech. ECE – II Semester

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**(EC23APC405) ELECTRONIC CIRCUIT ANALYSIS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Plot the characteristics of Differential amplifiers, feedback and power amplifiers.
- Analyze the response of tuned amplifiers and multivibrators.
- Categorize different oscillator circuits based on the application.
- Design the electronic circuits for the given specifications and for a given application.

**COURSE OUTCOMES:**

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

- CO 1:** Evaluate gain and bandwidth of multistage amplifiers from its frequency response.
- CO 2:** Analyze the operation of different feedback amplifiers and oscillators.
- CO 3:** Evaluate the efficiency of power amplifiers.
- CO 4:** Compute the resonant frequency of tuned amplifiers.
- CO 5:** Simulate electronic circuits by using appropriate simulation software.

**LIST OF EXPERIMENTS:**

1. Design and Analysis of Darlington pair.
2. Frequency response of CE – CC multistage Amplifier.
3. Design and Analysis of Cascode Amplifier.
4. Frequency Response of Differential Amplifier
5. Design and Analysis of any two topologies of feedback amplifies and find the frequency response of it.
6. Design and Analysis of Class A power amplifier.
7. Design and Analysis of Class AB amplifier.
8. Design and Analysis of RC phase shift oscillator.
9. Design and Analysis of LC Oscillator
10. Frequency Response of Single Tuned amplifier
11. Design a Bistable Multivibrator and analyze the effect of commutating capacitors and draw the wave forms at base and collector of transistors.
12. Design an Astable Multivibrator and draw the wave forms at base and collector of transistors.
13. Design a Monostable Multivibrator and draw the input and output waveforms.
14. Draw the response of Schmitt trigger for gain of greater than and less than one

**Note:** At least **12** experiments shall be performed.

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

**II Year B.Tech. ECE – II Semester**

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**(EG23ASC401) SOFT SKILLS****COURSE OBJECTIVES:**

The objective of this course are to:

- Encourage all round development of the students by focusing on soft skills.
- Make the students aware of critical thinking and problem-solving skills.
- Enhance healthy relationship and understanding within and outside an organization.
- Function effectively with heterogeneous teams.

**COURSE OUTCOMES:**

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

- CO 1:** List out various elements of soft skills.
- CO 2:** Describe methods for building professional image.
- CO 3:** Apply critical thinking skills in problem solving.
- CO 4:** Analyze the needs of an individual and team for well-being.
- CO 5:** Assess the situation and take necessary decisions.
- CO 6:** Create a productive workplace atmosphere using social and work-life skills ensuring personal and emotional well-being

**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.

#### **TEXT 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:**

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 Maximize 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.
7. Jain Er. A. K, Bhatia, S R Pravin and Sheik A.M., Professional Communication Skills: Publisher: S Chand, Revised Edition 2014.

#### **ONLINE RESOURCES:**

1. [https://youtu.be/DUlsNJtg2L8?list=PLLy\\_2iUCG87CQhELCyvXh0E\\_y-bOO1\\_q](https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCyvXh0E_y-bOO1_q)
2. [https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel\\_j2PUy0pwjVUgj7KIJ](https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KIJ)
3. <https://youtu.be/-Y-R9hDI7IU>

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](https://onlinecourses.nptel.ac.in/noc24_hs15/preview)
9. [https://onlinecourses.nptel.ac.in/noc21\\_hs76/preview](https://onlinecourses.nptel.ac.in/noc21_hs76/preview)

## COMMUNITY SERVICE PROJECT

### Experiential learning through community engagement

#### INTRODUCTION

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development.
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will benefit with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and emerge as a socially responsible institution.

#### OBJECTIVE

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships.

The main objectives of this Course are to:

- Sensitize students to the living conditions of the people who are around them. To help students to realize the stark realities of society.
- Bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- Make students aware of their inner strength and help them to find new /out of box solutions to social problems.
- Make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- Help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

#### Implementation of Community Service Project

- Every student should put in 6 weeks for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, housewives, etc
- A logbook must be maintained by each of the students, where the activities undertaken/involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty in charge.
- An evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student. The Community Service Project should be different from the regular programs of
- NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project reports should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training.

#### Procedure

A group of students or even a single student could be assigned for a particular habitation or

village or municipal ward, as far as possible, in the near vicinity of their place of stay, to enable them to commute from their residence and return back by evening or so.

The Community Service Project is a twofold one –

- First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
- Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like
  - Agriculture Health
  - Marketing and Cooperation
  - Animal Husbandry
  - Horticulture
  - Fisheries Sericulture
  - Revenue and Survey
  - Natural Disaster Management
  - Irrigation
  - Law & Order
  - Excise and Prohibition
  - Mines and Geology
  - Energy
  - Internet
  - Free Electricity
  - Drinking Water

## **EXPECTED OUTCOMES**

### **Benefits of Community Service Project To Students**

#### **Learning Outcomes**

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
- Improved ability to understand complexity and ambiguity

#### **Personal Outcomes**

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills.

#### **Social Outcomes**

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

#### **Career Development**

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity.

#### **Relationship with the Institution**

- Stronger relationships with faculty
- Greater satisfaction with college

- Improved graduation rates

#### **Benefits of Community Service Project to Faculty Members**

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research.

#### **Benefits of Community Service Project to Colleges and Universities**

- Improved institutional commitment. Improved student retention
- Enhanced community relations

#### **Benefits of Community Service Project to Community**

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals.
- New energy, enthusiasm and perspectives applied to community Work. Enhanced community-university relations.

#### **SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT**

The following are the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions, and modifications. Colleges are expected to focus on specific local issues for this kind of project. The students are expected to carry out these projects with involvement, commitment, responsibility, and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of project. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting should be ensured.

#### **For Engineering Students**

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation

27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilization of free electricity to farmers and related issues
40. Gender ration in schooling level- observation.

**Complementing the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programs are**

**Programs for School Children**

1. Reading Skill Program (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Program on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Program on Socially relevant themes.

**Programs for Women Empowerment**

1. Government Guidelines and Policy Guidelines
2. Women's Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

**General Camps**

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti-Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

**Programs for Youth Empowerment**

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

**Common Programs**

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –

- i. Agriculture
- ii. Health
- iii. Marketing and Cooperation
- iv. Animal Husbandry
- v. Horticulture
- vi. Fisheries
- vii. Sericulture
- viii. Revenue and Survey
- ix. Natural Disaster Management
- x. Irrigation
- xi. Law & Order
- xii. Excise and Prohibition
- xiii. Mines and Geology
- xiv. Energy

### **Role of Students:**

- Students may not have the expertise to conduct all the programs on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also, with the Governmental Departments. If the program is rolled out, the District Administration could be roped in for the successful deployment of the program.
- An in-house training and induction program could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

### **Timeline for the Community Service Project Activity**

#### **Duration: 8 weeks**

#### **1. Preliminary Survey (One Week)**

- A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
- A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

#### **2. Community Awareness Campaigns (One Week)**

- Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

#### **3. Community Immersion Programme (Three Weeks)**

- **Along with the Community Awareness Programmes**, the student batch can also work with any one of the below-listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to experiential learning about the community and its dynamics. Programs could be in consonance with the Govt. Departments.

#### **4. Community Exit Report (One Week)**

- During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks' works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily logbook need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

## III Year B. Tech– I Semester

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## (CS23AES501) INTRODUCTION TO QUANTUM TECHNOLOGY AND APPLICATIONS

**COURSE OBJECTIVES:**

The objectives of the course are to:

- Introduce fundamental quantum concepts like superposition and entanglement.
- Understand theoretical structure of qubits and quantum information.
- Explore conceptual challenges in building quantum computers.
- Explain principles of quantum communication and computing.
- Examine real-world applications and the future of quantum technologies.

**COURSE OUTCOMES:**

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

- CO1:** Explain core quantum principles in a non-mathematical manner.
- CO2:** Compare classical and quantum information systems.
- CO3:** Identify theoretical issues in building quantum computers.
- CO4:** Discuss quantum communication and computing concepts.
- CO5:** Recognize applications, industry trends, and career paths in quantum technology.

**UNIT I:****(9 Periods)**

**Introduction to Quantum Theory and Technologies:** The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms, The concept of quantization: discrete energy levels, why quantum? Strategic, scientific, and technological significance, A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India's Quantum Mission, EU, USA, China

**UNIT II:****(9 Periods)**

**Theoretical Structure of Quantum Information Systems:** Qubit, Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view), Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

**UNIT III:****(9 Periods)**

**Building a Quantum Computer – Theoretical Challenges and Requirements:** Building a Quantum Computer, Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison), Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what's working and what remains elusive, The role of quantum software in managing theoretical complexities

**UNIT IV:****(9 Periods)**

**Quantum Communication and Computing – Theoretical Perspective:** Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at

Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential

**UNIT V:****(9 Periods)**

**Applications, Use Cases, and the Quantum Future:** Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, Psi Quantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race.

**Total Periods: 45****TEXT BOOKS:**

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10<sup>th</sup> Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.

**REFERENCE BOOKS:**

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
4. Alastair I.M. Rae, Quantum Physics: A Beginner's Guide, Oneworld Publications, Revised Edition, 2005.
5. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
6. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
7. Bruce Rosenblum, Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press, 2<sup>nd</sup> Edition, 2011.
8. Giuliano Benenti, Giulio Casati, Giuliano Strini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing, 2004.
9. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission, 2020.
10. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications, 2020 onward.
11. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

**ONLINE RESOURCES:**

1. [IBM Quantum Experience and Qiskit Tutorials](#)
2. [Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley](#)
3. edX – The Quantum Internet and Quantum Computers
4. [YouTube – Quantum Computing for the Determined by Michael Nielsen](#)
5. Qiskit Textbook – IBM Quantum

## III Year B. Tech– I Semester

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**(EC23APC501) ANALOG AND DIGITAL IC APPLICATIONS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp.
- Analyse linear and non-linear applications of Op-Amp.
- Gain knowledge on active filters, timers and phased locked loops.
- Understand the working of Voltage Regulators and Converters.
- Study about different types of Digital ICs and their applications.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp.
- CO 2:** Analyse linear and non-linear applications of Op-Amp.
- CO 3:** Gain knowledge on active filters, timers and phased locked loops.
- CO 4:** Understand the working of Voltage Regulators and Converters.
- CO 5:** Know about different types of Digital ICs and their applications.

**UNIT I:****(9 Periods)**

**Integrated Circuits and Operational Amplifier:** Introduction, Classification of IC's, IC chip size and circuit complexity, basic information of Op-Amp IC741 and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics - DC and AC, Features of 741 Op-Amp.

**UNIT II:****(9 Periods)**

**Linear Applications of Op-Amp:** Inverting, non-inverting, Differential amplifiers, adder, sub tractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator.

**Non-Linear Applications of Op-Amp:** Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multi vibrators, Triangular and Square waveform generators, Oscillators.

**UNIT III:****(9 Periods)**

**Active Filters:** Introduction, Butterworth filters – 1<sup>st</sup> order, 2<sup>nd</sup> order low pass and high pass filters, band pass, band reject and all pass filters.

**Timer and Phase Locked Loops:** Introduction to IC 555 timer, description of functional diagram, mono stable and a stable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL.

**UNIT IV:****(9 Periods)**

**Voltage Regulator:** Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

**D to A and A to D Converters:** Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R ladder DAC, A to D converters - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

**UNIT V:****(9 Periods)**

**CMOS Logic:** CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic.

**Combinational Logic IC's:** Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Parallel Binary Adder/ Subtractor, Magnitude Comparators.

**Sequential Logic IC's:** Familiarity with commonly available 74XX & CMOS40XX Series ICs - All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.

**Total Periods:45**

**TEXT BOOKS:**

1. D. Roy Choudhury, Shail B. Jain, Linear Integrated Circuit, New Age International Pvt. Ltd., 4th Edition, 2012, New Delhi, India
2. Floyd, Jain, Digital Fundamentals, Pearson Education, 8<sup>th</sup> Edition (2009), New Delhi.

**REFERENCES:**

1. Ramakant A. Gayakwad, OP-AMP and Linear Integrated Circuits, Prentice Hall / Pearson Education, 4<sup>th</sup> Edition (2012), New Delhi.
2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, McGraw Hill, New Delhi, 1997
3. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.

## III Year B. Tech – I Semester

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**(EC23APC502) ANTENNAS AND WAVE PROPAGATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the antennas basic terminology, radiation mechanism of antennas and dipole antennas.
- Gain knowledge on HF, VHF & UHF antennas, their operation and applications.
- Analyze the working and applications of Microwave antennas.
- Understand different techniques involved in the design of antenna arrays and antenna parameter measurements.
- Study the various types of radio wave propagation methods.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the antennas basic terminology and radiation mechanism of antennas.
- CO 2:** Gain knowledge on VHF and UHF antennas, their operation and applications.
- CO 3:** Design and analyze the working and applications of Microwave antennas.
- CO 4:** Analyze different techniques involved in the design of Antenna arrays and Antenna parameter measurements.
- CO 5:** Gain a comprehensive knowledge about the types of radio wave propagation methods.

**UNIT I:****(9 Periods)**

**Antenna Basics & Dipole Antennas:** Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Antenna Theorems. Radiation – Basic Maxwell's equations, Retarded Potential-Helmholtz Theorem, Radiation from Small Electric Dipole, Quarter wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Beam width, Natural current distributions, far fields and patterns of Thin Linear Center-fed Antennas of different lengths, Illustrative problems.

**UNIT II:****(9 Periods)**

**HF, VHF and UHF Antennas:** Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics. Log periodic Antenna, Helical Antennas-Helical Geometry, Helix modes, Practical Design considerations for Monofilar Helical Antenna in Axial and Normal Modes. Horn Antennas- Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Illustrative Problems.

**UNIT III:****(9 Periods)**

**Microwave Antennas :** Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, Impact of different parameters on characteristics, reflector antennas - Introduction, Flat sheet and corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning , Tolerances, Applications, Illustrative Problems.

**UNIT IV:****(9 Periods)**

**Antenna Arrays:** Point sources - Definition, Patterns, arrays of 2 Isotropic sources-

Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, BSAa with Non- uniform Amplitude Distributions - General considerations and Binomial Arrays, Illustrative problems.

**Antenna Measurements:** Introduction, Sources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods).

**UNIT V:****(9 Periods)**

**Wave Propagation:** Introduction, Definitions, Characterizations and general classifications, different modes of wave propagation, Ray/Mode concepts, Ground wave propagation (Qualitative treatment) - Introduction, Plane earth reflections, Space and surface waves, wave tilt, curved earth reflections, Space wave propagation - Introduction, field strength variation with distance and height, effect of earth's curvature, absorption, Super refraction, M-curves and duct propagation, scattering phenomena, tropospheric propagation, fading and path loss calculations, Sky wave propagation - Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance, Multi-HOP propagation, Energy loss in Ionosphere, Summary of Wave Characteristics in different frequency ranges, Illustrative problems.

**Total Periods:45****TEXT BOOKS:**

1. John D. Kraus, Ronald J. Marhefka and Ahmad S.Khan, Antennas and wave propagation, TMH, 4<sup>th</sup> Edition, New Delhi, 2010.
2. C.A. Balanis, Antenna Theory- Analysis and Design, John Wiley & Sons, 2<sup>nd</sup> Edition, 2001.
3. K.D. Prasad and Satya Prakashan, Antennas and Wave Propagation, Tech. India Publications, New Delhi, 2001.

**REFERENCES:**

1. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems PHI, 2<sup>nd</sup> Edition, 2000.
2. G.S.N Raju, Antenna and Wave Propagation, Pearson Education India, 3<sup>rd</sup> Edition 2009.
3. R K Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill, 2006

## III Year B. Tech – I Semester

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**(EC23APC504) MICROPROCESSORS AND MICROCONTROLLERS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the fundamental architectural concepts of microprocessors.
- Gain knowledge about assembly language programming concepts.
- Get familiar about 8086 interfacing.
- Understand the fundamentals of the 8051 Microcontroller.
- Learn interfacing with the 8051 Microcontroller.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the fundamental architectural concepts of microprocessors.
- CO 2:** Gain knowledge about assembly language programming concepts.
- CO 3:** Understand the concepts of 8086 interfacing.
- CO 4:** Learn the fundamentals of the 8051 Microcontroller.
- CO 5:** Know the interfacing with the 8051 Microcontroller.

**UNIT I:****(9 Periods)**

**8086 Architecture:** Main features, pin diagram/description, 8086 Microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

**UNIT II:****(9 Periods)**

**8086 Programming:** Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

**UNIT III:****(9 Periods)**

**8086 Interfacing:** Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

**UNIT IV:****(9 Periods)**

**Micro Controller:** Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V:****(9 Periods)**

**Interfacing Microcontroller:** - Programming 8051 Timers - Serial Port Programming - Interrupts Programming - LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

**Total Periods:45****TEXT BOOKS:**

1. Douglas V Hall, SSSP Rao, Microprocessors and Interfacing – Programming and Hardware, Tata McGraw Hill Education Private Limited, 3<sup>rd</sup> Edition, 1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, McGraw Hill Education, 3<sup>rd</sup> Edition, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson, 2<sup>nd</sup> Edition, 2012.

**REFERENCES:**

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, Penram International Publishing, 6<sup>th</sup> Edition, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, 3<sup>rd</sup> Edition, 2004.

## III Year B. Tech – I Semester

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**(EC23APE501) COMPUTER ARCHITECTURE & ORGANIZATION****(Professional Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the design of various functional units of digital computers and performance issues of computer systems.
- Understand the basic processing unit and their connections.
- Get familiar with different types of Data representation and Computer Arithmetic operations.
- Know about different types of memory and their interconnections.
- Learn the basics of parallel computing and pipelining.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the design of various functional units of digital computers and performance issues of computer systems.
- CO 2:** Understand the basic processing unit and their connections.
- CO 3:** Know about different types of Data representation and Computer Arithmetic operations.
- CO 4:** Learn about different types of memory and their interconnections.
- CO 5:** Understand the basics of parallel computing and pipelining.

**UNIT I:****(9 Periods)****Digital Computers:** Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.**Register Transfer Language 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.**Basic Computer Organization and Design:** Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.**UNIT II:****(9 Periods)****Micro Programmed Control:** Control memory, Address sequencing, micro program example, design of control unit.**Central Processing Unit:** General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.**UNIT III:****(9 Periods)****Data Representation:** Data types, Complements, Fixed Point Representation, Floating Point Representation.**Computer Arithmetic:** Addition and subtraction, multiplication Algorithms, Division Algorithms, floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.**UNIT IV:****(9 Periods)****Input-Output Organization:** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

**UNIT V:**

**(9 Periods)**

**Reduced Instruction Set Computer:** CISC Characteristics, RISC Characteristics. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Inter-processor arbitration, Inter-processor communication and synchronization, Cache Coherence.

**Total Periods:45**

**TEXTBOOK:**

1. M. Moris Mano, Computer System Architecture, Pearson/PHI ,3<sup>rd</sup> Edition.
2. William Stallings, Computer Organization and Architecture, Pearson/PHI, 6<sup>th</sup> Edition.

**REFERENCES:**

1. Car Hamacher, Zvonks Vranesic, Safea Zaky, Computer Organization, McGraw Hill, 5<sup>th</sup> Edition.
2. Andrew S. Tanenbaum, Structured Computer Organization, 4<sup>th</sup> Edition,

## III Year B. Tech – I Semester

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**(EC23APE502) DETECTION AND ESTIMATION THEORY****(Professional Elective – I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the impact of white Gaussian noise on the detection of signals.
- Analyze the detection of deterministic signals and random signals.
- Learn about the nonparametric detections.
- Analyse estimation signal parameter and apply suitable estimation techniques.
- Understand the signal estimation in Discrete-Time techniques.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the impact of white Gaussian noise on the detection of signals
- CO 2:** Analyze the detection of deterministic signals and random signals.
- CO 3:** Learn about the nonparametric detections
- CO 4:** Analyze estimation signal parameter and apply suitable estimation techniques
- CO 5:** Understand the signal estimation in Discrete-Time techniques

**UNIT I: (9 Periods)**

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

**UNIT II: (9 Periods)**

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

**Detection of Random Signals:** Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection

**UNIT III: (9 Periods)**

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

**UNIT IV: (9 Periods)**

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

**UNIT V: (9 Periods)**

**Signal Estimation in Discrete-Time:** Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

**Total Periods:45**

**TEXT BOOKS:**

1. H. L. Van Trees, Detection, Estimation and Modulation Theory: Part I, II, and III, John Wiley, NY, 1968.
2. H. V. Poor, An Introduction to Signal Detection and Estimation, Springer, 2<sup>nd</sup> Edition, 1998.

**REFERENCES**

1. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall PTR, 1993.
2. S. M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Prentice Hall PTR, 1998.

## III Year B. Tech – I Semester

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**(EC23APE503) INFORMATION THEORY AND CODING****(Professional Elective–I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide an insight into the concept of information in the context of communication theory and communication receivers.
- Implement various source coding algorithms and analyze their performance.
- Gain knowledge about techniques for error detection and error correction.
- Design linear block codes and cyclic codes.
- Get familiar with various convolutional codes.

**COURSE OUTCOMES:**

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

**CO 1:** Learn the concepts of information in the context of communication theory and communication receivers.

**CO 2:** Implement various source coding algorithms and analyze their performance

**CO 3:** Gain knowledge about techniques for error detection and error correction.

**CO 4:** Design linear block codes and cyclic codes.

**CO 5:** Understand various convolutional codes.

**UNIT I:****(9 Periods)**

**Information Theory:** Introduction, Definition of Entropy, Conditional Entropy, Relative Entropy, Basic Properties of Entropy, Mutual Information, Information Inequalities, Problem solving.

**Block to Variable Length Coding:** Prefix-free Code, Coding a single Random Variable, Prefix, Free Code, Kraft Inequality, Bounds on optimal Code length, Coding a Single Random Variable, Rooted Tree with Probabilities, Shanon-Fano Coding, Free fix code, Coding an information Source, Huffman Coding, Example.

**Variable to Block Length Coding:** Proper message set, Assigning probabilities to K-ary rooted tree corresponding to a proper message set, Prefix free Coding of a proper message set, Tunstall message set, Tunstall coding.

**UNIT II:****(9 Periods)**

Asymptotic Equi-partition Property, Chebyshev inequality, Weak law of large numbers, Typical Sequences, Block to Block Coding of DMS: Consequences of Asymptotic Equipartition Property, Problem solving.

**Universal Source Coding:** Lempel-Ziv Algorithm, LZ -77 Encoding and Decoding, Lempel-Ziv Welch (LZW) Algorithm, LZW Encoding, and Decoding.

Coding of Sources with memory, Channel Capacity, Noisy Channel Coding Theorem, Differential Entropy, Gaussian Channel, Rate Distortion Theory, Blahut - Arimoto Algorithm, problem solving.

**UNIT III:****(9 Periods)**

**Error Control Coding:** Introduction to Error Control Codes, Error Probability with Repetition in the Binary Symmetric Channel, Parity Check Bit Coding for Error Detection, Block Coding for Error Detection and Correction, The Hamming Distance, The upper bound of the Probability of Error with Coding, Soft Decision Decoding, Hard Decision Decoding.

**UNIT IV:****(9 Periods)**

**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Encoding Block Codes, Decoding of Block Codes, Single Parity Check bit Code, Repeated Codes, Hadamard Code, Hamming Code, Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Encoding and Decoding of Cyclic Codes, BCH codes, Reed-Solomon Code.

**UNIT V:**

**(9 Periods)**

Convolutional Coding, Code Generation, Decoding Convolutional Code, the Code Tree, Decoding in the presence of Noise, State and Trellis Diagrams, The Viterbi Algorithm, Comparison of Error Rates in Coded and Uncoded Transmission, Turbo Codes, LDPC codes, Hard and Soft Decision Decoding.

**Total Periods:45**

**TEXT BOOKS:**

1. Thomas M.Cover, Joy A. Thomas, Elements of Information Theory, John Wiley & Sons, 2<sup>nd</sup> Edition, 2006.
2. Herbert Taub, Donald L Shilling, Goutam Saha, Principles of Communication Systems, 4<sup>th</sup> Edition, McGraw Hill, 2017.

**REFERENCES:**

1. Shu Lin, Daniel J. Costello Jr., Error Control Coding, Pearson, 2<sup>nd</sup> Edition, 2013.
2. Simon Haykin, Communication Systems, John Wiley, 4<sup>th</sup> Edition, 2010.

## III Year B. Tech – I Semester

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**(BA23AOE501) ENTREPRENEURSHIP AND VENTURE CREATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership
- Encourage creativity and innovation
- Enable them to learn pitching and presentation skills
- Make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept
- Enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Persona

**COURSE OUTCOMES:**

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

- CO 1:** Develop an entrepreneurial mind set and appreciate the concept of entrepreneurship.
- CO 2:** Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution
- CO 3:** Understand and apply customer-centric innovation by designing solutions aligned with Jobs-to-be-Done, developing MVP prototypes, assessing competitive positioning, and evaluating market size and opportunity potential.
- CO 4:** Develop and apply comprehensive business and financial models, go-to-market strategies, and funding plans by leveraging lean methodologies, financial planning, marketing, and sales fundamentals tailored to startup growth.
- CO 5:** Prepare and deliver an investible pitch deck of the impractical venture to attract stakeholders

**UNIT I:****(7 Periods)**

**Entrepreneurship Fundamentals and context:** Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus

**UNIT II:****(8 Periods)**

**Problem & Customer Identification:** Understanding and analyzing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion-identifying and defining problem using Design thinking principles -Analyzing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

**UNIT III:****(10 Periods)**

**Solution design, Prototyping & Opportunity Assessment and Sizing:** Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

**UNIT IV:****(11 Periods)**

**Business & Financial Model, Go-to-Market Plan:** Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure - Lean approach.

**Business Planning:** components of Business plan- Sales plan, People plan and financial plan.

**Financial Planning:** Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance.

**Introduction to Marketing and Sales:** Selecting the Right Channel, creating digital presence, building customer acquisition strategy.

Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Life-cycle to Funding Options.

#### **UNIT V:**

**(9 Periods)**

**Scale Outlook and Venture Pitch Readiness:** Understand and identify potential and aspiration for scale vis-a-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

**Total Periods: 45**

#### **TEXT BOOKS:**

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha Entrepreneurship, McGrawHill, 11<sup>th</sup> Edition, 2020
2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business, 2011.
3. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons, 2010.

#### **REFERENCES:**

1. Simon Sinek, Start with Why, Penguin Books limited, 2011
2. Brown Tim, Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business, 2019
4. Namita Thapar, The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited, 2022
5. Saras D. Sarasvathy, Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd., 2008

## III Year B. Tech – I Semester

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**(EC23APC506) ANALOG & DIGITAL IC APPLICATIONS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Design an Inverting and Non-inverting Amplifier using an Op Amp.
- Demonstrate the Linear and Non-Linear Applications using IC 741.
- Design Astable and Monostable Multivibrator using timer ICs.
- Analyse the Digital to Analog and Analog to Digital Converters.
- Design Counters and Registers using digital ICs.

**COURSE OUTCOMES:**

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

- CO 1:** Design an Inverting and Non-inverting Amplifier using an Op Amp.
- CO 2:** Demonstrate the Linear and Non-Linear Applications using IC 741.
- CO 3:** Design Astable and Monostable Multivibrator using timer ICs.
- CO 4:** Analyse the DAC and ADC converter.
- CO 5:** Design Counters and Registers using digital ICs.

**LIST OF EXPERIMENTS:**

1. Design an Inverting and Non-inverting Amplifier using Op Amp and calculate gain.
2. Design Adder and Subtractor using Op Amp and verify addition and subtraction process.
3. Design a Comparator using Op Amp and draw the comparison results of  $A=B$ ,  $A>B$ ,  $A<B$
4. Design an Integrator and Differentiator Circuits using IC741 and derive the required condition practically.
5. Design an Active LPF, HPF with a cutoff frequency of 2 KHZ and find the roll off of it.
6. Design a Circuit using IC741 to generate sine/square/triangular wave with Frequency of 1KHZ and draw the output waveform.
7. Construct Mono-stable Multivibrator using IC 555 and draw its output waveform.
8. Construct Astable Multivibrator using IC 555 and draw its output waveform and also find its duty cycle.
9. Design a Schmitt Trigger Circuit and find its LTP and UTP.
10. Design Voltage Regulator using IC723, IC 7805/7809/7912 and find its load regulation factor.
11. Design R-2R ladder DAC and find its resolution and write a truth table with respective voltages.
12. Design Parallel comparator type/ counter type/ successive approximation ADC and find its efficiency.
13. Design 8x1 multiplexer using digital ICs.
14. Design 4-bit Adder/Subtractor using digital ICs
15. Design a Decade counter and verify its truth table and draw respective waveforms.
16. Design an Up/down counter using IC 74163 and draw read/write waveforms.
17. Design Universal shift register using IC 74194/195 and verify its shifting operation.
18. Design 8x3 encoder/3x8 decoder and verify its truth table.

**NOTE: At least 8 Linear and 4 Digital IC experiments shall be performed.**

**III Year B. Tech – I Semester**

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**(EC23APC507) MICROPROCESSORS AND MICROCONTROLLERS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- To become skilled in 8086 Assembly Language programming.
- To understand the detailed software and hardware structure of the microprocessor.
- Train their practical knowledge through laboratory experiments.
- To understand and learn 8051 Microcontroller.
- To acquire knowledge on microprocessors and microcontrollers, interfacing various peripherals, and configuring.

**COURSE OUTCOMES:**

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

- CO 1:** Formulate a program and implement algorithms using Assembly language.
- CO 2:** Describe an Assembly language program for the 8086 Microprocessor.
- CO 3:** Develop programs for different applications in the 8086 Microprocessor.
- CO 4:** Interface peripheral devices with 8086 and 8051.
- CO 5:** Use an Assembly/Embedded C programming approach for solving real-world problems.

**LIST OF EXPERIMENTS:**

- 1. Programs for 16 Bit Arithmetic Operations** (Using various addressing modes)
  - a) Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
  - b) Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
  - c) Write an ALP to find square, cube and factorial of a given number.
- 2. Programs Involving Bit Manipulation Instructions**
  - a) Write an ALP to find the given data is positive or negative.
  - b) Write an ALP to find the given data is odd or even.
  - c) Write an ALP to find Logical ones and zeros in a given data.
- 3. Programs on Arrays for 8086**
  - a) Write an ALP to find Addition/subtraction of N no's.
  - b) Write an ALP for finding largest/smallest no.
  - c) Write an ALP to sort given array in Ascending/descending order.
- 4. Programs on String Manipulations for 8086**
  - a) Write an ALP to find String length.
  - b) Write an ALP for Displaying the given String.
  - c) Write an ALP for Comparing two Strings.
  - d) Write an ALP to reverse String and Checking for palindrome.
- 5. Programs for Digital Clock Design Using 8086**
  - a) Write an ALP for Designing clock using INT 21H Interrupt.
  - b) Write an ALP for Designing clock using DOS Interrupt Functions.
  - c) Write an ALP for Designing clock by reading system time.
- 6. Interfacing Stepper Motor with 8086**
  - a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosing variable step-size.
  - b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.

**7. Interfacing ADC/DAC with 8086**

- a) Write an ALP to 8086 processor to Interface ADC.
- b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Stepsignal.

**8. Communication between Two Microprocessors**

- a) Write an ALP to have Parallel communication between two microprocessors using 8255
- b) Write an ALP to have Serial communication between two microprocessor kits using 8251.

**9. Programs using Arithmetic and Logical Instructions for 8051**

- a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction,
- b) Multiplication and Division.
- c) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.
- d) Programs related to Register Banks.

**10. Programs to Verify Timers/Counters of 8051**

- a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
- b) Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.
- c) Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.
- d) Write a program to create a delay of 80 µsec using counter1 in mode 1 and blink all the Pins of P3.

**11. UART Operation in 8051**

- a) Write a program to transfer a character serially with a baud rate of 9600 using UART.
- b) Write a program to transfer a character serially with a baud rate of 4800 using UART.
- c) Write a program to transfer a character serially with a baud rate of 2400 using UART.

**12. Interfacing LCD with 8051**

- a) Develop and execute the program to interface 16\*2 LCD to 8051.
- b) Develop and execute the program to interface LCD to 8051 in 4-bit or 8-bit mode.

**NOTE:** Any **TEN** of the experiments are to be conducted

**REFERENCES:**

1. Kenneth. J. Ayala, The 8051 microcontroller, 3<sup>rd</sup> Edition, Cengage learning, 2010.
2. A.K ray and K.M. Bhurchandani, Advanced microprocessors and peripherals, TMH, 2<sup>nd</sup> Edition 2006.
3. Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems: Using Assembly and C , Janice Gillispie Mazidi, 2<sup>nd</sup> Edition.

## III Year B. Tech – I Semester

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**(EC23ASC501) PCB DESIGN AND PROTOTYPE DEVELOPMENT****COURSE OBJECTIVES:**

The objectives of this course are to:

- Identifying Electronic Components Symbols & Footprints.
- Analyse the capability to produce PCBs of their circuit.
- Effectively use the design rules & interfacing between schematic & PCB.

**COURSE OUTCOMES:**

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

- CO 1:** Students can design a schematic of their circuit.
- CO 2:** Students can design PCB layout of their design.
- CO 3:** Detailed description and practical of PCB designing.

**UNIT I:**

**Fundamental of basic electronics:** Component identification, Component symbols & their footprints, understand schematic, creating new PCB, browsing footprints libraries, Setting up the PCB layers, Design rule checking, Track width selection, Component selection, Routing and completion of the design

**UNIT II:**

**Introduction to PCB:** Definition and Need/Relevance of PCB, Background and History of PCB, Types of PCB, Classes of PCB Design, Terminology in PCB Design, Different Electronic design automation (EDA)tools and comparison.

**UNIT III:**

**PCB Design Process:** PCB Design Flow, Placement and routing, Steps involved in layout design, Artwork generation Methods - manual and CAD, General design factors for digital and analogue circuits, Layout and Artwork making for Single-side, double-side and Multilayer Boards, Design for manufacturability, Design-specification standards.

**Practice Exercises: Any twelve experiments are to be done**

1. Practice following PCB Design steps
  - Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, Netlist generation.
  - Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic.
  - Create new schematic components.
  - Create new component footprints.
2. Regulator circuit using 7805
3. Inverting Amplifier or Summing Amplifier using op-amp
4. Full-wave Rectifier
5. Astable multi vibrator using IC555
6. Mono stable multi vibrator using IC555
7. RC Phase - shifter oscillator using transistor.
8. Wein-bridge Oscillator using op- amp
9. Full-Adder using half-adders.
10. 4-bit binary /MOD N counter using D-Flip flops.
11. One open-ended (analog/ digital/mixed circuit) experiments of similar nature and magnitude to the above are to be assigned by the teacher (Student is expected to solve and execute/simulate independently).

12. Design an 8051 Development board having Power section consisting of IC7805, capacitor, resistor, headers, LED.
13. Design an 8051 Development board having Serial communication section consisting of MAX 232, Capacitors, DB9connector, Jumper, LEDs
14. Design an 8051 Development board having Reset & Input/output sections consisting of 89C51 Microcontroller, Electrolytic Capacitor, Resistor, Jumper, Crystal Oscillator, Capacitors
15. Fabricate a single-sided PCB, mount the components and assemble them in a cabinet for any one of the circuits mentioned in the above exercises.

**REFERENCES:**

1. Jon Varteresian, Fabricating Printed Circuit Boards, z, 2002
2. R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill 2001
3. C. Robertson. PCB Designer 's Reference. Prentice Hall, 2003
4. Open-source EDA Tool KiCad Tutorial: <http://kicad-pcb.org/help/tutorials/> 13. PCB

**FABRICATION USER GUIDE PAGE:**

<http://www.wikihow.com/Create-Printed-Circuit-Boards>

[http://www.siongboon.com/projects/2005-09-07\\_home\\_pcb\\_fabrication/](http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/)

[http://reprap.org/wiki/MakePCBInstructions#Making\\_PCBs\\_yourself](http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself)

PCB Fabrication at home(video): <https://www.youtube.com/watch?v=mv7Y0A9YeUc>,

<https://www.youtube.com/watch?v=imQTCW1yWkg>

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**(EC23ACS501) COMMUNITY SERVICE PROJECT INTERNSHIP****COURSE DESCRIPTION:**

The Community Service Project (CSP) is an experiential learning strategy that integrates meaningful community service with academic instruction, active participation, and real-life problem-solving. It provides students with opportunities to engage in community development activities, apply their classroom knowledge in real-world contexts, and reflect on their learning for both personal and academic growth.

The initiative is designed to foster a strong linkage between the college and the community for mutual benefit. While communities benefit from the focused contributions of students toward local/village development, colleges gain the opportunity to instill in students a sense of social sensitivity, responsibility, and accountability—thus positioning themselves as socially responsible institutions.

CSP also serves as an effective alternative to summer internships, apprenticeships, or on-the-job training in situations where students cannot pursue those options. By immersing students in societal realities, the project enhances their holistic development, cultivates leadership qualities, and strengthens their commitment to inclusive growth and sustainable development

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Develop understanding of societal structures, cultural practices, traditions, habits, lifestyles, resource utilization, wastage management, social problems, public administration system and the roles and responsibilities of different persons across different social systems, enabling students to analyze the living conditions, challenges, and aspirations of communities.
- Enhance students' abilities in analyzing societal problems, designing and implementing innovative solutions, applying problem-solving techniques, using appropriate tools and technologies, managing projects and resources effectively, communicating professionally, and working efficiently both individually and in teams while engaging in community development activities in coordination with local communities, public agencies, and government authorities.
- Cultivate social responsibility, empathy, ethical awareness, societal consciousness, and accountability, fostering holistic perspectives and empowering students to address societal challenges responsibly and creatively.

**COURSE OUTCOMES:**

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

- CO 1:** Create engineering solutions or processes to address complex societal problems by applying modern tools, relevant codes, standards, policies, and emerging developments.
- CO 2:** Evaluate environmental, sustainability, ethical, and economic aspects with project management principles to formulate impactful community interventions.
- CO 3:** Demonstrate teamwork, leadership, and effective communication (written, oral, graphical) while executing and reflecting on community service projects.

## III Year B. Tech – II Semester

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**(EC23APC601) DIGITAL SIGNAL PROCESSING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Get familiar with the properties of discrete time signals, systems and z-transform.
- Learn the importance of FFT algorithm for computation of Discrete Fourier Transform and Fast Fourier Transform with decimations.
- Understand the implementations of digital filter structures.
- Analyse the FIR filter design using Fourier series and windowing methods.
- Gain the knowledge on Programmable DSP Devices.

**COURSE OUTCOMES:**

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

**CO 1:** Familiar with the properties of discrete time signals, systems and z-transform

**CO 2:** Learn the importance of FFT algorithm for computation of Discrete Fourier transform and Fast Fourier Transform with decimations.

**CO 3:** Understand the implementations of digital filter structures.

**CO 4:** Analyse the FIR filter design using Fourier series and windowing methods

**CO 5:** Gain the knowledge on Programmable DSP Devices.

**UNIT I:****(9 Periods)**

**Introduction to Discrete time signals and systems:** Introduction to digital signal processing, Review of discrete-time signals and systems, Analysis of discrete-time linear time invariant systems, frequency domain representation of discrete time signals and systems

**Z-Transform:** Definition, ROC, Properties, Poles and Zeros in Z-plane, the inverse Z-Transform, System analysis, Transfer function, BIBO stability, System Response to standard signals, Solution of difference equations with initial conditions, Illustrative Problems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.

**UNIT II:****(9 Periods)**

**Discrete Fourier Transform:** Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT, properties of DFT, Linear and Circular convolution, convolution using DFT, sampling, Quantization effects.

**Fast Fourier Transform:** Introduction, Fast Fourier Transform, Radix-2 Decimation in time and Decimation in frequency FFT, Inverse FFT (Radix-2).

**UNIT III:****(9 Periods)**

**IIR Filters:** Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformations, Basic structures of IIR Filters - Direct form-I, Direct form-II, Cascade form and Parallel form realizations.

**UNIT IV:****(9 Periods)**

**FIR Filters:** Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular, Triangular, Raised Cosine, Hanning, Hamming, Blackman), Comparison of IIR & FIR filters, Basic structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

**UNIT V:****(9 Periods)**

**Architectures for Programmable DSP Devices:** Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers,

program controller, some flags in the status registers, On- chip memory, On-chip peripherals.

**Total Periods:45**

**TEXTBOOKS:**

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing, PHI.

**REFERENCES:**

1. S.K.Mitra, Digital Signal Processing – A practical approach, 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2004.
2. MH Hayes, Digital Signal Processing, Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab, Thomson, 2007.

## III Year B. Tech – II Semester

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**(EC23APC602) MICROWAVE AND OPTICAL COMMUNICATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Analyse different modes of operation in rectangular wave guides, circular wave guides and resonators.
- Study and analyse various microwave components and microwave sources.
- Gain knowledge on different microwave semiconductor devices and microwave measurements procedures.
- Analyse different optical Fiber modes and to study different types of distortions and losses in optical communication.
- Study various optical sources, optical detectors and to analyze various optical links.

**COURSE OUTCOMES:**

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

- CO 1:** Analyze different modes of operation in rectangular wave guides, circular waveguides and resonators.
- CO 2:** Understand and analyze various microwave components and microwave sources
- CO 3:** Gain knowledge on different microwave semiconductor devices and microwave measurements procedures
- CO 4:** Analyze different optical Fiber modes and to study different types of distortions and losses in optical communication
- CO 5:** Understand sstudy various optical sources, optical detectors and to analyze various optical links.

**UNIT I:****(9 Periods)**

**Waveguides:** Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes (**Qualitative treatment only**), Wave propagation, Cavity resonators (**Qualitative treatment only**).

**UNIT II:****(9 Periods)**

**Passive Microwave Devices:** Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Directional Couplers – Bethe hole and Two hole Couplers, Deriving Scattering matrix for Microwave passive devices. Microwave propagation in Ferrites, Gyator, Isolator, Circulator.

**Microwave Amplifiers and Oscillators:** Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process (**Qualitative treatment only**). Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition.

**UNIT III:****(9 Periods)**

**Microwave Semiconductor Devices:** Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.

**Microwave Measurements:** Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of 'Q' of a cavity, Impedance measurements.

**UNIT IV:****(9 Periods)**

**Introduction to Optical Fibers and Transmission Characteristics** - The propagation of

light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes, Attenuation: Absorption, Scattering, Bending losses. Modal dispersion and chromatic dispersion – Single mode fiber - waveguide dispersion– MFD – PMD

**UNIT V:**

**(9 Periods)**

**Optical Transmitters and Receivers:** Optical Sources: - Light source materials – LED homo and hetero structures – surface and edge emitters – Quantum efficiency – Injection Laser Diode – Modes and threshold condition – Structures and Radiation Pattern. Optical detectors: – Physical principles – PIN and APD diodes – Photo detector noise

**Optical Link Design:** Point- to- point links – System considerations – Link Power budget – Rise time budget.

**Total Periods:45**

**TEXT BOOKS:**

1. David M. Pozar, Microwave Engineering, John Wiley & Sons, Inc. 4<sup>th</sup> edition, 2012
2. Samuel Y. Liao, Microwave Devices and Circuits, PHI publications, 3<sup>rd</sup> Edition, 1997.
3. Gerd Keiser, Optical Fiber Communications, McGraw Hill, 3<sup>rd</sup> Edition, 2000.

**REFERENCES:**

1. R. E. Collin, Foundations for Microwave Engineering, Wiley Student Edition, 2<sup>nd</sup> Edition, 2009.
2. Om.P.Ga ndhi, Microwave: Engineering and Applications, Kai Fa Book Company, 1981.
3. Reich H. J., et al, Microwave Principles, MIT Press, 1972.
4. F E Terman, Electronic and Radio Engineering, McGraw Hill, 4<sup>th</sup> Edition, 1984

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**(EC23APC603) VLSI DESIGN****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the steps involved in fabrication of ICs using MOS transistor Technology.
- Learn about the VLSI design processes, Stick diagrams and Layouts.
- Gain knowledge on the Gate Level Design concepts.
- Learn the design of various subsystems with different VLSI Design styles.
- Get familiar with CMOS testing techniques.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the steps involved in fabrication of ICs using MOS transistor technology.
- CO 2:** Learn about the VLSI design processes, Stick diagrams and Layouts.
- CO 3:** Gain knowledge on the Gate Level Design concepts.
- CO 4:** Learn the design of various subsystems with different VLSI Design styles.
- CO 5:** Familiar with CMOS testing techniques.

**UNIT I:****(9 Periods)**

**Introduction:** Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. Basic Electrical Properties of MOS and BiCMOS Circuits:  $I_{DS}$ - $V_{DS}$  relationships, MOS transistor Threshold Voltage, figure of merit, Transconductance, Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters

**UNIT II:****(9 Periods)**

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda( $\lambda$ )-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

**UNIT III:****(9 Periods)**

**Gate Level Design:** Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance  $R_s$  and its concepts to MOS, Area Capacitances calculations, Inverter Delays, driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out

**UNIT IV:****(9 Periods)**

**Subsystem Design:** Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

**UNIT V:****(9 Periods)**

**CMOS Testing:** Need for testing, Design for testability - built in self-test (BIST)-testing combinational logic -testing sequential logic - practical design for test guide lines - scan design techniques.

**Total Periods:45****TEXT BOOKS:**

1. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, Eshraghian Douglas, A.Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3 Ed., 1997, Pearson Education.

**REFERENCES:**

1. CMOS VLSI Design-A Circuits and Systems Perspective, Neil H.E Weste, David Harris, Ayan Banerjee, 3<sup>rd</sup> Edition, Pearson, 2009.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2003.
3. Jan M. Rabaey, Digital Integrated Circuits, Anantha Chandrakasan and Borivoje Nikolic, Prentice-Hall of India Pvt.Ltd, 2<sup>nd</sup> Edition, 2009.

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**(EC23APE601) CELLULAR AND MOBILE COMMUNICATIONS**  
**(Professional Elective – II)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Explain the basic cellular system and its working.
- Understand the impact of multipath fading channels and techniques to mitigate fading effects in cellular communication.
- Explore frequency management, channel assignment strategies, and different types of handoffs in cellular networks.
- Analyze the performance of mobile antennas, interference issues, and cellular system design principles.
- Evaluate system performance metrics such as dropped call rates, handoff strategies, and spectrum efficiency

**COURSE OUTCOMES:**

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

- CO 1:** Understand the basic cellular system and its working.
- CO 2:** Explain the impairments caused by multipath fading and methods to fading effects in mobile communication.
- CO 3:** Apply concepts of cellular communication to solve problems related to mobile antennas and system design.
- CO 4:** Analyze co-channel and non-co-channel interferences, different types of handoffs, and dropped call rates.
- CO 5:** Evaluate the performance of cellular systems, including signal reception, handoff efficiency, and spectrum utilization.

**UNIT I: (9 Periods)**

**Cellular Mobile Radio Systems:** Introduction to Cellular Mobile system, basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems.

**UNIT II: (9 Periods)**

**Elements of Cellular Radio System Design:** General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, Cell splitting, consideration of the components of cellular system.

**Interference:** Introduction to Co-channel interference, real time co-channel interference, Co-channel measurement, design of Antenna system, Antenna parameters and their effects, diversity receiver, non-co-channel interference-different types.

**UNIT III: (9 Periods)**

**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 antenna height gain, form of a point-to-point model.

**UNIT IV: (9 Periods)**

**Cell Site and Mobile Antennas:** Sum and difference patterns and their synthesis, Omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain 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: (9 Periods)**

**Handoff:** Handoff, dropped calls and cell splitting, types of handoffs, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation.

**System Evaluations:** Performance evaluation, Signal evaluation, Measurement of average received level and level crossings, Spectrum efficiency evaluation.

**Total Periods:45**

**TEXT BOOKS:**

1. W.C.Y. Lee, Mobile cellular telecommunications, Tata Mc-Graw Hill, 2<sup>nd</sup> Edition, 2006.
2. Theodore. S. Rapport, Wireless communications, Pearson Education, 2<sup>nd</sup> Edition, 2002.

**REFERENCES:**

1. Gordon L. Stuber, Principles of Mobile communications, Springer International 2<sup>nd</sup> Edition, 2007.
2. Lee, Wireless and Mobile Communications, Mc Graw Hills, 3<sup>rd</sup> Edition, 2006.
3. Jon W.Mark and WeihuaZhqung, Wireless communications and Networking, PHI, 2005.
4. R.Blake, Wireless communication Technology, Thompson Asia Pvt.Ltd., 2004.

III Year B. Tech – II Semester

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**(EC23APE602) ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**  
**(Professional Elective – II)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Know about the performance characteristics of instruments and measurement of electrical quantities.
- Understand the construction, working and applications of different types of CRO's.
- Analyze the working of different types of bridges.
- Study the working of signal & function generators and analyzers.
- Analyze the working of sensors and transducers in measuring physical parameters.

**COURSE OUTCOMES:**

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

- CO 1:** Understand and analyze the performance characteristics of instruments.  
**CO 2:** Demonstrate the use of Understand the construction, working and applications of different types of CRO's.  
**CO 3:** Compare the working of different types of bridges.  
**CO 4:** Know the working of signal & function generators and analyzers.  
**CO 5:** Grasp the working of sensors and transducers in measuring physical parameters.

**UNIT I: (9 Periods)**

**Performance Characteristics of Instruments:** Static characteristics, Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics-speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters-multirange, range extension/solid state and differential voltmeters, AC voltmeters-multirange, range extension. Thermocouple type RF ammeter, ohm meters, series type, shunt type, multimeter for voltage, current and resistance measurements.

**UNIT II: (9 Periods)**

**Oscilloscopes:** Introduction, Basic Principle, Standard specifications of CRO, CRT features, vertical and horizontal amplifiers, horizontal and vertical deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive, and attenuator type, triggered sweep CRO, and Delayed sweep, dual trace/beam CRO, Measurement of amplitude, frequency and phase (Lissajous method). Principles of sampling oscilloscope, storage oscilloscope, and digital storage oscilloscope, Digital frequency counters, time & Period measurements.

**UNIT III: (9 Periods)**

**Bridges:** DC Bridges for Measurement of resistance: Wheat stone bridge, Kelvin's Bridge, AC Bridges for Measurement of inductance- Maxwell's bridge, Hay's Bridge, Anderson bridge. Measurement of capacitance- Schearing Bridge, Wien Bridge. Errors and precautions in using bridges.

**UNIT IV: (9 Periods)**

**Signal Generators:** Signal generator-fixed and variable, AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach) Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, and Logic analyzers.

**UNIT V: (9 Periods)**

**Sensors and Transducers** - Active and passive transducers: Measurement of

displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples and thermistors), Velocity, Acceleration, Vibration, pH measurement Signal Conditioning Circuits.

**Introduction to Advanced Sensors:** Bio Medical Sensors (Heart rate and body temperature sensors).

**Total Periods:45**

**TEXT BOOKS:**

1. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 5<sup>th</sup> Edition, PHI, 2002.
2. H.S.Kalsi, "Electronic Instrumentation", 2<sup>nd</sup> Edition, Tata McGraw Hill, 2004.

**REFERENCES:**

1. David A. Bell, Electronic Instrumentation & Measurements, 2<sup>nd</sup> Edition, PHI, 2003.
2. K. Lal Kishore, "Electronic Measurements & Instrumentations", Pearson Education,2009.

## III Year B. Tech – II Semester

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**(EC23APE604) SPEECH PROCESSING****(Professional Elective – II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Impart knowledge on anatomy and physiology of speech organs and the process of Speech Production.
- Understand the methods for extracting of speech using Time domain parameters.
- Learn the Frequency Domain Methods for Speech Processing.
- Interpret and analyze LPC Parameters for Speech Processing.
- Introduce the concepts of homomorphic Speech Processing.

**COURSE OUTCOMES:**

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

- CO 1:** Gain knowledge on anatomy and physiology of speech organs and the process of Speech production.
- CO 2:** Understand the methods for extracting of speech using Time domain parameters.
- CO 3:** Learn the Frequency Domain Methods for Speech Processing.
- CO 4:** Interpret and analyze LPC Parameters for Speech Processing.
- CO 5:** Grasp the concepts of homomorphic Speech Processing.

**UNIT I:****(9 Periods)**

**Fundamentals of Digital Speech Processing:** Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production – Uniform lossless tube model, effect of losses in vocal tract and radiation at lips, Digital models for speech signals.

**UNIT II:****(9 Periods)**

**Time Domain Methods for Speech Processing:** Time domain parameters of speech, methods for extracting the parameters: Zero crossings, Auto-correlation function, pitch estimation.

**UNIT III:****(9 Periods)**

**Frequency Domain Methods for Speech Processing:** Short time Fourier analysis, Filter bank analysis, Spectrographic analysis, Formant extraction, Pitch extraction.

**UNIT IV:****(9 Periods)**

**Linear Predictive Coding (LPC) for Speech:** Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains, Method of Solution of the LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

**UNIT V:****(9 Periods)**

**Homomorphic Speech Processing:** Introduction Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, pitch Detection and Formant Estimation; Applications of speech processing – Speech Enhancement, Speech recognition, Speech synthesis and Speaker Verification.

**Total Periods:45****TEXT BOOKS:**

1. L.R. Rabiner and S. W. Schafer, Digital Processing of Speech Signals, Pearson Education.
2. Douglas O' Shaughnessy, Speech Communications: Human & Machine, 2<sup>nd</sup> Ed., Wiley-IEEE Press.

**REFERENCES:**

1. Thomas F. Quatieri, Discrete Time Speech Signal Processing: Principles and Practice, 1<sup>st</sup> Ed., Pearson Education.
2. Ben Gold & Nelson Morgan, Speech and Audio Signal Processing: Processing and Perception of Speech and Music ,1<sup>st</sup> Ed., Wiley.

## III Year B. Tech – II Semester

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**(EC23APE606) EMBEDDED SYSTEMS AND IOT****(Professional Elective – III)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the Architecture, Development & Design of Embedded Systems and IoT.
- Learn the architecture and programming of ARM Microcontroller.
- Able to work with Raspberry Pi using Python Programming.
- Know about the IoT standards, communication technologies and protocols for IoT devices.
- Implement case studies and applications using the tools and techniques of IoT Platform.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the Architecture, Development & Design of Embedded Systems and IoT.
- CO 2:** Learn the architecture and programming of ARM Microcontroller.
- CO 3:** Work with Raspberry Pi using Python Programming.
- CO 4:** Know about the IoT standards, communication technologies and protocols for IoT devices.
- CO 5:** Implement case studies and applications using the tools and techniques of IoT Platform

**UNIT I: (9 Periods)**

**Introduction to Embedded Systems and Internet of Things (IoT):** Introduction, Hardware & Software Architecture of Embedded Systems, Embedded Systems Development process, Architecture of Internet of Things, Physical Design & Logical Design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Tools, Applications of Embedded Systems and IoT, Design Methodology for IOT Products.

**UNIT II: (9 Periods)**

**ARM Microcontrollers Architecture and Programming:** Architecture, Pin Diagram, Register Set & Modes, Memory Organization, Instruction set, Programming ports, Timer/Counter, Serial communication, I/O System, Development Tools, interrupts in C, Introduction ARM mBed platform.

**UNIT III: (9 Periods)**

**Fundamentals of Python Programming & Raspberry Pi:** Introduction to python programming, Data Types & Data Structures, working with functions, Modules & Packages, File Handling, classes, REST full Web Services, Client Libraries, Introduction & programming Raspberry Pi3, Interfaces, Integrating Input Output devices with Raspberry Pi3

**UNIT IV: (9 Periods)**

**IoT Technologies, Standards, Tools & M2M Network:** Fundamental characteristics and high-level requirements of IoT, IoT Reference models; Introduction to Communication Technologies & Protocols of IoT: BLE, Wi-Fi, LoRA, 3G/4G Technologies and HTTP, MQTT, CoAP protocols; Relevant Practicals on above technologies, M2M Network, SDN (Software Defined Networking) & NFV (Network Function Virtualization) for IoT

**UNIT V: (9 Periods)**

**IoT Platform, Cloud Computing Platforms & Data Analytics for IoT Development:** IOT Platform Architecture (IBM Internet of Things & Watson Platforms); API Endpoints for

Platform Services; Devices Creation and Data Transmission; Introduction to NODE-RED and Application deployment, Introduction to Data Analytics, Apache Hadoop, Apache Oozie, Spark & Storm

**Total Periods:45**

**TEXT BOOKS:**

1. ArsheepBahga, Vijay Madiseti, Internet of Things: A Hands-On Approach, 1<sup>st</sup> Edition, VPT, 2014.
2. K.V.K.K.Prasad, Embedded Real Time Systems: Concepts, Design and Programming, 1<sup>st</sup> Edition, Dreamtech Publication, 2014.
3. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley Publications, 2013

**REFERENCES:**

1. Jonathan W Valvano, Embedded Microcomputer Systems: Real-Time Interfacing, 3<sup>rd</sup> Edition, Thomson Engineering, 2012.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key applications and Protocols, 2<sup>nd</sup> Edition, Wiley Publications, 2012.
3. Rene Beuchat , Andrea Guerrieri & Sahand Kashani ,Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers, Paperback, August 2021.

III Year B. Tech – II Semester

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**(EC23APE607) NANOELECTRONICS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the evolution and basics of Nanoelectronics.
- Understand various fabrication methods in nanotechnology (top down & bottom up).
- Analyze and discuss various characterization methods in nanotechnology (optical, electrical, AFM, SEM, TEM, and nanoindentation).
- Understand nano electronic systems and building blocks such as: low dimensional semiconductors, hetero structures, carbon nano tubes, quantum dots, nano wires etc.
- Familiarize students with the present research front in Nanoelectronics and to be able to critically assess future trends.

**COURSE OUTCOMES:**

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

- CO 1:** Get an insight of quantum mechanical effects associated with low dimensional semiconductors.
- CO 2:** Explain the different processes involved in the fabrication of nanoparticles and nano layers.
- CO 3:** Explain the different techniques for characterizing nanolayers and nanoparticles
- CO 4:** Integrate and model the device with basic quantum structures.
- CO 5:** Correlating device structures with type of materials, which are commonly used for fabrication, defend the tunneling devices with several parameters of hetero structures; compare characteristics study for the MOS/FET devices

**UNIT I:****(9 Periods)**

**Fundamentals of Nanoelectronics:** Moore's Law, Wave functions, wave packets, Schrodinger's wave equation, potential barriers and tunneling, Fermi-Dirac statistics, Density of states, Limitations of conventional FET in nanoscales, Quantum Well, Quantum wire, Quantum dot, current flow in two terminal Quantum dots, ballistic transport, Single Electron Transistor

**UNIT II:****(9 Periods)**

**Introduction to methods of fabrication of Nano-Layers:** Physical vapour deposition-evaporation & Sputtering, Chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods. Fabrication of nanoparticles: grinding with iron balls, laser ablation, reduction methods, sol gel, self-assembly, precipitation of quantum dots.

**UNIT III:****(9 Periods)**

**Introduction to characterization of nanostructures:** Principle of operation of Scanning Tunneling Microscope, Atomic Force Microscope, Scanning Electron microscope- specimen interaction, X-Ray Diffraction analysis

**UNIT IV:****(9 Periods)**

Basic quantum structures: Quantum wells, quantum wires and quantum dots, Single electron devices charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.

**UNIT V:****(9 Periods)**

**Nano electronic Devices:** Carbon nanotubes based devices CNFET, characteristics; Spin-based devices spin FET, characteristics, Applications of MOSFET, CNFET and Spin FET devices.

**TEXT BOOKS:**

1. George W Hanson, Fundamentals of Nanoelectronics, Prentice Hall, 2008.
2. Karl Goser, Nanoelectronics and Nano systems: From Transistors to Molecular and Quantum Devices, Springer, 1<sup>st</sup> Edition, 2005.

**REFERENCES:**

1. Rainer Waser (Ed), Nanoelectronics and Information Technology, 2<sup>nd</sup> Edition, Wiley VCH, 2003.
2. Mary Eshaghian- Wilner, Bio inspired and Nano Scale Integrated Computing, Wiley, 2009.

III Year B. Tech – II Semester

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**(EC23APE607) SATELLITE COMMUNICATIONS****(Professional Elective – III)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the principles of orbital mechanics and satellite launch system with performance parameters.
- Describe the elements of communication satellite design for matching reliability.
- Know the working concepts of various multiple access techniques and Onboard processing.
- Learn the satellite links design with communication links.
- Study the working of earth station design with satellite broadcasting.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the principles of orbital mechanics & satellite launch system with performance parameters.
- CO 2:** Understand the elements of communication satellite design for matching reliability.
- CO 3:** Gain knowledge on various multiple access techniques and Onboard processing.
- CO 4:** Analyze the satellite links design with communication links.
- CO 5:** Evaluate the working of earth station design with satellite broadcasting.

**UNIT I: (9 Periods)**

Elements of orbital mechanics. Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Multistage rocket launchers and their performance.

**UNIT II: (9 Periods)**

Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

**UNIT III: (9 Periods)**

Multiple access techniques. FDMA, TDMA, CDMA. Random access techniques. Satellite onboard processing.

**UNIT IV: (9 Periods)**

Satellite link design: Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based personal communication links.

**UNIT V: (9 Periods)**

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting.

**Total Periods:45****TEXT BOOKS:**

1. T. Pratt and C.W. Bostain, Satellite Communication, Wiley, 2000.
2. D. Roddy, Satellite Communication, McGraw- Hill, 4<sup>th</sup> Edition, 2009.

**REFERENCES:**

1. B.N. Agrawal, Design of Geo Synchronous Spacecraft, Prentice- Hall, 1986.

## III Year B. Tech – II Semester

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**(EC23APC604) MICROWAVE AND OPTICAL COMMUNICATIONS LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the working of microwave bench set up and characteristics of microwave sources.
- Verify the characteristics of various microwave components and to draw the radiation pattern of antennas.
- Verify the characteristics of optical sources and detectors and to study about losses in optical fiber.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the working of microwave bench set up and characteristics of microwave sources.
- CO 2:** Verify the characteristics of various microwave components and to draw the radiation pattern of antennas.
- CO 3:** Verify the characteristics of optical sources and detectors and to study about losses in optical fiber.

**PART-A: Microwave Lab - Any Seven (7) Experiments**

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Attenuation Measurement
4. Directional Coupler Characteristics
5. VSWR Measurement
6. Impedance Measurements
7. Frequency and Wavelength measurement
8. Scattering Parameters of Directional coupler
9. Scattering Parameters of Magic TEE
10. Radiation pattern measurement of a Antenna
11. Antenna gain measurement

**Part B: Optical Fiber Lab - Any five (5) Experiments**

1. Characterization of LED
2. Characterization of Laser Diode
3. Intensity Modulation of Laser output through Optical fiber
4. Measurement of data rate for digital Optical link
5. Measurement of Numerical Aperture.
6. Measurement of Losses for Analog optical link

## III Year B. Tech – II Semester

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**(EC23APC605) VLSI DESIGN LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Design a logic circuit using CMOS transistor using 180 nm technology in terms of schematic, symbol, test bench, DC and AC analysis.
- Evaluate different schematics & output responses for AOI logic by using different software tools.
- Design CMOS circuits using Full & Semi custom IC designs for analysis.
- Design different layouts using different software tools for Analog circuits.

**COURSE OUTCOMES:**

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

- CO 1:** Design a logic circuit using CMOS transistor using 180 nm technology in terms of schematic, symbol, test bench, DC and AC analysis.
- CO 2:** Evaluate different schematics & output responses for AOI logic by using different software tools.
- CO 3:** Design CMOS circuits using Full & Semi custom IC designs for analysis.
- CO 4:** Design different layouts using different software tools for Analog circuits.

**LIST OF EXPERIMENTS:****1. Design and analysis of CMOS Inverter**

- a) Implement CMOS inverter schematic using 180 nm technology and design its symbol.
- b) Implement test bench for CMOS Inverter and check its output response.
- c) Perform DC and AC analysis for CMOS inverter.
- d) Check the performance of CMOS inverter using parametric sweep.

**2. Design and analysis of NAND and NOR Logic gates**

- a) Implement NAND/NOR schematic using 180 nm technology and design its symbol.
- b) Implement test bench for NAND/NOR and check its output response.
- c) Perform DC and AC analysis for NAND/NOR.
- d) Check the performance of NAND/NOR using parametric sweep.

**3. Design and analysis of XOR and XNOR Logic gates**

- a) Implement XOR/XNOR schematic using 180 nm technology and design its symbol.
- b) Implement test bench for XOR/XNOR and check its output response.
- c) Perform DC and AC analysis for XOR/XNOR.
- d) Check the performance of XOR/XNOR using parametric sweep.

**4. Design of AOI logic**

- a) Design Schematic for  $AB+C'D$  and check its output response.
- b) Design Schematic for  $AB'+C'D$  and check its output response.
- c) Design Schematic for  $(A+B')(C+D)$  and check its output response.
- d) Design Schematic for  $(A+B')(C'+D)$  and check its output response.

**5. Design and analysis of Full adder**

- a) Design full adder using Full custom IC design.
- b) Design full adder using Semi custom IC design.

**6. Analysis of NMOS and PMOS characteristics**

- a) Implement test bench for NMOS/PMOS transistor.
- b) Perform DC and AC analysis for NMOS/PMOS transistor
- c) Check the performance of NMOS/PMOS transistor using parametric sweep.

**7. Design and analysis of Common source amplifier**

- a) Implement CS amplifier schematic using 180 nm technology and design its symbol.
- b) Implement test bench for CS amplifier and check its output response.
- c) Perform DC and AC analysis for CS amplifier.
- d) Check the performance of CS amplifier using parametric sweep.

**8. Design and analysis of Common drain amplifier**

- a) Implement CD amplifier schematic using 180 nm technology and design its symbol.
- b) Implement test bench for CD amplifier and check its output response.
- c) Perform DC and AC analysis for CD amplifier.
- d) Check the performance of CD amplifier using parametric sweep.

**9. Design of MOS differential amplifier**

- a) Design differential amplifier schematic using 180 nm technology and its symbol.
- b) Implement test bench for differential amplifier and check its output response.
- c) Perform DC and AC analysis for differential amplifier.
- d) Check the performance of differential amplifier using parametric sweep.

**10.Design of differential amplifier using FET/BJT**

- a) Design differential amplifier using FET/BJT schematic using 180 nm technology and its symbol.
- b) Implement test bench for two stage differential amplifier and check its output response.
- c) Perform DC and AC analysis for differential amplifier.
- d) Check the performance of differential amplifier using parametric sweep.

**11.Design of Inverter Layout**

- a) Design and implement inverter schematic.
- b) Design the layout for inverter using 180 nm tech file.
- c) Perform LVS for schematic and layout
- d) Check and remove all DRC violations.
- e) Extract parasitic R and C in layout.

**12.Design of NAND/NOR Layout**

- a) Design and implement NAND/NOR schematic.
- b) Design the layout for inverter using 180 nm tech file.
- c) Perform LVS for schematic and layout
- d) Check and remove all DRC violations.
- e) Extract parasitic R and C in layout

The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the experiments with the Industry standard EDA Tools.

**SOFTWARE REQUIRED:**

- i. Mentor Graphics/ Synopsis/ Cadence / Equivalent Industry Standard Software.
- ii. Personal computer system with necessary software to run the programs and to implement.

**NOTE: Any TEN of the experiments are to be conducted**

## III Year B. Tech – I Semester

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**(EC23AES501) TINKERING LAB****COURSE OBJECTIVES:**

The objectives of the course are to

- Encourage Innovation and Creativity.
- Provide Hands-on Learning and Impart Skill Development.
- Foster Collaboration and Teamwork.
- Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship.
- Impart Problem-Solving mind-set.

**COURSE OUTCOMES:**

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

- CO 1:** Demonstrate creativity and innovation by designing and developing working prototypes for real-world applications.
- CO 2:** Apply interdisciplinary knowledge of electronics, programming, mechanical design, and data science/AI in problem-solving.
- CO 3:** Use modern engineering tools such as microcontrollers, sensors, 3D printing, and CAD software for prototype development.
- CO 4:** Work collaboratively in teams to plan, design, and execute projects, demonstrating leadership, communication, and teamwork skills.
- CO 5:** Analyze, test, and evaluate prototype performance to validate solutions against given requirements.

**LIST OF EXPERIMENTS:**

- 1) Make your own parallel and series circuits using breadboard for any application of your choice.
- 2) Design and 3D print a Walking Robot
- 3) Design and 3D Print a Rocket.
- 4) Temperature & Humidity Monitoring System (DHT11 + LCD)
- 5) Water Level Detection and Alert System
- 6) Automatic Plant Watering System
- 7) Bluetooth-Based Door Lock System
- 8) Smart Dustbin Using Ultrasonic Sensor
- 9) Fire Detection and Alarm System
- 10) RFID-Based Attendance System
- 11) Voice-Controlled Devices via Google Assistant
- 12) Heart Rate Monitoring Using Pulse Sensor
- 13) Soil Moisture-Based Irrigation
- 14) Smart Helmet for Accident Detection
- 15) Milk Adulteration Detection System
- 16) Water Purification via Activated Carbon
- 17) Solar Dehydrator for Food Drying
- 18) Temperature-Controlled Chemical Reactor
- 19) Ethanol Mini-Plant Using Biomass
- 20) Smart Fluid Flow Control (Solenoid + pH Sensor)
- 21) Portable Water Quality Tester
- 22) AI Crop Disease Detection
- 23) AI-based Smart Irrigation
- 24) ECG Signal Acquisition and Plotting
- 25) AI-Powered Traffic Flow Prediction
- 26) Smart Grid Simulation with Load Monitoring
- 27) Smart Campus Indoor Navigator
- 28) Weather Station Prototype
- 29) Firefighting Robot with Sensor Guidance
- 30) Facial Recognition Dustbin

- 31) Barcode-Based Lab Inventory System
- 32) Growth Chamber for Plants
- 33) Biomedical Waste Alert System
- 34) Soil Classification with AI
- 35) Smart Railway Gate
- 36) Smart Bin Locator via GPS and Load Sensors
- 37) Algae-Based Water Purifier
- 38) Contactless Attendance via Face Recognition

**Note:**

1. The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
2. A minimum of **8** to **10** experiments must be completed by the students.

III Year B. Tech – II Semester

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**(EC23ASC601) MACHINE LEARNING AND DSP****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the modules and dependencies for machine learning corresponding to different applications.
- Understand a range of machine learning regression techniques & clustering along with their datasets.
- Write the programs and implement k-Nearest Neighbor algorithm to classify the iris data sets, images & CNN.
- Simulate the basic signal processing operations like convolution and correlation.
- Simulate the DSP operations like DFT, FFT & implement IIR and FIR filters using simulation software and verify their frequency responses.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the modules and dependencies for machine learning corresponding to different applications.
- CO 2:** Learn a range of machine learning regression techniques & clustering along with their datasets.
- CO 3:** Write the programs and implement k-Nearest Neighbor algorithm to classify the iris data sets, images & CNN.
- CO 4:** Simulate the basic signal processing operations like convolution and correlation.
- CO 5:** Simulate the DSP operations like DFT, FFT & implement IIR and FIR filters using simulation software and verify their frequency responses.

**MACHINE LEARNING**

Implement the following concepts using python with supporting applications.

1. Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML Familiarization with NumPy, Panda and Matplotlib by Loading Dataset in Python.
2. **Linear regression:** Predict the profit of a company/House price from a dataset using the concept of linear regression. Implement the speech recognition model (NLP) from a speech/audio dataset using the concept of linear regression.
3. **Logistic regression:**
  - a) Identify whether the patient has diabetes or not from diabetes dataset using Logistic regression.
  - b) Implement the speech to text model (NLP- Speech recognitions system) from a speech dataset using the concept of linear regression.
4. **Polynomial regression:**
  - a) Determine the quality of wine using wine dataset with the help of polynomial regression.
  - b) Implement the speech recognition model (NLP) from a speech / audio data set using the concept of polynomial regression.
5. **K-means clustering:** Apply the concept of K-means clustering for image segmentation problem (Brain tumor and Lung images)/Color quantization.
6. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set to demonstrate the working of the decision tree based ID3 algorithm.
7. Write a program to implement the k-Nearest Neighbor algorithm for image classification and distance metric learning for large margin with image classification applications using k-nearest neighbor.
8. **PCA/LDA:** Reduce the dimensionality of a dataset for Face recognition system
9. Design an Artificial neural network for Digit classification using Back Propagation Algorithm for MNIST Data set. Train MLP using Gradient descent algorithm by applying Linear, Sigmoid, tanh, and ReLU activation functions.

10. **Digit recognition using CNN:** Identify the digits 0-9 from MNIST data and CIFR 10 set using CNN.
11. Image Classification using CNN: Classify cats and dogs using CNN from the given dataset.
12. LSTM (Long Short-Term Memory Networks)/ARIMA--- Implementation biomedical signals (like EEG, ECG, EMG) classifications and disease prediction.

**DIGITAL SIGNAL PROCESSING (Implement any six concepts)**

1. Generate the following standard discrete time signals.
2. i) Unit Impulse ii) Unit step iii) Ramp iv) Exponential v) Saw tooth
3. Generate sum of two sinusoidal signals and find the frequency response (magnitude and phase).
4. Implement and verify linear and circular convolution between two given signals.
5. Implement and verify autocorrelation for the given sequence and cross correlation between two given signals.
6. Compute and implement the N-point DFT of a given sequence and compute the power density spectrum of the sequence.
7. Implement and verify N-point DIT-FFT of a given sequence and find the frequency response (magnitude and phase).
8. Implement and verify N-point IFFT of a given sequence.
9. Design IIR Butterworth filter and compare their performances with different orders (Low Pass Filter /High Pass Filter)
10. Design IIR Chebyshev filter and compare their performances with different orders (Low Pass Filter /High Pass Filter).
11. Design FIR filter (Low Pass Filter /High Pass Filter) using windowing technique.
12. Using rectangular window, ii. Using hamming window, iii. Using Kaiser window
13. Design and verify Filter (IIR and FIR) frequency response by using Filter design and Analysis Tool.
14. Compute the Decimation and Interpolation for the given signal.
15. Real time implementation of an audio signal using a digital signal processor.

**REFERENCES**

1. S.N.Sivanandam and S.N. Deepa, Introduction to neural networks using Matlab, 2006.
2. Simon Haykin, Neural Network sand Learning Machines, PHI, 3<sup>rd</sup> Edition, 2008.
3. Alon V. Oppenheim, Digital Signal Processing, PHI.
4. S.K. Mitra, Digital Signal Processing, 2<sup>nd</sup> Edition, TMH.

**NOTE:** Implement any **6** concepts from Machine learning and **6** concepts from Digital Signal Processing.

## III Year B. Tech – II Semester

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**(CS23AMC601) TECHNICAL PAPER WRITING AND IPR****COURSE OBJECTIVES:**

The objectives of this course are to:

- Enable the students to practice the basic skills of research paper writing.
- Make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
- Practice the basic skills of performing quality literature review
- Help them in knowing the significance of real-life practice and procedure of Patents.
- Enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks.

**COURSE OUTCOMES:**

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

- CO 1:** Identify key secondary literature related to their proposed technical paper writing
- CO 2:** Explain various principles and styles in technical writing.
- CO 3:** Use the acquired knowledge in writing a research/technical paper.
- CO 4:** Analyze rights and responsibilities of holder of Patent, Copyright, trademark, International Trademark etc.
- CO 5:** Evaluate different forms of IPR available at national & international level Develop skill of making search of various forms of IPR by using modern tools and techniques.

**UNIT I:****(9 Periods)**

**Principles of Technical Writing:** styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language - highlighting your findings- discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

**UNIT II:****(9 Periods)**

**Technical Research Paper Writing:** Abstract- Objectives-Limitations-Review of Literature Problems and Framing Research Questions- Synopsis.

**UNIT III:****(9 Periods)**

**Process of Research:** publication mechanism: types of journals- indexing-seminars-conferences proof reading -plagiarism style; seminar & conference paper writing; Methodology-discussion results- citation rules.

**UNIT IV:****(9 Periods)**

**Introduction to Intellectual Property:** Introduction, types of intellectual property, International organizations, agencies and ties, importance of intellectual property rights Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

**UNIT V:****(9 Periods)**

**Law of Copy Rights:** Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

**Law of patents:** Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

**Total Periods: 45**

**TEXT BOOKS:**

1. Deborah E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013.
2. Meenakshi Raman, Sangeeta Sharma, Technical Communication: Principles and Practices, Oxford University Press, 2011.

**REFERENCES:**

1. R. Myneni, Law of Intellectual Property, Asia Law House, 9<sup>th</sup> Edition, 2019.
2. Prabuddha Ganguli, Intellectual Property Rights, Tata McGraw Hill, 2001.
3. P. Narayan, Intellectual Property Law, Eastern Law House, 3<sup>rd</sup> Edition, 2007.
4. Adrian Wallwork, English for Writing Research Papers, Springer Cham Heidelberg New York, 2<sup>nd</sup> Edition, 2016.
5. Dan Jones, Sam Dragga, Technical Writing Style, Longman, 1995.

**ONLINE RESOURCES:**

1. <https://theconceptwriters.com.pk/principles-of-technical-writing/>
2. <https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html>
3. <https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html>
4. <https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/>
5. <https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf>
6. <https://lawbhoomi.com/intellectual-property-rights-notes/>
7. <https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf>

## IV Year B. Tech – I Semester

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**(BA23AHS701) BUSINESS ETHICS AND CORPORATE GOVERNANCE****COURSE OBJECTIVES:**

The objectives of this course are to:

- Make the student understand the principles of business ethics.
- Enable them in knowing about the ethics in management.
- Facilitate the student role in corporate culture.
- Impart knowledge about the fair-trade practices.
- Encourage the student in knowing about the corporate governance.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the meaning of loyalty and ethical Behavior.
- CO 2:** Develop ethical values in self and organization.
- CO 3:** Understand the key elements of corporate culture.
- CO 4:** Make use of Environmental Protection and Fair Trade Practices.
- CO 5:** Analyze role of auditors, board of directors and shareholders in corporate governance.

**UNIT I:****(5 Periods)**

**Ethics:** Introduction–Meaning–Nature, Scope, significance, Loyalty, and ethical behavior. Value systems – Business Ethics-Types, Characteristics, Factors, Contradictions and Ethical Practices in Management-Corporate Social Responsibility–Issues of Management–Crisis Management. Ethics in the Digital Age: AI Ethics, Data Privacy, Cybersecurity Ethics.

**UNIT II:****(6 Periods)**

**Ethics In Management:** Introduction-Ethics in production, finance, Human resource management and Marketing Management –The Ethical Value System–Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics–Ethical Values in different Cultures -Culture and Individual Ethics – professional ethics and technical ethics. Ethical Challenges in Startups & Gig Economy.

**UNIT III:****(7 Periods)**

**Corporate Culture:** Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change Toxic Workplaces: Recognizing and Managing Ethical Culture Failures.

**UNIT IV:****(5 Periods)**

**Legal Frame Work:** Law and Ethics -Agencies enforcing Ethical Business Behavior -Legal Impact –Environmental Protection, ESG (Environmental, Social, Governance) Regulations, Fair Trade Practices, legal Compliances, Safeguarding Health and wellbeing of Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

**UNIT V:****(7 Periods)**

**Corporate Governance:** Introduction - Meaning–Corporate governance code, transparency & disclosure -Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory frame work - Corporate Scams-Committees in India and abroad, corporate social responsibility. BoDs composition, Cadbury Committee –

Various committees- Reports –Benefit sand Limitations. Emerging Global Trends in Corporate Governance (OECD Guidelines)

**Total Periods: 30**

**TEXTBOOKS:**

1. Murthy CSV, Business Ethics and Corporate Governance, HPH July 2017
2. Bholanath Dutta, S.K.Podder–Corporation Governance, VBH, June 2010

**REFERENCES:**

1. Dr.K.Nirmala, KarunakaraReaddy, Business Ethics and Corporate Governance, HPH
2. H.R. Machiraju: Corporate Governance, HPH,2013
3. K.Venkataramana, Corporate Governance, SHBP.
4. N.M.Khandelwal, Indian Ethos and Values for Managers

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_mg46/](https://onlinecourses.nptel.ac.in/noc21_mg46/)
2. <https://archive.nptel.ac.in/courses/110/105/110105138/>
3. [https://onlinecourses.nptel.ac.in/noc21\\_mg54/](https://onlinecourses.nptel.ac.in/noc21_mg54/)
4. [https://onlinecourses.nptel.ac.in/noc22\\_mg54/](https://onlinecourses.nptel.ac.in/noc22_mg54/)
5. <https://archive.nptel.ac.in/courses/109/106/109106117/>

## IV Year B. Tech – I Semester

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**(BA23AHS702) E-BUSINESS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide knowledge on emerging concept on E-Business related aspect
- Understand various electronic markets & business models.
- Impart the information about electronic payment systems & banking.
- Create awareness on security risks and challenges in E-commerce.
- Aware on different e-marketing channels & strategies.

**COURSE OUTCOMES:**

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

- CO 1:** Remember E-Business & its nature, scope and functions.
- CO 2:** Understand the concept of business models.
- CO 3:** Understand the Electronic payment system.
- CO 4:** Understand E-Security, Contrast and compare security protocols and public network.
- CO 5:** Understand the concept of on line marketing.

**UNIT I:****(6 Periods)**

**Electronic Business:** Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC)- Advantages & Disadvantages of E-Commerce – E-Commerce and E-Business, Internet Services, Online Shopping- E-Commerce Opportunities for Industries. Green E-Business & Sustainable Digital Practices

**UNIT II:****(7 Periods)**

**Electronic Markets and Business Models:** Introduction –E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals -Business Models-Business to Business (B2B)-Business to Customers(B2C) - Business to Government(B2G)- Auctions-B2B Portals in India. Platform-Based Business Models (e.g., Uber, Amazon, Airbnb), Subscription-Based E-Business Models (SaaS, DaaS).

**UNIT III:****(5 Periods)**

**Electronic Payment Systems:** Introduction to electronic payment systems (EPS) -Types of electronic payments - Credit/debit cards, e-wallets, UPI, and crypto currencies -Smart cards and digital wallets: Features and usage -Electronic Fund Transfer (EFT): Role in business transactions -Infrastructure requirements and regulatory aspects of e-payments. Cross-Border E-Commerce and Global Payment Gateways (PayPal , Stripe, Razor pay).

**UNIT IV:****(7 Periods)**

**E-Security:** Security risks and challenges in electronic commerce - Cyber threats -Phishing, hacking, identity theft, and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL, TLS) -Firewalls in securing e-business platforms. Data Privacy Laws and Compliance (GDPR, PDP Bill - India).

**UNIT V:****(5 Periods)**

**E-Marketing:** Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research–E-marketing planning: Online branding, social media marketing, and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM) E-supply chain management (e-SCM).AI in Personalized Marketing (Chatbots, Product Recommendations).

**Total Periods: 30**

**TEXTBOOKS:**

1. Arati Oturkar&Sunil Khilari. E-Business. Everest Publishing House,2022
2. P.T.SJoseph. E-Commerce, 4<sup>th</sup> Edition, Prentice Hall of India,2011

**REFERENCES:**

1. Debjani, Kamalesh K Bajaj.E-Commerce,2<sup>nd</sup> Edition Tata Mc Graw-Hill, 2005
2. Dave Chaffey. E-Commerce E-Management, 2<sup>nd</sup> Edition, Pearson,2012.
3. Henry Chan.E-Commerce Fundamentals and Application, Raymond Leatham Wiley India 2007
4. S.Jaiswal. E-CommerceGalgotiaPublicationPvtLtd.,2003.

**ONLINE RESOURCES:**

1. <https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771>
2. <https://www.slideshare.net/VikramNani/e-commerce-business-models>
3. <https://www.slideshare.net/RiteshGoyal/electronic-payment-system>
4. <https://www.slideshare.net/WelingkarDLP/electronic-security>
5. <https://www.slideshare.net/Ankitha2404/emarketing-ppt>

## IV Year B. Tech – I Semester

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**(BA23AHS703) MANAGEMENT SCIENCE****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide fundamental knowledge on Management, Administration, Organization and its concepts.
- Make the students understand the role of management in Production.
- Impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts.
- Create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management.
- Make the students aware of the contemporary issues in modern management.

**COURSE OUTCOMES:**

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

- CO 1:** Remember the concepts & principles of management and designs of organization in a practical world.
- CO 2:** Understand the knowledge of Work-study principles & Quality Control techniques in industry.
- CO 3:** Apply the process of Recruitment & Selection in organization.
- CO 4:** Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
- CO 5:** Create awareness on contemporary issues in modern management & technology.

**UNIT I:****(5 Periods)**

**Introduction to Management:** Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Elton Mayo's Human relations -Organizational Designs - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management. Global Management Practices – cross-cultural management insights.

**UNIT II:****(7 Periods)**

**Operations Management:** Principles and Types of Plant Layout -Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Material Management - Objectives - Inventory- Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Marketing Management - Concept-Meaning-Nature-Functions of Marketing-Marketing Mix-Channels of Distribution-Advertisement and Sales Promotion-Marketing Strategies based on Product Life Cycle.Smart Manufacturing / Industry 4.0 – IoT, automation, robotics in production.

**UNIT III:****(6 Periods)**

**Human Resources Management (HRM):** HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection -Process -Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration. Remote Work & Hybrid Workforce Management

**UNIT IV:****(5 Periods)**

**Strategic& Project Management:** Definition& Meaning - Setting of Vision - Mission - Goals-Corporate Planning Process – Environmental Scanning-Steps in Strategy Formulation

and Implementation –SWOT Analysis- Project Management - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM)Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems). Risk Management in Projects – identification and mitigation

**UNIT V:****(7 Periods)**

**Contemporary Issues in Management:** Customer Relations Management (CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management (SCM) - Enterprise Resource Planning (ERP) - Performance Management – employee engagement and retention - Business Process Re- engineering and Bench Marking - Knowledge Management – change management – sustainability and corporate social responsibility. Corporate Social Innovation (CSI).

**Total Periods: 30****TEXTBOOKS:**

1. Frederick S. Hillier, MarkS.Hillier, Introduction to Management Science, 2023
2. A.R. Aryasri, Management Science, TMH, 2019

**REFERENCES:**

1. Stoner, Freeman, Gilbert. Management, Pearson Education, New Delhi, 2019.
2. Koontz & Wehrich, Essentials of Management, 6/e, TMH, 2005.
3. Thomas N. Duening & John M. Ivancevich, Management Principles and Guidelines, Biztantra.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
5. Samuel C. Certo, Modern Management, 9/e, PHI, 2005.

**ONLINE RESOURCES:**

1. <https://www.slideshare.net/slideshow/introduction-to-management-and-organization-231308043/231308043>
2. <https://nptel.ac.in/courses/112107238>
3. <https://archive.nptel.ac.in/courses/110/104/110104068/>
4. <https://archive.nptel.ac.in/courses/110/105/110105069/>

## IV Year B. Tech – I Semester

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**(EC23APC701) DATA COMMUNICATIONS AND NETWORKING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide a conceptual understanding of the fundamentals of data communications and computer networks.
- Explore different network architectures, models, and transmission media used in data communication.
- Analyze error detection and correction methods, data link protocols, and medium access techniques.
- Understand the functioning of network and transport layer protocols, including addressing, routing, and congestion control.
- Study application layer protocols, network security mechanisms, and techniques to ensure data integrity.

**COURSE OUTCOMES:**

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

- CO 1:** Understand of the fundamentals of data communications and computer networks
- CO 2:** Learn different network architectures, models, and transmission media used in data communication.
- CO 3:** Analyze error detection and correction methods, data link protocols, and medium access techniques.
- CO 4:** Grasp the functioning of network and transport layer protocols, including addressing, routing, and congestion control.
- CO 5:** Gain knowledge on application layer protocols, network security mechanisms, and techniques to ensure data integrity.

**UNIT I: (9 periods)**

**Overview of Data Communication and Networking:** Introduction; Data communications: components, direction of data flow; network criteria, physical structure, categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

**UNIT II: (9 periods)**

**Physical Layer:** Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided), queuing theory, its applications in data communication, Data Encoding Techniques, Circuit switching, time division & space division switching.

**UNIT III: (9 periods)**

**Data link Layer:** Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC

**Medium Access sub layer:** Point to Point Protocol, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet.

**UNIT IV: (9 periods)**

**Network layer:** Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6

**Transport layer:** Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.

**UNIT V:**

**(9 periods)**

**Application Layer:** Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.

**Total Periods:45**

**TEXT BOOKS:**

1. B. A. Forouzan, Data Communications and Networking, TMH, 3<sup>rd</sup> Edition.
2. A.S. Tanenbaum, Computer Networks, Pearson Education/PHI, 4<sup>th</sup> Edition.

**REFERENCES:**

1. W. Stallings, Data and Computer Communications, PHI/ Pearson Education, 5<sup>th</sup> Edition.
2. Kurose and Rose, Computer Networking -A top down approach featuring the internet, Pearson Education.
3. Leon, Garica, Widjaja, Communication Networks, TMH.

**IV Year B. Tech – I Semester**

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**(EC23APE701) DIGITAL IMAGE PROCESSING****(Professional Elective – IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the fundamentals of Image Processing with different Transforms.
- Understand functions of Intensity Transformations and working fundamentals of Spatial Filters.
- Implement various models of Restoring and Reconstruction of Images from filtering projections.
- Study the concepts of image compression using different coding & Wavelet and Multiresolution Processes.
- Design image processing systems using Segmentation techniques for Morphological & Color Images.

**COURSE OUTCOMES**

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

- CO 1:** Learn the fundamentals of Image Processing with different Transforms.
- CO 2:** Understand the functions of Intensity Transformations and working Fundamentals of Spatial Filters
- CO 3:** Implement various models of Restoring and Reconstruction of Images from filtering projections.
- CO 4:** Grasp the concepts of image compression using different coding & Wavelets and Multiresolution Processes.
- CO 5:** Design the image processing systems using Segmentation techniques for Morphological & Color Images.

**UNIT I:****(9 periods)**

**Introduction:** Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing. Image Transforms: Need for image transforms, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform, Importance of Phase, Walsh Transform. Hadamard transform, Haar Transform, Slant transform, Discrete Cosine transform, KL Transform, SVD and Radon Transform, Comparison of different image transforms.

**UNIT II:****(9 periods)**

**Intensity Transformations and Spatial Filtering:** Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, Combining spatial enhancement methods Filtering in the Frequency Domain: Preliminary concepts, The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.

**UNIT III:****(9 periods)**

**Image Restoration and Reconstruction:** A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering, constrained least squares filtering, geometric mean filter, image reconstruction from projections.

**UNIT IV:****(9 periods)**

**Image compression:** Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding, Predictive coding Wavelets and Multiresolution Processing: Image pyramids, sub band coding, Multiresolution expansions, wavelet transforms in one dimensions & two dimensions, Wavelet coding.

**UNIT V:****(9 periods)**

**Image segmentation:** Fundamentals, point, line, edge detection, thresholding, region – based segmentation. Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds.

**Color image processing:** color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

**Basic Steps of video processing-** Analog video, Digital video, Time varying image formation model, Geometric image formation, Sampling of video signal.

**Total Periods:45****TEXT BOOKS:**

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3<sup>rd</sup> Edition, Prentice Hall, 2008.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, Tata McGraw-Hill Education, 2011.
3. Yao wang, Joem Ostarmann and Ya–quin Zhang, Video processing and communication, 1<sup>st</sup>Edition, PHI.

**REFERENCES:**

1. Anil K.Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 9<sup>th</sup> Edition, Indian Reprint, 2002.
2. B.Chanda, D.DuttaMajumder, Digital Image Processing and Analysis, PHI, 2009.
3. M. Tekalp ,Digital video Processing, Prentice Hall International.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/117105079>
2. <https://nptel.ac.in/courses/117105135>

## IV Year B. Tech – I Semester

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**(EC23APE702) DSP PROCESSORS & ARCHITECTURES****(Professional Elective – IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Describe the unique features and significance of Digital Signal Processing (DSP).
- Demonstrate various computational parameters and accuracy considerations in DSP systems.
- Introduce architectural improvements in programmable DSP devices and their execution models.
- Expose students to basic DSP algorithms, including filtering, FFT, and adaptive processing.
- Outline DSP processor applications and their interfacing with memory and I/O peripherals.

**COURSE OUTCOMES:**

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

- CO 1:** Summarize the fundamental features and role of Digital Signal Processing in real world applications.
- CO 2:** Evaluate dynamic range, precision, and error sources in DSP implementations.
- CO 3:** Explain the architectural features of DSP processors and their computational efficiency.
- CO 4:** Analyze the performance of DSP algorithms on programmable DSP Platforms for specific applications.
- CO 5:** Select and implement DSP processors for real-time applications, including memory and peripheral interfacing.

**UNIT I:****(9 periods)**

**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, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.

**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****(9 periods)**

**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.

**Execution Control and Pipelining:** Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

**UNIT-III****(9 periods)**

**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**

**(9 periods)**

**Implementations of Basic DSP Algorithms:** The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing.

**Implementation of FFT Algorithms:** An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

**UNIT-V**

**(9 periods)**

**Interfacing Memory and I/O Peripherals to Programmable DSP Devices:** Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

**Total Periods:45**

**TEXT BOOKS:**

1. Avtar Singh and S. Srinivasan, Digital Signal Processing Implementation, 1<sup>st</sup> Edition, Cengage Learning, 2004.
2. Lapsley et al. S. Chand and Co, DSP Processor Fundamentals, Architectures & Features, 2000.

**REFERENCES:**

1. B. Venkata Ramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TMH, 2004.
2. Jonathan Stein, Digital Signal Processing: A Computer Science Perspective, John Wiley, 2000.

**IV Year B. Tech – I Semester**

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**(EC23APE703) RADAR ENGINEERING**  
**(Professional Elective – IV)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic working principle of Radar and target detection procedure.
- Learn about the working and applications of CW and Frequency modulated Radar.
- Comprehend the working and applications of MTI and Pulse Doppler Radar
- Understand different methods of tracking a target and their limitations.
- Analyze the effect of noise at the receiver and uses of phased array antennas and navigational aids.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the basic working principle of Radar and target detection procedure.
- CO 2:** Know the working and applications of CW and Frequency modulated Radar.
- CO 3:** Gain the knowledge of about MTI and Pulse Doppler Radar.
- CO 4:** Understand different methods of tracking a target and their limitations.
- CO 5:** Analyze the effect of noise at the receiver and uses of phased array antennas and navigational aids.

**UNIT I:****(9 periods)**

**Basics of Radar:** Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Display types, Illustrative Problems.

**UNIT II:****(9 periods)**

**CW and Frequency Modulated Radar:** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

**UNIT III:****(9 periods)**

**MTI and Pulse Doppler Radar:** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

**UNIT IV:****(9 periods)**

**Tracking Radar:** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two-coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

**UNIT V:****(9 periods)**

**Detection of Radar Signals in Noise:** Introduction, Noise Figure and Noise Temperature, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver. Introduction to Software Defined Radio, Introduction to Stealth technology.

**Radar Receivers:** Introduction to Phased Array Antennas- Basic Concepts, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency – scan Arrays, Radiation for Phased Array, Architecture for Phased Arrays. Radiation Pattern. Beam Steering and Beam Width changes. Navigational Aids: Direction Finder, VOR, ILS and Loran.

**Total Periods:45**

**TEXT BOOKS:**

1. Merrill I. Skolnik, Introduction to Radar Systems, 2<sup>nd</sup> Edition, TMH Special Indian Edition, 2007.
2. Byron Edde, Radar Principals, Technology, Applications, Pearson Education, 1992.

**REFERENCES:**

1. Peebles, Radar Principles, Wiley, New York, 1998.
2. G.S.N.Raju, Radar Engineering and Fundamentals of Navigational Aids, I. K. International Pvt. Ltd.
3. G. Sasi Bhushan Rao, Microwave and Radar Engineering, Pearson Education, 2014

## IV Year B. Tech – I Semester

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**(EC23APE704) 5G COMMUNICATIONS**  
**(Professional Elective – V)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts of 5G spectrum, radio access technologies, and system requirements.
- Understand the architecture and physical layer aspects of 5G networks, including MIMO and beamforming.
- Explore advanced 5G radio-access technologies and their role in multi-user communication.
- Study network slicing, SDN, NFV, and their applications in vehicular communications.
- Analyze mobility management, interference control, and dynamic network reconfiguration in 5G.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the 5G radio spectrum and channel models, including spectrum sharing and propagation challenges.
- CO 2:** Analyze the 5G network architecture, including the core network, RAN, and physical layer procedures.
- CO 3:** Evaluate different 5G radio-access technologies, including new waveforms and non-orthogonal multiple access schemes.
- CO 4:** Apply network slicing concepts and vehicular communication techniques for efficient 5G network deployment.
- CO 5:** Develop strategies for mobility and handoff management to optimize network performance and minimize interference.

**UNIT I:****(9 periods)**

**5G Radio Spectrum:** 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies.

**5G Channel Model:** The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling.

**5G Use Cases and System Concept:** Use cases and requirements, 5G system concept.

**UNIT II:****(9 periods)**

**Radio Interface Architecture:** 5G architecture options, core network architecture, RAN architecture. **5G PHYSICAL LAYER:** Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).

**UNIT III****(9 periods)**

**5G Radio-Access Technologies:** Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access

**UNIT IV****(9 periods)**

**Introduction to 5G Network Slicing:** Network Slicing, E2E Slicing, SDN and NFV Slicing

**Vehicular Communications:** From V2V to AV2X, key standards, VC architectures, V2X Use cases

**UNIT V****(9 periods)**

**Mobility and Handoff Management in 5G:** Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.

**Total Periods:45**

**TEXT BOOKS:**

1. Afif Osseiran, Jose F Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.
2. Saad Z. Asif, 5G Mobile Communications Concepts and Technologies, CRC Press, Taylor & Francis Group, 1<sup>st</sup> Edition, 2018.
3. Harri Holma, Antti Toskala, Takehiro Nakamura, 5G Technology 3GPP NEW RADIO, John Wiley & Sons 1<sup>st</sup> Edition, 2020.

**REFERENCES:**

1. Gordon L. Stuber, Principles of Mobile Communication, KLUWER ACADEMIC PUBLISHERS, 2<sup>nd</sup> Edition, 2002.
2. Joseph C. Liberti, Theodore S. Rappaport, Smart Antennas for Wireless Communications, Prentice Hall PTR, 1999
3. Ying Zhang, Network Function Virtualization Concepts and Applicability in 5G Networks, John Wiley & Sons, 2018.

## IV Year B. Tech – I Semester

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**(EC23APE705) LOW POWER VLSI DESIGN**  
**(Professional Elective – V)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the need for low-power circuit design and analyze different power dissipation mechanisms in VLSI circuits.
- Explore various low-power design approaches at the system, circuit, and mask levels.
- Study low-power adder architectures and their role in power-efficient computing.
- Examine different low-power multiplier architectures and their impact on digital design.
- Gain knowledge of low-power memory technologies and their future developments.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the need for low-power circuit design and analyze different power dissipation mechanisms in VLSI circuits.
- CO 2:** Learn various low-power design approaches at the system, circuit, and mask levels.
- CO 3:** Gain knowledge on low-power adder architectures and their role in power-efficient computing.
- CO 4:** Examine different low-power multiplier architectures and their impact on digital design.
- CO 5:** Grasp knowledge of low-power memory technologies and their future developments.

**UNIT I:****(9 periods)**

**Fundamentals:** Need for Low Power Circuit Design, Sources of Power Dissipation – Static and Dynamic Power Dissipation, Short Circuit 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:****(9 periods)**

**Low-Power Design Approaches:** Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

**UNIT III:****(9 periods)**

**Low-Voltage Low-Power Adders:** Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

**UNIT IV:****(9 periods)**

**Low-Voltage Low-Power Multipliers:** Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

**UNIT V:****(9 periods)**

**Low-Voltage Low-Power Memories:** Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

**Total Periods:45**

**TEXTBOOKS:**

1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

**REFERENCES:**

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Low Power CMOS Design – Anantha Chandra kasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons,2000.

## IV Year B. Tech – I Semester

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**(EC23APE706) WIRELESS SENSOR NETWORKS**  
(Professional Elective – V)

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts and architecture of wireless sensor networks.
- Explore various network architectures, optimization techniques, and design principles for wireless sensor networks.
- Study MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.
- Understand the infrastructure establishment of sensor networks, including topology control and synchronization.
- Provide knowledge on sensor network platforms, programming challenges, and simulation tools.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the fundamental concepts and architecture of wireless sensor networks
- CO 2:** Explore various network architectures, optimization techniques, and design principles for wireless sensor networks.
- CO 3:** Gain knowledge of MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.
- CO 4:** Understand the infrastructure establishment of sensor networks, including topology control and synchronization.
- CO 5:** Grasp the knowledge on sensor network platforms, programming challenges, and simulation tools.

**UNIT I:****(9 periods)**

**Overview of Wireless Sensor Networks:** Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.

**UNIT II:****(9 periods)**

**Architectures:** Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts.

**UNIT III:****(9 periods)**

**Networking Sensors:** MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - SMAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy-Efficient Routing, Geographic Routing.

**UNIT IV:****(9 periods)**

**Infrastructure Establishment:** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

**UNIT V:****(9 periods)**

**Sensor Network Platforms and Tools:** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

**Total Periods:45**

**TEXT BOOKS:**

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks-An Information Processing Approach, Elsevier, 2007

**REFERENCES**

1. Walten egus Dargie, Christian Poellabauer, Fundamentals Of Wireless Sensor Networks Theory And Practice, By John Wiley & Sons Publications, 2011
2. KazemSohraby, Daniel Minoli, &TaiebZnati, Wireless Sensor Networks-Technology, Protocols, and Applications, John Wiley, 2007.
3. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003

## IV Year B. Tech – I Semester

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**(EC23ASC701) RF SYSTEM DESIGN TOOLS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce RF design software and tools for designing and simulating RF systems.
- Understand impedance matching techniques and the role of scattering parameters in RF circuit design.
- Explore the design of RF power amplifiers, filters, oscillators, mixers, and voltage-controlled oscillators (VCOs).
- Analyze microstrip transmission lines, their discontinuities, and their applications in RF systems.
- Study the design, simulation, and measurement of antennas and microwave integrated circuits.

**COURSE OUTCOMES:**

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

- CO 1:** Utilize RF design software and tools to simulate and analyze RF circuits and components.
- CO 2:** Design and implement impedance matching networks such as L-match, Pi-match, and T-match circuits.
- CO 3:** Develop and evaluate RF amplifiers, filters, oscillators, and mixers for high-frequency applications.
- CO 4:** Analyze microstrip transmission lines and measure their characteristics using S-parameters and Smith charts.
- CO 5:** Design and simulate various types of antennas, including micro strip patch antennas, Yagi-Uda antennas, and horn antennas.

**Basic Concepts in RF Design:** Introduce any RF design software and orient students with the tools of the laboratory. Practice the tool to use it for significant design. Introduction to RF Design, Time Variance and Nonlinearity, Effects of nonlinearity, Passive impedance transformation, scattering parameters, impedance matching, L match, Pi match, T match, Passive IC Components- Resistors, capacitors Inductors, Schottky Diode, RF Switch.

**RF Power Amplifiers and Filters:** RF Power amplifier design examples, gain equalizers, Voltage controlled oscillators, Phase locked loops, Linearized PLL models, PLL design examples, High frequency oscillators, Loop filters, lumped filter. LPF, HPF and BPF.

**LNA, VCO and Mixers:** General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Voltage Controlled Oscillators, Mixers-General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

**Micro strip transmission lines and discontinuities:** S parameters of a Micro strip Transmission Line, Smith Chart, Analysis of Micro strip Transmission Line standing wave patterns at various frequencies, Different types of Transmission lines like CPW, Micro strip and Co-axial cable. Different types of Micro strip discontinuities like Bend, T, Via, Gap etc., Micro strip Ring Resonator.

**Antennas and Microwave Integrated Circuits:** Radiation Pattern, Gain, S Parameters, Return loss and VSWR. Design considerations of Microstrip Patch Antenna and Microstrip Array, Yagi Uda Antenna and Horn Antenna. Hybrid Microwave Integrated Circuits, Monolithic Microwave Integrated Circuits, Microwave Integrated Circuits: MMIC Amplifier.

**ANY TWELVE EXPERIMENTS ARE TO BE DONE:**

1. Design and simulate Impedance matching circuits like L-Matching, Pi Matching and T-Matching.
2. Design and Simulate a Schottky Diode and RF Switch.
3. Design and simulate a RF BJT Amplifier and LNA.
4. Design and simulate a Power Amplifier and Gain Equalizer.

5. Analyze and measure the gain of a Power Amplifier and equalise its gain using an Equalizer.
6. Design and simulate a High Frequency Oscillator and Lumped Filter.
7. Measurement of insertion loss, -3dB Cut of frequency of LPF,HPF and BPF.
8. Design and Simulate a VCO and RF Mixer.
9. Measure the S parameters of a Micro strip Transmission Line and plot the normalized impedance on a smith chart
10. Analysis of Microstrip Transmission Line standing wave pattern at various frequencies.
11. Study of different types of Transmission lines like CPW, Microstrip and Co-axial and find/measure its Insertion Loss ( S<sub>21</sub> and S<sub>12</sub> )
12. Study of different types of Microstrip discontinuities like Bend, T, Via , Gap etc and find/measure its Insertion loss.
13. Determine the Bandwidth and Quality Factor of a Microstrip Ring Resonator.
14. Design and simulate the Radiation Pattern, gain, S<sub>11</sub>and VSWR of a Microstrip Patch Antenna and Microstrip Array.
15. Design and simulate the Radiation Pattern, gain, S<sub>11</sub>and VSWR of a Yagi Uda Antenna and Horn Antenna.
16. Design and Simulate a MMIC Amplifier.

**EQUIPMENT REQUIRED:**

1. RF Circuit Design and Simulation Software
2. RF Training System
3. Antenna Measurement System with Antenna Design Software.

## IV Year B. Tech – I Semester

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**(EC23ASC702) INDUSTRIAL IOT AND AUTOMATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamentals of Industrial IoT (IIoT), its architecture, and its differences from traditional IoT.
- Understand the components of IIoT, including sensors, actuators, and control systems, and their integration with embedded platforms.
- Explore communication technologies such as ZigBee, Bluetooth, NFC, RFID, and MQTT for IIoT applications.
- Study data visualization techniques, dashboard creation, and web-based connectivity for IIoT systems.
- Learn data retrieval techniques, machine-to-machine (M2M) communication, and cloud integration for IIoT applications.
- Implement automation using PLCs, SCADA, and real-time control systems for industrial applications.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the fundamental concepts of IIoT, its architecture, and the challenges associated with industrial automation.
- CO 2:** Demonstrate the integration of sensors and actuators with Raspberry Pi/Node MCU for real-time monitoring and control.
- CO 3:** Implement communication protocols such as MQTT, ZigBee, and Bluetooth to enable seamless IIoT connectivity.
- CO 4:** Develop web-based dashboards for real-time visualization and remote monitoring of IIoT devices.
- CO 5:** Retrieve, analyze, and transmit industrial data using web-based interactions and M2M communication.

**(All the modules need to be conducted and minimum one project to be done)**

**MODULE 1: Introduction & Architecture**

What is IIoT and connected world? The difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT. Practice

1. Introduction to Arduino, Introduction to raspberry Pi.  
<https://www.youtube.com/watch?v=AQdLQV6vhbk>

**MODULE 2: IIOT Components**

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basic Sensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Practice

1. Measurement of temperature & pressure values of the process using raspberry pi/node mcu.
2. Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.
3. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

**MODULE 3: Communication Technologies of IIoT**

Communication Protocols: IEEE 802.15.4, ZigBee, Bluetooth, BLE, NFC, RFID Industry standards communication technology (MQTT), wireless network communication.

Practice

1. Demonstration of MQTT communication.

#### **MODULE 4: Visualization and Data Types of IIoT**

Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

1. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')
2. Sending alert message to the user. ways to control and interact with your environment)

#### **MODULE 5: Retrieving Data**

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

1. Device control using mobile Apps or through Web pages.
2. Machine to Machine communication.

#### **MODULE 6: Control & Supervisory Level of Automation**

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA).

Practice

1. Digital logic gates programming using ladder diagram.
2. Implementation of Boolean expression using ladder diagram.
3. Simulation of PLC to understand the process control concept.

#### **PROJECTS:**

IIoT based smart energy meter

Smart Agriculture system

Automation using controller via Bluetooth

Temperature controlled Fan/cooler using controller

Automatic streetlight

Smart Baggage Tracker

#### **TEXTBOOKS:**

1. Mahmood, The Internet of Things in the Industrial Sector, Springer Publication, Zaigham Edition.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cyber manufacturing System, Springer Publication.
3. Ismail Butun, Industrial IoT Challenges, Design Principles, Applications, and Security.

## IV Year B. Tech – I Semester

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**(BA23AAC701) GENDER SENSITIZATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Enable students to understand the gender related issues, vulnerability of women and men.
- Familiarize them about constitutional safeguard for gender equality.
- Expose the students to debates on the politics and economics of work.
- Help students reflect critically on gender violence.
- Make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider community and the workplace.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the basic concepts of gender and its related terminology.
- CO 2:** Identify the biological, sociological, psychological and legal aspects of gender.
- CO 3:** Use the knowledge in understanding how gender discrimination works in our society and how to counter it.
- CO 4:** Able to critically analyze the concept, types, and consequences of gender-based violence.
- CO 5:** Able to evaluate gender representations in media, literature, and language.

**UNIT I:****(7 Periods)**

**UNDERSTANDING GENDER:** Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

**UNIT II:****(5 Periods)**

**GENDER ROLES AND RELATIONS:** Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences- Declining Sex Ratio- Demographic Consequences-Gender Spectrum

**UNIT III:****(7 Periods)**

**GENDER AND LABOUR:** Division and Valuation of Labour-Housework: The Invisible Labor-"My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

**UNIT IV:****(5 Periods)**

**GENDER-BASED VIOLENCE:** The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence

**UNIT V:****(6 Periods)**

**GENDER AND CULTURE:** Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language- Just Relationships.

**Total Periods: 30**

**TEXT BOOKS:**

1. A.Suneetha, Uma Bhrugubanda, Towards a World of Equals: A Bilingual Textbook on Gender, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity. UK Paperback Edition, 1990.

**REFERENCES:**

1. W.tatt, Robin and Massood, Nazia, Broken Mirrors: The dowry Problems in India, London: Sage Publications, 2011.
2. Datt. R, and Kornberg. J, Women in Developing Countries, Assessing Strategies for Empowerment, London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., Gender and Governance, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, Women and Politics World Wide, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, Gender Sensitization: Issues and Challenges (English, Hardcover), Raj Publications, 2019
6. A. Revathy & Murali, Nandini, A Life in Trans Activism (Lakshmi Narayan Tripathi). The University of Chicago Press, 2016.

**ONLINE RESOURCES:**

1. [https://onlinecourses.swayam2.ac.in/nou24\\_hs53/preview](https://onlinecourses.swayam2.ac.in/nou24_hs53/preview)
2. <https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are-gender-roles-and-stereotypes>
3. <https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships-7499408>
4. [https://onlinecourses.swayam2.ac.in/cec23\\_hs29/preview](https://onlinecourses.swayam2.ac.in/cec23_hs29/preview)
5. <https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-and-how-can-it-be-redressed>
6. [https://onlinecourses.nptel.ac.in/noc23\\_mg67/preview](https://onlinecourses.nptel.ac.in/noc23_mg67/preview)
7. [https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language\\_content\\_entity=en](https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language_content_entity=en)
8. [https://onlinecourses.swayam2.ac.in/nou25\\_ge38/preview](https://onlinecourses.swayam2.ac.in/nou25_ge38/preview)
9. <https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/>
10. <https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/>
11. <https://archive.nptel.ac.in/courses/109/106/109106136/>
12. <https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girls>

## IV Year B. Tech – I Semester

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**(EC23AIP701) INDUSTRY INTERNSHIP**

**COURSE DESCRIPTION:** This course is designed to expose students to the industrial environment and prepare them as competent professionals for the industry. It sharpens real-time technical and managerial skills required on the job, while providing valuable professional experience and an understanding of engineers' responsibilities and ethics. Students will gain familiarity with the latest equipment, materials, and technologies, develop proficiency in technical report writing, and acquire first-hand exposure to corporate working culture.

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Equip students with an understanding of industrial processes, organizational structures, professional practices, and emerging technologies relevant to engineering domains.
- Enhance technical competence, analytical ability, problem-solving, leadership, team spirit, finance, project management, and communication skills through hands-on engagement in real-time industrial projects.
- Cultivate professional ethics, social responsibility, adaptability to corporate culture, environmental and sustainability awareness, and a lifelong learning mindset for industry readiness.

**COURSE OUTCOMES:**

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

- CO 1: Evaluate** industrial processes, latest equipment, materials, and technologies to solve complex engineering problems in compliance with relevant standards, codes, policies, and regulations.
- CO 2:** Evaluate safety, health, societal, environmental, sustainability, ethical, economic, and managerial considerations in industrial problem-solving and decision-making.
- CO 3:** Analyze individual and team performance, leadership, and professional communication effectiveness in written, oral, and graphical forms while practicing engineering in real-time industrial settings.

## IV Year B. Tech – II Semester

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**(EC23AIP801) INTERNSHIP**

**COURSE DESCRIPTION:** This semester-long course provides students with comprehensive, hands-on exposure to industry, national laboratories, or academic institutions, relevant to their branch-specific or interdisciplinary interests, through offline, online, or blended modes. It is designed to prepare students as competent professionals by sharpening real-time technical, managerial, and problem-solving skills, while fostering an understanding of professional responsibilities, ethics, and workplace culture.

Students will analyze, design, and develop innovative solutions to real-world engineering problems, gain familiarity with latest equipment, materials, and technologies, and enhance proficiency in technical report writing, documentation, and professional communication. They will also acquire first-hand exposure to organizational processes and corporate working culture, preparing them to function effectively in diverse professional settings.

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Equip students with an understanding of industrial processes, organizational structures, professional practices, and emerging technologies relevant to engineering domains.
- Enhance technical competence, analytical ability, design, problem-solving, leadership, team spirit, finance, project management, and communication skills through hands-on engagement in real-time industrial projects.
- Cultivate professional ethics, social responsibility, adaptability to corporate culture, environmental and sustainability awareness, and a lifelong learning mindset for industry readiness.

**COURSE OUTCOMES:**

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

- CO 1:** Create real-world engineering solutions using industrial processes, latest equipment, materials, and technologies in compliance with relevant standards, codes, policies, and regulations.
- CO 2:** Evaluate safety, health, societal, environmental, sustainability, ethical, economic, and managerial considerations in industrial problem-solving and decision-making.
- CO 3:** Analyze individual and team performance, leadership, and professional communication effectiveness in written, oral, and graphical forms while practicing engineering in real-time industrial settings.

## IV Year B. Tech – II Semester

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**(EC23APW801) PROJECT**

**COURSE DESCRIPTION:** This capstone course provides students with the opportunity to conceptualize, design, and execute a comprehensive project, either research-oriented or application-oriented, relevant to their discipline or interdisciplinary areas. Students will identify a project topic, perform a critical literature survey, and gather preliminary data. They will evaluate feasibility through time, cost, and resource analysis, select suitable tools and methodologies, and carry out detailed design, analysis, and implementation. The project emphasizes creating solutions to real-world problems, supported by ethical, sustainable, and professional considerations. The outcomes are documented in a thesis and defended through a formal presentation before an evaluation committee.

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Develop a thorough understanding of project identification, planning, and execution by integrating domain knowledge, research insights, and emerging trends in engineering practice.
- Equip students with the ability to design, develop, and implement project-based engineering solutions through systematic analysis, application of modern tools and techniques, project and financial management, leadership, and effective individual and team participation.
- Foster professional ethics, societal and environmental responsibility, and a lifelong learning mindset by engaging students in real-world project work that addresses contemporary challenges and community needs.

**COURSE OUTCOMES:**

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

- CO 1:** Create engineering systems or processes to solve complex problems by applying appropriate tools, techniques, standards, codes, policies, regulations, and the latest developments.
- CO 2:** Evaluate societal, health, safety, environmental, sustainability, economic, and project management considerations in developing engineering solutions.
- CO 3:** Demonstrate effective individual or teamwork, leadership, and professional communication in written, oral, and graphical forms while executing engineering projects.

# OPEN ELECTIVES

## III Year B. Tech – I Semester

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**(CE23AOE501) CONSTRUCTION TECHNOLOGY AND MANAGEMENT****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand project management fundamentals, organizational structures, and leadership principles in construction.
- Analyse manpower planning, equipment management, and cost estimation in civil engineering projects.
- Apply planning, scheduling, and project management techniques such as CPM and PERT.
- Evaluate various contract types, contract formation, and legal aspects in construction management.
- Assess safety management practices, accident prevention strategies, and quality management systems in construction.

**COURSE OUTCOMES:**

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

- CO 1:** Understand project management fundamentals, organizational structures, and leadership principles in construction.
- CO 2:** Analyse manpower planning, equipment management, and cost estimation in civil engineering projects.
- CO 3:** Apply planning, scheduling, and project management techniques such as CPM and PERT.
- CO 4:** Evaluate various contract types, contract formation, and legal aspects in construction management.
- CO 5:** Assess safety management practices, accident prevention strategies, and quality management systems in construction.

**UNIT I:****(9 Periods)**

**Introduction:** Project forms, Management Objectives and Functions; Organizational Chart of a Construction Company; Manager's Duties and Responsibilities; Public Relations; Leadership and Team - Work; Ethics, Morale, Delegation and Accountability.

**UNIT II:****(10 Periods)**

**Man and Machine:** Man-Power Planning, Training, Recruitment, Motivation, Welfare Measures and Safety Laws; Machinery for Civil Engineering, Earth Movers and Hauling Costs, Factors Affecting Purchase, Rent, and Lease of Equipment, and Cost Benefit Estimation.

**UNIT III:****(9 Periods)**

**Planning, Scheduling and Project Management:** Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network- formulation and Time Computation.

**UNIT IV:****(9 Periods)**

**Contracts:** Types of Contracts, formation of Contract – Contract Conditions – Contract for Labour, Material, Design, Construction – Drafting of Contract Documents Based On IBRD/MORTH Standard Bidding Documents – Construction Contracts – Contract Problems – Arbitration and Legal Requirements Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.

**UNIT V:****(8 Periods)**

~~**Safety Management:** Implementation and Application of QMS in Safety Programs, ISO~~

9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.

**Total Periods: 45**

**TEXT BOOKS:**

3. SK. Sears, GA. Sears, RH. Clough, Construction Project Management, John Wiley and Sons, 6<sup>th</sup> Edition, 2016.
4. Saleh Mubarak, Construction Project Scheduling and Control, 4<sup>th</sup> Edition, 2019.

**REFERENCES:**

1. Brien, J.O. and Plotnick, F.L., CPM in Construction Management, Mcgraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and Control with PERT and CPM, Laxmi Publications, 2002.
3. Stephens Nunnally, Construction Methods and Management: Pearson New International Edition, 8<sup>th</sup> Edition.
4. Rhoden, M and Cato B, Construction Management and Organisational Behaviour, Wiley-Blackwell, 2016.
5. T.R. Jagadish and M.A. Jayaram, Design of Bridges Structure, Prentice Hall of India Pvt., Delhi.
6. Pandey, I.M, Financial Management, Pearson India Education Services Pvt. Ltd, 12<sup>th</sup> Edition, 2021.

## III Year B. Tech – I Semester

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**(CE23AOE502) GREEN BUILDINGS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts of green buildings, their necessity, and sustainable features.
- Analyze green building concepts, rating systems, and their benefits in India.
- Apply green building design principles, energy efficiency measures, and renewable energy sources.
- Evaluate air conditioning systems, HVAC designs, and energy modeling for sustainable buildings.
- Assess material conservation strategies, waste management, and indoor environmental quality in green buildings.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the importance of green buildings, their necessity, and sustainable features.
- CO 2:** Analyze various green building practices, rating systems, and their impact on environmental sustainability.
- CO 3:** Apply principles of green building design to enhance energy efficiency and incorporate renewable energy sources.
- CO 4:** Evaluate HVAC systems, energy-efficient air conditioning techniques, and their role in sustainable building design.
- CO 5:** Assess material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings.

**UNIT I:****(9 Periods)**

**Introduction to Green Building:** Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing a Green Building, Important Sustainable Features for Green Buildings.

**UNIT II:****(10 Periods)**

**Green Building Concepts and Practices:** Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

**UNIT III:****(9 Periods)**

**Green Building Design:** Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

**UNIT IV:****(9 Periods)**

**Air Conditioning:** Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

**UNIT V:**

**(8 Periods)**

Material Conservation– Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health– Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke.

**Total Periods: 45**

**TEXT BOOKS:**

1. Handbook on Green Practices, Indian Society of Heating Refrigerating and Air Conditioning Engineers, 2009.
2. Tom Woolley and Sam Kimings, Green Building Hand Book, 2009.

**REFERENCES:**

1. T.R. Jagadish and M.A. Jayaram, Design of Bridges Structure, Prentice Hall of India Pvt., Delhi.
2. Trish Riley, Complete Guide to Green Buildings
3. Kent Peterson, Standard for the Design for High Performance Green Buildings, 2009
4. Energy Conservation Building Code –ECBC-2020, Published by BEE

**ONLINE RESOURCES:**

1. <https://archive.nptel.ac.in/courses/105/102/105102195/>

## III Year B. Tech – I Semester

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**(CS23AOE501) PRINCIPLES OF OPERATING SYSTEMS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental components and design principles of operating systems.
- Explore the concepts of processes, threads, interprocess communication, and synchronization.
- Analyze problems related to concurrency, deadlocks, and CPU scheduling.
- Study memory management strategies including paging and virtual memory.
- Understand file systems and their management in modern operating systems.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the roles and responsibilities of operating systems in resource management.
- CO 2:** Design and evaluate algorithms for process scheduling and memory management.
- CO 3:** Apply synchronization mechanisms to solve concurrency problems.
- CO 4:** Analyze and prevent deadlock scenarios in multitasking environments.
- CO 5:** Describe file system structures and their role in storage management.

**UNIT I:****(9 Periods)**

**Operating Systems Overview:** Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems

**System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

**UNIT II:****(10 Periods)**

**Processes:** Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues.

**CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

**UNIT III:****(9 Periods)**

**Synchronization Tools:** The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization.

**Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

**UNIT IV:****(9 Periods)**

**Memory-Management Strategies:** Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

**UNIT V:****(8 Periods)**

**File System:** File System Interface: File concept, Access methods, Directory Structure;

**File system Implementation:** File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; **File-System Internals:** File-System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection,

Principles of protection, Protection Rings, Domain of protection, Access matrix.

**Total Periods: 45**

**TEXT BOOKS:**

1. Silberschatz A, Galvin P B, Gagne G, Operating System Concepts Wiley, 10<sup>th</sup> Edition, 2018
2. Tanenbaum A S, Modern Operating Systems, Pearson, 4<sup>th</sup> Edition, 2016

**REFERENCES:**

1. Stallings W Operating Systems -Internals and Design Principles, Pearson, 9<sup>th</sup> Edition, 2018
2. D.M. Dhamdhare, Operating Systems: A Concept Based Approach, McGraw- Hill, 3<sup>rd</sup> Edition, 2013.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106/106/106106144/>
2. <https://peterindia.net/OperatingSystems.html/>

## III Year B. Tech – I Semester

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**(AM23AOE501) ARTIFICIAL INTELLIGENCE TOOLS AND TECHNIQUES****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts and real-world applications of Artificial Intelligence.
- Explore AI tools and platforms with minimal mathematical complexity.
- Provide practical experience in building intelligent systems using Python-based libraries.
- Develop AI thinking through hands-on use cases from multiple domains.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the key areas and applications of Artificial Intelligence.
- CO 2:** Apply search and logic-based reasoning techniques for simple problem solving.
- CO 3:** Use standard AI libraries to implement basic ML and NLP applications.
- CO 4:** Analyze real-life problems and apply suitable AI tools to solve them.
- CO 5:** Demonstrate the ability to use AI ethically and responsibly.

**UNIT I:****(8 Periods)**

What is AI? Scope and Applications, Intelligent Agents and Simple AI Systems  
 Search Techniques: Breadth-First Search, Depth-First Search, Problem-solving with heuristics (A\* algorithm), Tools Introduction: Google Colab, Jupyter Notebook

**UNIT II:****(9 Periods)**

Basics of Logic and Inference, Knowledge Representation: Facts and Rules, Simple Rule-Based Systems, Constraint Satisfaction Problems (CSP), Tools: Prolog demo or Scikit-learn Rule-based models

**UNIT III:****(10 Periods)**

What is Machine Learning? Types of ML, Basic Algorithms: Decision Trees, k-NN, Clustering, Train/Test Split, Accuracy, Confusion Matrix, Using Scikit-learn for classification tasks, Hands-on: Predicting student performance, loan default detection.

**UNIT IV:****(10 Periods)**

Natural Language Processing (NLP) Basics: Tokenization, Stopwords, Sentiment Analysis using NLTK/spaCy, Basics of Image Processing: OpenCV introduction, Simple CNN for image classification (using pre-trained models), Mini-project: Text-based chatbot or object recognition system.

**UNIT V:****(8 Periods)**

**Overview of AI Platforms:** Google AI, AWS AI, Azure AI, Streamlit for AI web app deployment, OpenAI GPT & Chatbot APIs (Intro Only), AI in Healthcare, Education, Finance, and Agriculture, Ethics in AI: Data Bias, Responsible AI, Future of Work.

**Total Periods: 45****TEXT BOOKS:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3<sup>rd</sup> Edition.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2022.

**REFERENCES:**

1. E. Rich and K. Knight, Artificial Intelligence, 3<sup>rd</sup> Edition.
2. Patrick Henny Winston, Artificial Intelligence, Pearson Education, 3<sup>rd</sup> Edition.

## III Year B. Tech – I Semester

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**(AM23AOE502) INTRODUCTION TO ARTIFICIAL INTELLIGENCE****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the distinction between optimal reasoning Vs. human like reasoning.
- Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- Learn different knowledge representation techniques.
- Understand the applications of AI, namely game playing, theorem proving, and machine learning.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the distinction between optimal reasoning Vs human like reasoning and formulate an efficient problem space for a problem expressed in natural language. Also select a search algorithm for a problem and estimate its time and space complexities.
- CO 2:** Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
- CO 3:** Learn different knowledge representation techniques.
- CO 4:** Understand the concepts of state space representation, exhaustive Search, heuristic search together with the time and space complexities.
- CO 5:** Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.

**UNIT I:****(8 Periods)**

Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

**UNIT II:****(9 Periods)**

Games - Optimal Decisions in Games, Alpha-Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic-Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

**UNIT III:****(10 Periods)**

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

**UNIT IV:****(10 Periods)**

Planning - Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.

**UNIT V:****(8 Periods)**

**Probabilistic Reasoning:** Acting under Uncertainty, Basic Probability Notation Bayes' Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.

**Total Periods: 45**

**TEXT BOOKS:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 3<sup>rd</sup> Edition.
2. E. Rich and K. Knight, Artificial Intelligence, TMH, 3<sup>rd</sup> Edition.

**REFERENCES:**

1. Patrick Henny Winston, Artificial Intelligence, Pearson Education, 3<sup>rd</sup> Edition.
2. Shivani Goel, Artificial Intelligence, Pearson Education.

## III Year B. Tech – I Semester

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**(CY23APC301) COMPUTER NETWORKS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the different types of networks
- Discuss the software and hardware components of a network
- Develop an understanding the principles of computer networks.
- Familiarize with OSI model and the functions of layered structure.
- Explain networking protocols, algorithms and design perspectives

**COURSE OUTCOMES:**

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

- CO 1:** Identify the software and hardware components of a Computer network.
- CO 2:** Explain the functionality of each layer of a computer network.
- CO 3:** Identify and analyze flow control, congestion control, and routing issues.
- CO 4:** Analyze and interpret the functionality and effectiveness of the routing protocols.
- CO 5:** Choose the appropriate transport protocol based on the application requirements.

**UNIT I:****(8 Periods)**

**Introduction:** Types of Computer Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship of Services to Protocols, Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

**UNIT II:****(10 Periods)**

**The Data Link Layer:** Guided Transmission Media, Persistent Storage, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Data Link Layer Design Issues, Services Provided to The Network Layer, Framing Error Control, Flow Control, Error Detection and Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission and Receipt, Simplex Link-Layer Protocols, Half duplex, Full-Duplex.

**Sliding Window Protocols:** The Channel Allocation Problem, Static Channel Allocation, Assumptions for Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet.

**UNIT III:****(9 Periods)**

**The Network Layer:** Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, unicast Routing, Internetworking, **Internetworks:** An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes: Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6.

**UNIT IV:****(8 Periods)**

~~**The Transport Layer:** The Transport Service, Services Provided to The Upper Layers,~~

Transport Service Primitives, Error Control and Flow Control, Multiplexing, Congestion Control, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction to UDP, Remote Procedure Call, Real-Time Transport Protocols, **The Internet Transport Protocols:** TCP, Introduction To TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

**UNIT V:**

**(10 Periods)**

**The Application Layer:** Electronic Mail, Architecture and Services, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.

**Total Periods: 45**

**TEXT BOOKS**

3. Andrew Tanenbaum, Feamster, Wetherall, Computer Networks (Global Edition), Pearson, 6<sup>th</sup> Edition, 2021.
4. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, 5<sup>th</sup> Edition, 2017.

**REFERENCES:**

6. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson, 6<sup>th</sup> Edition, 2019.
7. Youlu Zheng, Shakil Akthar, Networks for Computer Scientists and Engineers, Oxford Publishers, 1<sup>st</sup> Edition, 2016.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106105183/25>
2. <http://www.nptelvideos.in/2012/11/computer-networks.html>
3. <https://nptel.ac.in/courses/106105183/3>

## III Year B. Tech – I Semester

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**(DS23AOE501) DATA ANALYSIS WITH R PROGRAMMING****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts of computing and data analysis using the R programming language.
- Learn statistical concepts such as measures of central tendency, variability, and correlation, and apply them using real-world datasets.
- Develop the ability to perform hypothesis testing and interpret the results in the context of statistical inference.
- Explore advanced R programming constructs and statistical modeling techniques for applied data analysis.

**COURSE OUTCOMES:**

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

- CO 1:** Use R to perform basic data operations, handle datasets, and create simple visualizations.
- CO 2:** Analyze data patterns and relationships using visualizations and probability distributions in R.
- CO 3:** Perform exploratory data analysis, hypothesis testing, and linear regression modeling using R.
- CO 4:** Calculate and interpret correlation and perform hypothesis tests on means using R.
- CO 5:** Apply advanced R programming and statistical modeling techniques, including linear regression, loops, and hypothesis testing.

**UNIT I:****(8 Periods)**

**Introduction to Computing:** Installation of R, The basics of R syntax, workspace, Matrices and lists, Sub setting, System-defined functions; the help system, Errors and warnings; coherence of the workspace.

**Getting Used to R:** Describing Data: Viewing and manipulating Data, Plotting data, Reading the data from console, file (.csv) local disk and web, Working with larger datasets.

**UNIT II:****(10 Periods)**

**Shape of Data and Describing Relationships:** Tables, charts and plots, Univariate data, measures of central tendency, frequency distributions, variation, and Shape, Multivariate data, relationships between a categorical and a continuous variable, Relationship between two continuous variables – covariance, correlation coefficients, comparing multiple correlations, Visualization methods – categorical and continuous variables, two categorical variables, two continuous variables.

**Probability Distributions:** Sampling from distributions – Binomial distribution, normal distribution, tTest, zTest, Chi Square test 194, Density functions, Data Visualization using ggplot – Box plot, histograms, scatter plotter, line chart, bar chart, heat maps.

**UNIT III:****(9 Periods)**

**Exploratory Data Analysis:** Demonstrate the range, summary, mean, variance, median, standard deviation, histogram, box plot, scatter plot using population dataset.

**Testing Hypothesis:** Null hypothesis significance testing, Testing the mean of one sample, Testing two means.

**Predicting Continuous Variables:** Linear models, Simple linear regression, Multiple regression, Bias-variance trade-off – cross-validation.

**UNIT IV:****(9 Periods)**

**Correlation:** How to calculate the correlation between two variables, How to make scatter plots, Use the scatter plot to investigate the relationship between two variables.

**Tests of Hypotheses:** Perform tests of hypotheses about the mean when the variance is known, Compute the p-value, Explore the connection between the critical region, the test statistic, and the p-value.

**UNIT V: (9 Periods)**

**Estimating A Linear Relationship:** Demonstration on a Statistical Model for, Linear Relationship, Least Squares Estimates, The R Function lm, Scrutinizing the Residuals.

**Apply-Type Functions:** Defining user defined classes and operations, Models and methods in R, Customizing the user's environment, Conditional statements, Loops and iterations.

**Statistical Functions in R:** Write Demonstrate Statistical functions in R, Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models, advanced modeling methods.

**Total Periods: 45**

**TEXT BOOKS:**

1. Sandip Rakshit, Statistics with R Programming, 1<sup>st</sup> Edition, 2018.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer Texts in Statistics, 2017.

**REFERENCES:**

1. Joseph Schmuller, Statistical Analysis with R for Dummies, Wiley, 2017.
2. K G Srinivasa, G M Siddesh, ChetanShetty, Sowmya B J, Statistical Programming in R, Oxford Higher Education, 2017.

## III Year B. Tech – I Semester

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**(IT23AOE501) WEB PROGRAMMING CONCEPTS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide students with insights into Internet programming and the skills to design and implement complete web-based applications.
- Equip students with the knowledge of web servers and web application servers, and to develop their ability to apply design methodologies.
- Provide students with insights on programming Common Gateway Interfaces (CGI), and developing user interfaces for web applications.

**COURSE OUTCOMES:**

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

- CO 1:** Analyze a web page and identify its elements and attributes.
- CO 2:** Create web pages using XHTML and Cascading Styles sheets.
- CO 3:** Installation and usage of Server software's.
- CO 4:** Database Connectivity to web applications
- CO 5:** Build web applications using Servlet and JSP

**UNIT I:****(9 Periods)****Web Basics and Overview:** Introduction to Internet, World Wide Web, Web Browsers, URL, MIME, HTTP, Web Programmers Tool box.**HTML Common tags:** List, Tables, images, forms, frames, Cascading Style Sheets (CSS) & its Types. Introduction to Java Script, Declaring variables, functions, Event handlers (onclick, on submit, etc.,) and Form Validation**UNIT II:****(9 Periods)****Introduction to XML:** Document type definition, XML Schemas, Presenting XML, Introduction to XHTML, Using XML Processors: DOM and SAX.**PHP:** Declaring Variables, Data types, Operators, Control structures, Functions.**UNIT III:****(9 Periods)****Web Servers and Servlets:** Introduction to Servlets, Lifecycle of a Servlet, JSDK, Deploying Servlet, The Servlet API, The javax. Servlet Package, Reading Servlet parameters, Reading Initialization parameters. The javax. servlet HTTP package, Handling Http Request & Responses, Cookies and Session Tracking**UNIT IV:****(9 Periods)****Database Access:** Database Programming using JDBC, JDBC drivers, Studying Javax.sql.\* package, Connecting to database in PHP, Execute Simple Queries, Accessing a Database from a Servlet. Introduction to struts frameworks.**UNIT V:****(9 Periods)****JSP Application Development:** The Anatomy of a JSP Page, JSP Processing. JSP Application Design and JSP Environment, JSP Declarations, Directives, Expressions, Scripting Elements, implicit objects. Java Beans: Introduction to Beans, Deploying java Beans in a JSP page.**Total Periods: 45****TEXT BOOKS:**

1. Chris Bates, Web Programming, Building Internet Applications, Wiley Dream Tech, 2<sup>nd</sup> Edition, 2006.

2. Marty Hall and Larry Brown, Core Servlets and Java Server Pages, Volume 1: Core Technologies, Pearson, 2003.

**REFERENCES:**

1. Sebesta, Programming world wide web, Pearson Education, 2007.
2. Dietel and Nieto, Internet and World Wide Web, 2018.

## III Year B. Tech – I Semester

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**(EC23AOE501) ELECTRONIC CIRCUITS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand semiconductor diodes, their characteristics and applications.
- Explore the operation, configurations, and biasing of BJTs.
- Study the operation, analysis, and coupling techniques of BJT amplifiers.
- Learn the operation, applications and uses of feedback amplifiers and oscillators.
- Analyze the characteristics, configurations, and applications of operational amplifiers

**COURSE OUTCOMES:**

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

**CO 1:** Understand semiconductor diodes, their characteristics and applications.**CO 2:** Explore the operation, configurations, and biasing of BJTs.**CO 3:** Gain knowledge about the operation, analysis, and coupling techniques of BJT amplifiers.**CO 4:** Learn the operation, applications and uses of feedback amplifiers and oscillators.**CO 5:** Analyze the characteristics, configurations, and applications of operational amplifiers.**UNIT I:****(9 Periods)****Semiconductor Diode and Applications:** Introduction, PN junction diode – structure, operation and VI characteristics, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only).**Special Diodes:** Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode.**UNIT II:****(9 Periods)****Bipolar Junction Transistor (BJT):** Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, SelfBias, Bias Stability, Bias Compensation using Diodes.**Single stage amplifiers:** Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model.**UNIT III:****(9 Periods)****Multistage amplifiers:** Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).**UNIT IV:****(9 Periods)****Feedback amplifiers:** Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only).**Oscillators:** Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.**UNIT V:****(9 Periods)****Op-amp:** Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, ~~741 op-amp and its features, modes of operation-inverting, non-inverting, differential.~~

**Applications of op-amp:** Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.

**Total Periods:45**

**TEXT BOOKS:**

1. J. Millman and Christos. C. Halkias, Electronics Devices and Circuits, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2006.
2. David A. Bell, Electronics Devices and Circuits Theory, Oxford University press, 5<sup>th</sup> Edition, 2008.

**REFERENCES:**

- 1 . Electronics Devices and Circuits Theory, R.L.Boylestad, Louis Nashelsky and K.Lal Kishore, 12<sup>th</sup> Edition, 2006, Pearson, 2006.
2. Electronic Devices and Circuits, N. Salivahanan, and N.Suresh Kumar, TMH, 3<sup>rd</sup> Edition, 2012.
3. S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 5<sup>th</sup> Edition.

## III Year B. Tech – I Semester

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**(EE23AOE501) ELECTRICAL SAFETY PRACTICES AND STANDARDS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand fundamentals of electrical safety and causes of electrical hazards.
- Learn safety components and protection against overvoltages and static electricity.
- Study grounding principles and determine safe working conditions.
- Apply electrical safety practices in various environments.
- Familiarize with electrical safety standards and statutory regulations.

**COURSE OUTCOMES:**

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

**CO 1:** Understanding the Fundamentals of Electrical Safety.**CO 2:** Identifying and Applying Safety Components.**CO 3:** Analyzing Grounding Practices and Electrical Bonding.**CO 4:** Applying Safety Practices in Electrical Installations and Environments.**CO 5:** Evaluating Electrical Safety Standards and Regulatory Compliance.**UNIT I:****(9 Periods)****Introduction to Electrical Safety:** Fundamentals of Electrical safety-Electric Shock-physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.**UNIT II:****(10 Periods)****Safety Components:** Introduction to conductors and insulators- voltage classification - safety against over voltages- safety against static electricity-Electrical safety equipment's - Fire extinguishers for electrical safety.**UNIT III:****(9 Periods)****Grounding:** General requirements for grounding and bonding- Definitions- System grounding- Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.**UNIT IV:****(9 Periods)****Safety Practices:** General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations- Case studies.**UNIT V:****(8 Periods)****Standards for Electrical Safety:** Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 - National Electric Safety code NESC-Statutory requirements from electrical inspectorate.**Total Periods: 45****TEXT BOOKS:**

1. Massimo A.G.Mitolo, Electrical Safety of Low-Voltage Systems, McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi, Electric Safety - Practice and Standards, CRC Press, USA, 2014.

**REFERENCES:**

1. Kenneth G. Mastrullo, Ray A. Jones, The Electrical Safety Program Book, Jones and Bartlett Publishers, London, 2<sup>nd</sup> Edition, 2011.
2. Palmer Hickman, Electrical Safety-Related Work Practices, Jones & Bartlett Publishers, London, 2009
3. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Electrical Safety Hand Book, McGraw-Hill, New York, USA, 4<sup>th</sup> Edition, 2012.

## III Year B. Tech – I Semester

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**(ME23AOE501) SUSTAINABLE ENERGY TECHNOLOGIES****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of energy systems and assess the current global energy scenario.
- Analyze the impact of fossil fuels on climate and the need for sustainable alternatives.
- Study the working principles and applications of various renewable energy technologies.
- Explore energy storage systems and their integration with renewable sources.
- Examine future energy solutions including hydrogen energy and carbon capture techniques.

**COURSE OUTCOMES:**

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

- CO 1:** Describe energy fundamentals, global energy demand, and the need for transition to renewables.
- CO 2:** Compare and evaluate different renewable energy sources like solar, wind, hydro, and biomass.
- CO 3:** Design and analyze basic solar photovoltaic and wind energy systems. Classify and explain various energy storage technologies and their applications.
- CO 4:** Evaluate advanced energy technologies such as hydrogen fuel cells and CCS for sustainable energy systems.
- CO 5:** Assess advanced energy technologies such as hydrogen fuel cells and CCS for sustainable energy systems

**UNIT I:****(9 Periods)****Fundamentals of Energy and Renewable Sources:** Introduction and Fundamental Concepts, Energy Scenario in Modern World, Fossil Fuels, Climate Change Impacts, and Overview of Renewable Energy Technology**UNIT II:****(9 Periods)****Renewable Energy Technologies:** Hydropower, Wind Energy, Solar Energy, Solar Photovoltaic Systems.**UNIT III:****(9 Periods)****Biomass and Emerging Renewable Sources:** Bioenergy and Biofuels, Geothermal Energy, Introduction to Energy Storage Systems.**UNIT IV:****(9 Periods)****Energy Storage Technologies:** Introduction, Mechanical Energy Storage Technologies, Energy Storage System through Capacitor, Electrochemical Energy Storage Systems, Thermal Energy Storage Systems**UNIT V:****(9 Periods)****Energy Storage – Advanced Concepts and Future Technologies:** Trends in Energy Storage Types and their Characteristics, Fuel Cells and Hydrogen Energy, Carbon Capture and Storage (CCS).**Total Periods: 45**

**TEXT BOOKS**

1. S. P. Sukhatme & J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 3<sup>rd</sup> Editio.
2. D. Y. Goswami, F. Kreith & J. F. Kreider, Principles of Solar Engineering, CRC Press.

**REFERENCES:**

1. B. K. Hodge, Alternative Energy Systems and Applications, Wiley.
2. Ibrahim Dincer & Mark A. Rosen, Thermal Energy Storage: Systems and Applications, Wiley.

**ONLINE RESOURCES:**

1. Energy Resources, Economics and Environment, NPTEL, IIT Bombay.  
<https://nptel.ac.in/courses/109101171>
2. <https://www.youtube.com/watch?v=E76q-9q7ZDg>

## III Year B. Tech – I Semester

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**(BA23AOE501) ENTREPRENEURSHIP AND VENTURE CREATION****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership
- Encourage creativity and innovation
- Enable them to learn pitching and presentation skills
- Make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept
- Enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Persona

**COURSE OUTCOMES:**

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

- CO 1:** Develop an entrepreneurial mindset and appreciate the concept of entrepreneurship.
- CO 2:** Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution
- CO 3:** Understand and apply customer-centric innovation by designing solutions aligned with Jobs-to-be-Done, developing MVP prototypes, assessing competitive positioning, and evaluating market size and opportunity potential.
- CO 4:** Develop and apply comprehensive business and financial models, go-to-market strategies, and funding plans by leveraging lean methodologies, financial planning, marketing, and sales fundamentals tailored to startup growth.
- CO 5:** Prepare and deliver an investible pitch deck of the impractical venture to attract stakeholders

**UNIT I:****(8 Periods)**

**Entrepreneurship Fundamentals and Context:** Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.

**UNIT II:****(8 Periods)**

**Problem & Customer Identification:** Understanding and analyzing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion-identifying and defining problem using Design thinking principles -Analyzing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

**UNIT III:****(10 Periods)**

**Solution Design, Prototyping & Opportunity Assessment and Sizing:** Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

**UNIT IV:****(10 Periods)**

**Business & Financial Model, Go-to-Market Plan:** Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models.

Importance of Build - Measure – Lean approach.

**Business Planning:** components of Business plan- Sales plan, People plan and financial plan.

**Financial Planning:** Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance.

**Introduction to Marketing and Sales:** Selecting the Right Channel, creating digital presence, building customer acquisition strategy.

Choosing a form of business organization specific to your venture, identifying sources of funds: Debt& Equity, Map the Start-up Life-cycle to Funding Options.

#### **UNIT V:**

**(9 Periods)**

**Scale Outlook and Venture Pitch Readiness:** Understand and identify potential and aspiration for scale is-a-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

**Total Periods: 45**

#### **TEXT BOOKS:**

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Entrepreneurship, Mcgraw Hill Education, 11<sup>th</sup> Edition, 2016
2. Peter F. Drucker, Innovation and Entrepreneurship, Harper Business, 1<sup>st</sup> Edition, 1985

#### **REFERENCES:**

1. Simon Sinek, Start with Why, Penguin Books limited, 2011.
2. Brown Tim, Changeby Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business, 2019.
4. Namita Thapar, The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited, 2022.
5. Saras D. Sarasvathy, Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd., 2008.

#### **ONLINE RESOURCES:**

1. <https://www.ediindia.org>
2. <https://www.wfnen.org>
3. <https://www.coursera.org/browse/business/entrepreneurship>

## III Year B. Tech – I Semester

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**(EG23AOE501) ACADEMIC WRITING AND PUBLIC SPEAKING****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Encourage all round development of the students by focusing on writing skills
- Make the students aware of non-verbal skills
- Develop analytical skills
- Deliver effective public speeches

**COURSE OUTCOMES:**

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

**CO 1:** Understand various elements of Academic Writing**CO 2:** Identify sources and avoid plagiarism**CO 3:** Demonstrate the knowledge in writing a Research paper**CO 4:** Analyze different types of essays**CO 5:** Build confidence in giving an impactful presentation to the audience and Assess the speeches of others to know the positive strengths of speakers**UNIT I:****(09 Periods)****Introduction to Academic Writing:** Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing.**UNIT II:****(09 Periods)****Academic Journal Article:** Art of condensation- summarizing and paraphrasing - Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading – Plagiarism.**UNIT III:****(09 Periods)****Essay & Writing Reviews:** Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review- SoP.**UNIT IV:****(09 Periods)****Public Speaking:** Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies – Analysis of Impactful Speeches- Speeches for Academic events.**UNIT V:****(09 Periods)****Public Speaking and Non-Verbal Delivery:** Body Language – Facial Expressions-Kinesics – Oculistics – Proxemics – Haptics – Chronemics - Paralanguage – Signs.**Total Periods: 45****TEXT BOOKS:**

1. Marilyn Anderson, Critical Thinking, Academic Writing And Presentation Skills: MG University Edition Paperback – 1 January 2010 Pearson Education; 1<sup>st</sup> Edition Pease, Allan & Barbara. The Definitive Book Ff Body Language RHUS Publishers, 2016.

**REFERENCES:**

1. Alice Savage, Masoud Shafiei, Effective Academic Writing, 2<sup>nd</sup> Edition. 2014.

2. Shalini Verma, Body Language, S Chand Publications 2011.

3. Sanjay Kumar and Pushpalata, Communication Skills 2<sup>nd</sup> Edition, Oxford, 2015.
4. Sharon Gerson, Steven Gerson, Technical Communication Process and Product, Pearson, New Delhi, 2014
5. Elbow, Peter. Writing with Power. OUP USA, 1998.

**ONLINE RESOURCES:**

1. <https://youtu.be/NNhTIT81nH8>
2. <https://www.youtube.com/watch?v=478ccrWKY-A>
3. <https://www.youtube.com/watch?v=nzGo5ZC1gMw>
4. <https://www.youtube.com/watch?v=Qve0ZBmJMh4>
5. <https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal-aspects-of-delivery/>
6. [https://onlinecourses.nptel.ac.in/noc21\\_hs76/preview](https://onlinecourses.nptel.ac.in/noc21_hs76/preview)
7. <https://archive.nptel.ac.in/courses/109/107/109107172/#>
8. <https://archive.nptel.ac.in/courses/109/104/109104107/>

## III Year B. Tech – I Semester

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**(MA23AOE501) MATHEMATICS FOR MACHINE LEARNING AND AI****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide a strong mathematical foundation for understanding and developing AI/ML algorithms.
- Enhance the ability to apply linear algebra, probability, and calculus in AI/ML models.
- Equip students with optimization techniques and graph-based methods used in AI applications.
- Develop critical problem-solving skills for analyzing mathematical formulations in AI/ML.

**COURSE OUTCOMES:**

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

- CO 6:** Apply linear algebra concepts to ML techniques like PCA and regression.
- CO 7:** Analyze probabilistic models and statistical methods for AI applications.
- CO 8:** Implement optimization techniques for machine learning algorithms.
- CO 9:** Utilize vector calculus and transformations in AI-based models.
- CO 10:** Develop graph-based AI models using mathematical representations

**UNIT I:****(9 Periods)**

**Linear Algebra for Machine:** Learning Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigenvalues, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

**UNIT II:****(8 Periods)**

**Probability and Statistics for AI:** Probability distributions: Gaussian, Binomial, Poisson. Baye's Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP). Entropy and Kullback -Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

**UNIT III:****(10 Periods)**

**Optimization Techniques for ML:** Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam) Newton's method, BFGS method.

**UNIT IV:****(10 Periods)**

**Vector Calculus & Transformations:** Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

**UNIT V:****(8 Periods)**

**Graph Theory for AI:** Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

**Total Periods: 45****TEXT BOOKS:**

3. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
4. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.

**REFERENCES:**

7. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.
8. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.

**ONLINE RESOURCES:**

1. MIT- Mathematics for Machine Learning <https://ocw.mit.edu>
2. Stanford CS229 – Machine Learning Course <https://cs229.stanford.edu/>
3. Deep AI – Mathematical Foundations for AI <https://deepai.org>

## III Year B. Tech – I Semester

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**(PH23AOE501) MATERIALS CHARACTERIZATION TECHNIQUES****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide exposure to different characterization techniques.
- Explain the basic principles and analysis of different spectroscopic techniques.
- Elucidate the working of Scanning electron microscope - Principle, limitations and applications.
- Illustrate the working of the Transmission electron microscope (TEM) - SAED patterns and its applications.
- Educate the uses of advanced electric and magnetic instruments for characterization.

**COURSE OUTCOMES:**

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

**CO 1:** Analyze the crystal structure and crystallite size by various methods**CO 2:** Analyze the morphology of the sample by using a Scanning Electron Microscope**CO 3:** Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope**CO 4:** Explain the principle and experimental arrangement of various spectroscopic techniques**CO 5:** Identify the construction and working principle of various Electrical & Magnetic Characterization technique**UNIT I:****(9 Periods)****Structure Analysis by Powder X-Ray Diffraction:** Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).**UNIT II:****(9 Periods)****Microscopy Technique -1 –Scanning Electron Microscopy (SEM):** Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.**UNIT III:****(9 Periods)****Microscopy Technique -2 - Transmission Electron Microscopy (TEM):** Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy**UNIT IV:****(9 Periods)****Spectroscopy Techniques:** Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).**UNIT V:****(9 Periods)****Electrical & Magnetic Characterization Techniques:** Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on ~~the electrical properties (Hall Effect). Magnetization measurement by induction method,~~

Vibrating sample Magnetometer (VSM) and SQUID.

**Total Periods: 45**

**TEXT BOOKS:**

1. Yang Leng, Material Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pvt. Ltd., 2013.
2. David Brandon, Wayne D Kalpan, John, Microstructural Characterization of Materials, Wiley & Sons Ltd., 2008.

**REFERENCES:**

1. Colin Neville Banwell, Elaine M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill, 4<sup>th</sup> Edition, 2008.
2. Bernard Dennis Cullity, Stuart R Stocks, Elements of X-ray diffraction, Prentice Hall, 2001.
3. Khalid Sultan, Practical Guide to Materials Characterization: Techniques and Applications, Wiley, 2021.
4. Sam Zhang, Lin Li, Ashok Kumar, Materials Characterization Techniques, CRC Press, 2008.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/115/103/115103030/>
2. [https://nptel.ac.in/content/syllabus\\_pdf/113106034.pdf](https://nptel.ac.in/content/syllabus_pdf/113106034.pdf)
3. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/>

## III Year B. Tech – I Semester

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**(CH23AOE501) CHEMISTRY OF ENERGY SYSTEMS****(Open Elective-I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Make the student understand basic Electrochemical principles such as standard electrode potentials, emf and applications of Electrochemical principles in the design of batteries.
- Understand the basic concepts of processing and limitations of Fuel cells & their applications.
- Impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications.
- Necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
- Impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquefaction method.

**COURSE OUTCOMES:**

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

- CO 1:** Apply the principles of electrochemistry to construct and analyze electrochemical cells and use the Nernst equation to calculate cell potentials.
- CO 2:** Analyze the efficiency and practical applications of fuel cells in energy conversion systems.
- CO 3:** Illustrate the design and functioning of photochemical cells
- CO 4:** Demonstrate understanding of the design, efficiency, and installation of solar panels, and evaluate the working and applications of various types of solar inverters.
- CO 5:** Use the knowledge of hydrogen storage technologies to analyze and compare chemical and physical methods of hydrogen storage, including compressed gas, liquid hydrogen, and advanced materials.

**UNIT I: (9 Periods)**

**Electrochemical Systems:** Electrochemical cell, Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction, Zinc-Air battery, Lead-acid, Nickel- cadmium batteries and their applications.

**UNIT II: (9 Periods)**

**Fuel Cells:** Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Methanol fuel cell, Fuel cell efficiency and applications.

**UNIT III: (9 Periods)**

**Photo and Photo-Electrochemical Conversions:** Photochemical Cells-Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.

**UNIT IV: (9 Periods)**

**Solar Energy:** Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications. Solar Panels– Design, efficiency, installation, Solar Inverters – String, micro inverters, hybrid.

**UNIT V (9 Periods)**

**Hydrogen Storage:** Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage,

Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel, and Organic hydrogen carriers.

**Total Periods: 45**

**TEXT BOOKS:**

1. Ira N. Levine, Physical Chemistry, 6<sup>th</sup> Edition, 2008.
2. Bahl and Bahl and Tuli, Essentials of Physical Chemistry, 28<sup>th</sup> Edition, 2024.

**REFERENCES:**

1. Fuel Cell Hand Book, by US Department of Energy, 7<sup>th</sup> Edition, (EG&G technical services and corporation).
2. Arvind Tiwari and Shyam, Hand Book of Solar Energy and Applications.
3. Klaus Jagar, Solar Energy Fundamental, Technology and Systems.
4. Levine Klebonoff, Hydrogen Storage.
5. Silver and Atkin, Inorganic Chemistry, 6<sup>th</sup> Edition, 2025.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/104106137>
2. [https://onlinecourses.nptel.ac.in/noc24\\_ee109/preview](https://onlinecourses.nptel.ac.in/noc24_ee109/preview)
3. [https://onlinecourses.nptel.ac.in/noc22\\_ch66/preview](https://onlinecourses.nptel.ac.in/noc22_ch66/preview)

## III Year B. Tech – II Semester

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**(CE23AOE601) DISASTER MANAGEMENT****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- Analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- Apply wind engineering principles and computational techniques in designing wind-resistant structures.
- Evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- Assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- CO 2:** Analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- CO 3:** Apply wind engineering principles and computational techniques in designing wind resistant structures.
- CO 4:** Evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- CO 5:** Assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

**UNIT I:****(9 Periods)**

**Introduction to Natural Disasters:** Types of Natural Disasters, Geographical and Climatic Distribution of Natural Disasters, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations and guidelines for Disaster Risk Reduction, Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).

**UNIT II:****(10 Periods)**

Cyclones and their Impact: Climate Change and Its Impact on Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structures in Past Cyclones and Windstorms, Case Studies. Cyclonic Retrofitting, Strengthening of Structures, and Adaptive Sustainable Reconstruction. Life-Line Structures and Emergency Infrastructure: Temporary and Permanent Cyclone Shelters

**UNIT III:****(9 Periods)**

**Wind Engineering and Structural Response:** Basic Wind Engineering, Aerodynamics of Bluff Bodies, Vortex Shedding, and Associated Unsteadiness Along and Across Wind forces. Lab: Wind Tunnel Testing and Its Salient Features. Introduction to Computational Fluid Dynamics (CFD). General Planning and Design Considerations Under Windstorms and Cyclones. Wind Effects on Buildings, towers, Glass Panels, Etc., and Wind-Resistant Features in Design. Codal Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction and Reconstruction in Coastal Areas. Innovative Construction Materials and Techniques, Traditional Construction Techniques in Coastal Areas.

**UNIT IV:****(9 Periods)**

~~Seismology and Earthquake Effects: Causes of Earthquakes, Plate Tectonics, types of Faults,~~

Seismic Waves, Earthquake parameters: Magnitude, Intensity, Epicenter, hypocenter, Energy Release, and Ground Motions. Earthquake Effects– On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes– Behavior of Various Types of Buildings and Structures, Collapse Patterns; Behavior of Non-Structural Elements Such as Services, Fixtures, and Mountings – Case Studies. Seismic Retrofitting– Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.

**UNIT V:****(8 Periods)**

**Planning and Design Considerations for Seismic Safety:** General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects, Etc.; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details– Various Types of Foundations, Soil Stabilization, Retaining Walls, Plinth Fill, Flooring, Walls, Openings, Roofs, Terraces, Parapets, Boundary Walls, Underground and Overhead Tanks, Staircases, and Isolation of Structures. Innovative Construction Materials and Techniques. Local Practices– Traditional Regional Responses. Computational Investigation Techniques.

**Total Periods: 45****TEXT BOOKS:**

1. David Alexander, Natural Disasters, CRC Press, 1<sup>st</sup> Edition, 2017.
2. Edward A. Keller and Duane E. DeVecchio, Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, Routledge, 5<sup>th</sup> Edition, 2019.

**REFERENCES:**

1. Ben Wisner, J.C. Gaillard, and Ilan Kelman (Editors), Handbook of Hazards and Disaster Risk Reduction and Management, Routledge, 2<sup>nd</sup> Edition, 2012.
2. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann, 4<sup>th</sup> Edition, 2020.
3. Bimal Kanti Paul, Environmental Hazards and Disasters: Contexts, Perspectives and Management, Wiley-Blackwell, 2<sup>nd</sup> Edition, 2020

## III Year B. Tech – II Semester

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**(CE23AOE602) SUSTAINABILITY IN CIVIL ENGINEERING PRACTICE****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- Analyze sustainable construction materials, their durability, and life cycle assessment.
- Apply energy calculations in construction materials and assess their embodied energy.
- Evaluate green building standards, energy codes, and performance ratings.
- Assess the environmental effects of energy use, climate change, and global warming.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- CO 2:** Analyze sustainable construction materials, their durability, and life cycle assessment.
- CO 3:** Apply energy calculations in construction materials and assess their embodied energy.
- CO 4:** Evaluate green building standards, energy codes, and performance ratings.
- CO 5:** Assess the environmental effects of energy use, climate change, and global warming.

**UNIT I:****(9 Periods)**Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - CO<sub>2</sub> Contribution from Cement and Other Construction Materials.**UNIT II:****(10 Periods)**

Materials Used in Sustainable Construction: Construction Materials and Indoor Air Quality - No/Low Cement Concrete - Recycled and Manufactured Aggregate - Role of QC and Durability - Life Cycle and Sustainability.

**UNIT III:****(9 Periods)****Energy Calculations:** Components of Embodied Energy - Calculation of Embodied Energy for Construction Materials - Energy Concept and Primary Energy - Embodied Energy Via-A-Vis Operational Energy in Conditioned Building - Life Cycle Energy Use**UNIT IV:****(9 Periods)**

Green Buildings: Control of Energy Use in Building - ECBC Code, Codes in Neighboring Tropical Countries - OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings – Role of Insulation and Thermal Properties of Construction Materials - Influence of Moisture Content and Modeling - Performance Ratings of Green Buildings - Zero Energy Building

**UNIT V:****(8 Periods)****Environmental Effects:** Non-Renewable Sources of Energy and Environmental Impact– Energy Norm, Coal, Oil, Natural Gas - Nuclear Energy - Global Temperature, Green House Effects, Global Warming - Acid Rain: Causes, Effects and Control Methods - Regional Impacts of Temperature Change.

**Total Periods: 45**

**TEXT BOOKS:**

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, Wiley Publishers, 4<sup>th</sup> Edition, 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

**REFERENCES:**

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques, Yesdee Publication Pvt. Ltd, 3<sup>rd</sup> Edition, 2012.

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## (CS23AOE601) FUNDAMENTALS OF OBJECT ORIENTED ANALYSIS AND DESIGN

(Open Elective-II)

### COURSE OBJECTIVES:

The objectives of this course are to:

- Describe the activities in the different phases of the object-oriented development lifecycle.
- Understand the concepts of object-oriented model with the E-R and EER models.
- Model a real-world application by using UML diagram.
- Design architectural modelling.
- Describing an application of UML.

### COURSE OUTCOMES:

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

- CO 1:** The importance of modelling in UML.
- CO 2:** Compare and contrast the object-oriented model with the E-R and EER models.
- CO 3:** Design use case diagram. Design an application using deployment diagram.
- CO 4:** Apply UML diagrams to build library application.
- CO 5:** Design an application of UML.

### UNIT I: (9 Periods)

**Introduction to UML:** Importance of modelling, principles of modelling, object-oriented modelling, conceptual model of the UML, Architecture, Software Development Life Cycle.

### UNIT II: (10 Periods)

**Basic Structural Modelling:** Classes, Relationships, common Mechanisms, and diagrams. Advanced Structural Modelling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. Class & Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams.

### UNIT III: (9 Periods)

**Basic Behavioural Modelling-I:** Interactions, Interaction diagrams.  
**Basic Behavioural Modelling-II:** Use cases, Use case Diagrams, Activity Diagrams.

### UNIT IV: (9 Periods)

**Advanced Behavioral Modelling:** Events and signals, state machines, processes and Threads, time and space, state chart diagrams.

### UNIT V: (8 Periods)

**Architectural Modelling:** Component, Deployment, Component diagrams and Deployment diagrams, Patterns and Frameworks, Artifact Diagrams.  
**Case Study:** The Unified Library application.

**Total Periods: 45**

### TEXT BOOKS:

1. Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, Pearson Education, 2<sup>nd</sup> Edition, 2005
2. John W. Satzinger, Robert B. Jackson, and Stephen D. Burd, *Object-Oriented Analysis and Design with the Unified Process*, Cengage Learning, 2004.

**REFERENCES:**

1. Fundamentals of Object-Oriented Design in UML, Meilir Page-Jones: Pearson Education.
2. Modelling Software Systems Using UML2, Pascal Roques, WILEY-Dreamtech India Pvt.Ltd.
3. Atul Kahate, Object Oriented Analysis & Design, The McGraw-Hill Companies.
4. Practical Object-Oriented Design with UML, Mark Priestley TMH.
5. Craig Larman Applying UML and Patterns: An introduction to Object Oriented Analysis and Design and Unified Process, Pearson Education.

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**(CS23AOE602) JAVA PROGRAMMING****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Identify Java language components and how they work together in applications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

**COURSE OUTCOMES:**

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

- CO 1:**Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.
- CO 2:**Design and implement classes to model real-world entities, with a focus on attributes, behaviors, and relationships between objects
- CO 3:**Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch.
- CO 4:**Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.
- CO 5:**Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX.

**UNIT I:****(9 Periods)**

**Object Oriented Programming:** Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

**Control Statements:** Introduction, if Expression, Nested if Expressions, if-else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.

**UNIT II:****(10 Periods)**

**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**UNIT III:****(9 Periods)**

~~**Arrays:** Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer~~

Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two- dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**UNIT IV:****(9 Periods)**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java. lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto un boxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java..Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throw able, Unchecked Exceptions, Checked Exceptions. Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java.

**UNIT V:****(8 Periods)**

**String Handling in Java:** Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

**Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter thread Communication - Suspending, Resuming, and Stopping of Threads. Java Database Connectivity: Introduction, JDBC Architecture, Installing My SQL and My SQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface

**Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events

**Total Periods: 45****TEXT BOOKS:**

1. Debasis Samanta, Monalisa Sarma, Joy with JAVA, Fundamentals of Object Oriented Programming, Cambridge, 2023.
2. Paul Deitel, Harvey Deitel, JAVA 9 for Programmers, Pearson, 4<sup>th</sup> Edition.

**REFERENCES:**

1. Herbert Schildt, *Java: The Complete Reference*, Tata McGraw-Hill, 11<sup>th</sup> Edition, 2019.
2. Kathy Sierra and Bert Bates, *Head First Java*, O'Reilly Media, 2<sup>nd</sup> Edition, 2005.
3. Cay S. Horstmann, *Core Java Volume I – Fundamentals*, Pearson, 12<sup>th</sup> Edition, 2022.
4. Cay S. Horstmann, *Core Java Volume II – Advanced Features*, Pearson, 12<sup>th</sup> Edition, 2022

## III Year B. Tech – II Semester

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**(AM23AOE601) MACHINE LEARNING CONCEPTS****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts of machine learning, its types, applications, and data preprocessing techniques.
- Learn to select, train, evaluate, and improve machine learning models while applying feature engineering techniques.
- Explore Bayesian methods for concept learning and understand various classification algorithms.
- Understand regression techniques for predictive modeling and methods to enhance model accuracy.
- Learn unsupervised learning techniques such as clustering and association rule mining for pattern discovery.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the significance of machine learning types, applications, and data quality in model building.
- CO 2:** Apply feature engineering methods to improve model performance and interpretability. Implement classification models such as k-NN, Decision Trees, and Random Forest for predictive tasks.
- CO 3:** Implement classification algorithms such as k-NN, Decision Trees, and Random Forests.
- CO 4:** Analyze regression algorithms and improve model accuracy using optimization techniques.
- CO 5:** Design clustering models using partitioning and density-based techniques for pattern recognition.

**UNIT I:****(8 Periods)**

**Introduction to Machine Learning & Preparing to Model:** Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning. Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing.

**UNIT II:****(9 Periods)**

**Modelling and Evaluation & Basics of Feature Engineering:** Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model. Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection.

**UNIT III:****(10 Periods)**

**Bayesian Concept Learning & Supervised Learning: Classification:** Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network. Supervised Learning: Classification: Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms-k-Nearest Neighbour (kNN), Decision tree, Random forest model, Support vector machines.

**UNIT IV: (10 Periods)**

**Supervised Learning: Regression:** Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.

**UNIT V: (8 Periods)**

**Unsupervised Learning:** Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, K-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN. Finding Pattern using Association Rule- Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules.

**Total Periods: 45**

**TEXT BOOKS:**

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019.
2. Ethern Alpaydin, Introduction to Machine Learning, MIT Press, 2004.

**REFERENCES:**

1. Stephen Marsland, Machine Learning - An Algorithmic Perspective, 2<sup>nd</sup> Edition.
2. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly.

**ONLINE RESOURCES:**

1. <https://www.deeplearning.ai/machine-learning- B.Techning/>
2. <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>

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**(CY23AOE601) INTRODUCTION TO CRYPTOGRAPHY AND NETWORK  
SECURITY  
(Open Elective-II)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the basic principles of cryptography and network security.
- Familiarize students with classical encryption methods and number theory fundamentals.
- Provide an overview of modern cryptographic algorithms such as AES, RSA, and ECC.
- Explain hash functions, digital signatures, and their applications in message authentication.
- Introduce network security protocols like TLS, IPSec, PGP, and the use of firewalls.

**COURSE OUTCOMES:**

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

- CO 1:** Explain basic security concepts, goals, threats, and mechanisms in cryptography and network security.
- CO 2:** Apply number theory concepts to design and analyze public key cryptography algorithms.
- CO 3:** Use hash functions and digital signatures to ensure data integrity and authentication.
- CO 4:** Implement authentication methods and network security protocols for secure communication.
- CO 5:** Apply web security standards and firewall techniques to protect systems and networks.

**UNIT I: (9 Periods)**

**Classical Encryption & Block Ciphers:** Security Goals, Attacks, and Services, Security Architecture and Network Security Model, Classical Encryption Techniques: Substitution and Transposition, Steganography, Block Ciphers: DES Overview, AES Structure and Transformations

**UNIT II: (9 Periods)**

**Number Theory & Public Key Cryptography:** Basics of Number Theory: GCD, Euclidean Algorithm, Modular Arithmetic, Fermat's & Euler's Theorems, Discrete Logarithms, Public Key Concepts and Algorithms: RSA, Diffie-Hellman, Elliptic Curve Cryptography.

**UNIT III: (9 Periods)**

**Hash Functions & Digital Signatures:** Cryptographic Hash Functions and Requirements, Secure Hash Algorithm (SHA), HMAC, CMAC, Digital Signature Concepts, DSA, X.509 Certificates, Public Key Infrastructure (PKI)

**UNIT IV: (9 Periods)**

**Authentication & Network Security Protocols:** User Authentication Principles, Kerberos Authentication Protocol, Email Security: PGP, S/MIME, IP Security: Overview, ESP, Internet Key Exchange (IKE)

**UNIT V: (9 Periods)**

**Web Security & Firewalls:** Web Security Requirements, Transport Layer Security (TLS), HTTPS, SSH, Firewalls: Characteristics, Types, and Configurations.

**Total Periods: 45**

**TEXT BOOKS:**

1. William Stallings, Cryptography and Net Work Security, Pearson Education, 8<sup>th</sup> Edition, 2020.
2. Bernard Menezes, Cryptography, Network Security and Cyber Laws, Engage Learning, 1<sup>st</sup> Edition, 2010.

**REFERENCES:**

1. Beerhouse Frozen, Debden Mukhopadhyaya, Cryptography and Network Security, McGraw Hill, 3<sup>rd</sup> Edition, 2015.
2. Jason Albanese, Wes Sonnenreich, Network Security Illustrated, McGraw-Hill Professional, 1<sup>st</sup> Edition, 2003.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106/105/106105031/lecture>
2. [https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhya IITKharagpur](https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhyaIITKharagpur)
3. [https://www.mitel.com/articles/web-communication-cryptography-and-network-security web articles by Mitel Power Connections](https://www.mitel.com/articles/web-communication-cryptography-and-network-security-web-articles-by-Mitel-Power-Connections)

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**(DS23AOE601) INTRODUCTION TO SOCIAL MEDIA MINING****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the nature and structure of social media data
- Learn techniques to collect, clean, and analyze social media content
- Apply machine learning and network analysis to social media data
- Explore real-world applications such as sentiment analysis, influence detection, and misinformation tracking
- Address ethical and privacy issues in social media mining

**COURSE OUTCOMES:**

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

- CO 1:** Understand Social Media Ecosystems.
- CO 2:** Collect and Manage Social Media Data.
- CO 3:** Pre-process and Clean Social Media Data.
- CO 4:** Apply Text Mining and NLP Techniques.
- CO 5:** Analyze Social Networks and Influencers.

**UNIT I:****(10****Periods)****Introduction to Social Media and Data Mining:** Overview of social media platforms, Differences between social media data and traditional data, Case studies and applications.**Data Collection Techniques APIs:** Twitter, Reddit, YouTube, Facebook (limitations), Web scraping basics (Beautiful Soup, Selenium), Handling rate limits and authentication, Legal and ethical considerations.**Pre-processing Social Media Data:** Data cleaning (removing spam, duplicates), Tokenization, stop words, stemming, lemmatization, Handling emoji's, hashtags, mentions**UNIT II:****(8 Periods)****Text Mining and Natural Language Processing (NLP):** Bag-of-words and TF-IDF, Named Entity Recognition (NER), Language detection and normalization.**Sentiment Analysis:** Lexicon-based vs. machine learning-based approaches, Tools: VADER, TextBlob, transformers, Visualizing sentiment over time.**UNIT III:****(9 Periods)****Topic Modeling:** Latent Dirichlet Allocation (LDA), Non-negative Matrix Factorization (NMF), Topic trends and interpretation.**Social Network Analysis (SNA):** Graph theory basics, Centrality measures (degree, betweenness, closeness), Detecting communities (modularity, Louvain method).**UNIT IV:****(10 Periods)****Influence and Virality:** Information diffusion models, Identifying influencers and key nodes, Modeling trends and virality (SIR, IC models).**Misinformation and Fake News Detection:** Misinformation vs. disinformation, Detecting fake news and bots, NLP techniques for credibility analysis.**Visualizing Social Media Data:** Word clouds, trend graphs, network graphs, Tools: Gephi, NetworkX, Plotly, Tableau.**UNIT V:****(8 Periods)****Case Studies and Real-World Applications:** Social media in marketing, politics, disaster response, and public health, Guest speaker / project presentation (optional).

**Ethics, Privacy, and Regulation:** GDPR, data ownership, and consent, Algorithmic bias and discrimination, Platform policies and responsibilities.

**Total Periods:45**

**TEXT BOOKS:**

1. Matthew Russell and Mikhail Klassen, Mining the Social Web, 3<sup>rd</sup> Edition.
2. Huan Liu, Mohammad Ali Abbasi, and Reza Zafarani, Social Media Mining: An Introduction

**REFERENCES:**

1. Julia Silge, David Robinson, Text Mining with R: A Tidy Approach.

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**(IT23APC401) SOFTWARE ENGINEERING****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the Evolution of Software Development, Gain Insight into Software Development Life Cycle Models.
- Develop Project Management Skills, Learn Requirements Engineering Techniques.
- Design Reliable Software Architectures, Explore User Interface Design Principles.
- Master the Practices of Coding and Testing, Understand Software Quality and Reliability.
- Introduce CASE Tools and Automation in SE, Understand Software Maintenance and Reuse

**COURSE OUTCOMES:**

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

- CO 1:** Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
- CO 2:** Analyze various software engineering models and apply methods for design and development of software projects.
- CO 3:** Develop system designs using appropriate techniques.
- CO 4:** Understand various testing techniques for a software project.
- CO 5:** Apply standards, CASE tools and techniques for engineering S/W projects

**UNIT I: (10 Periods)**

**Introduction:** Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

**Software Life Cycle Models:** Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model, Spiral model

**UNIT II: (9 Periods)**

**Software Project Management:** Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, risk management.

**Requirements Analysis and Specification:** Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

**UNIT III: (8 Periods)**

**Software Design:** Overview of the design process, How to characterize a good software design? Layered arrangement of modules, Cohesion and Coupling. approaches to software design.

**Agility:** Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, Tool Set for the Agile Process (Text Book 2)

**User Interface Design:** Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

**UNIT IV: (9 Periods)**

**Coding and Testing:** Coding, Code review, Software documentation, Testing, Black box testing, White-Box testing, Debugging, Program analysis tools, Integration testing

**Software Reliability and Quality Management:** Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000. SEI Capability maturity model. Few other important quality standards, and Six Sigma.

**UNIT V:****(9 Periods)**

**Computer-Aided Software Engineering (CASE):** CASE and its scope, CASE environment, CASE support in the software life cycle, other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

**Software Maintenance:** Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost.

**Software Reuse:** reuse- definition, introduction, reason behind no reuse so far, Basic issues in any reuse program and A reuse approach.

**Total Periods: 45****TEXT BOOKS:**

1. **Rajib Mall, Fundamentals of Software Engineering, PHI, 5<sup>th</sup> Edition.**
2. **Roger S. Pressman, Software Engineering A practitioner's Approach, Mc- Graw Hill International Edition, 9<sup>th</sup> Edition.**

**REFERENCES:**

1. Software Engineering, Ian Sommerville, Pearson, 10<sup>th</sup> Edition.
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106/105/106105182/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_01260589506387148827\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01260589506387148827_shared/overview)
3. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_013382690411003904735\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview)

## III Year B. Tech – II Semester

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**(EC23AOE601) DIGITAL ELECTRONICS****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- Analyze combinational circuits like adders, subtractors, and code converters.
- Explore combinational logic circuits and their applications in digital design.
- Understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- Gain knowledge about programmable logic devices and digital IC's.

**COURSE OUTCOMES:**

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

- CO 1:** Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- CO 2:** Analyze combinational circuits like adders, subtractors, and code converters.
- CO 3:** Explore combinational logic circuits and their applications in digital design.
- CO 4:** Understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- CO 5:** Gain knowledge about programmable logic devices and digital IC's.

**UNIT I:****(9 Periods)**

**Logic Simplification and Combinational Logic Design:** Review of Boolean Algebra and De-Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

**UNIT II:****(9 Periods)**

**Introduction to Combinational Design 1:** Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display.

**UNIT III:****(9 Periods)**

**Combinational Logic Design 2:** Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers

**UNIT IV****(9 Periods)**

**Sequential Logic Design:** Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers.

**UNIT V:****(9 Periods)**

**Programmable Logic Devices:** ROM, Programmable Logic Devices (PLA and PAL).  
**Digital IC's:** Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and demultiplexer (74x155), comparator (74x85).

**Total Periods:45****TEXT BOOKS:**

1. M.Morris Mano & Michel D. Ciletti, Digital Design, Pearson Education, 5<sup>th</sup> Edition, 1999.
2. ZviKohavi and NirahK.Jha, Switching theory and Finite Automata Theory, Tata

McGraw Hill, 2<sup>nd</sup> Edition,2005.

**REFERENCES:**

1. Charles H Roth Jr., Fundamentals of Logic Design, Brooks/Cole Cengage Learning, 5<sup>th</sup> Edition, 2004.

## III Year B. Tech – II Semester

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**(EE23AOE601) RENEWABLE ENERGY SOURCES****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand solar radiation principles, collectors, and thermal storage methods.
- Explore photovoltaic (PV) principles, module construction, and system configurations.
- Study wind energy conversion systems and evaluate their design parameters.
- Identify geothermal resources and examine their utilization and potential.
- Analyze ocean, biomass, and fuel cell technologies for energy generation.

**COURSE OUTCOMES:**

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

- CO 1:** Explain solar energy fundamentals, radiation measurement, and thermal storage systems.
- CO 2:** Illustrate the working of solar PV cells, modules, and system configurations.
- CO 3:** Analyze the design and aerodynamic aspects of horizontal and vertical axis wind turbines.
- CO 4:** Describe geothermal resources and evaluate their applications and limitations.
- CO 5:** Compare various emerging energy technologies like ocean, biomass, and fuel cells based on principles and performance.

**UNIT I:****(9 Periods)****Renewable Energy Overview:** Introduction to global and national renewable energy scenarios.**Solar Energy:** Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.**UNIT II:****(9 Periods)****PV Energy Systems:** Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.**UNIT III:****(9 Periods)****Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and energy estimation and site selection considerations**UNIT IV:****(9 Periods)****Geothermal Energy:** Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo- pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.**UNIT V: Miscellaneous Energy Technologies:****(9 Periods)****Ocean Energy:** Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations.

**Bio mass Energy:** Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration

**Fuel cell:** Principle of working of various types of fuel cells and their working, performance and limitations.

**Total Periods: 45**

**TEXT BOOKS:**

1. G. D. Rai, Non-Conventional Energy Source, Khanna Publishers, 4<sup>th</sup> Edition, 2000.
2. Chetan Singh Solanki, Solar Photovoltaics Fundamentals, Technologies and Applications, PHI Learning Private Limited, 2<sup>nd</sup> Edition 2012.

**REFERENCES:**

1. Stephen Peake, Renewable Energy Power for a Sustainable Future, Oxford International, 4<sup>th</sup> Edition, 2018.
2. S. P. Sukhatme, Solar Energy, Tata Mc Graw Hill Education Pvt. Ltd, 3<sup>rd</sup> Edition, 2008.
3. B H Khan, Non-Conventional Energy Resources, Tata Mc Graw Hill Education Pvt Ltd, 2<sup>nd</sup> Edition, 2011.
4. S. Hasan Saeed and D.K.Sharma, Non-Conventional Energy Resources, S.K.Kataria & Sons, 3<sup>rd</sup> Edition, 2012.
5. G. N. Tiwari and M.K.Ghosal, Renewable Energy Resource: Basic Principles and Applications, Narosa Publishing House, 2004.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/103103206>
2. <https://nptel.ac.in/courses/108108078>

## III Year B. Tech – II Semester

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**(ME23AOE601) DRONE TECHNOLOGY****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basics of drone concepts
- Learn and understand the fundamentals of design, fabrication and programming of drone
- Impart the knowledge of an flying and operation of drone
- Understand about the various applications of drone
- Understand the safety risks and guidelines of fly safely.

**COURSE OUTCOMES:**

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

- CO 1:** Know about a various type of drone technology, drone fabrication and programming.
- CO 2:** Execute the suitable operating procedures for functioning a drone
- CO 3:** Select appropriate sensors and actuators for Drones
- CO 4:** Develop a drone mechanism for specific applications
- CO 5:** Create the programs for various drones

**UNIT I:****(9 Periods)**

**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:****(9 Periods)**

**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, Methods of programming drone, Download program - Install program on computer, Running Programs, Multi rotor stabilization, Flight modes, Wi-Fi connection.

**UNIT III:****(9 Periods)**

**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:****(9 Periods)**

**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:****(9 Periods)**

**Future Drones and Safety:** Safety risks, Guidelines to fly safely, Specific aviation regulation and standardization- Drone license Miniaturization of drones, Increasing autonomy of drones, Use of drones in swarms.

**Total Periods: 45****TEXT BOOKS**

1. Daniel Tal & John Altschuld, Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation, John Wiley & Sons, Inc., 2021.
2. Terry Kilby & 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. Završnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance, Springer, 2018.

**ONLINE RESOURCES:**

1. Flight Dynamics and Control, NPTEL, IIT Bombay.  
<https://nptel.ac.in/courses/101106042>
2. Drone Systems and Control, NPTEL, IISc Bangalore  
<https://nptel.ac.in/courses/101108661>

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**(ME23AOE602) SYSTEM DESIGN FOR SUSTAINABILITY****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts of sustainability and its relevance to engineering and design.
- Equip students with knowledge of life cycle thinking and sustainable design methodologies.
- Expose students to sustainable materials, product-service systems, and circular economy principles.
- Provide tools and strategies for designing products and systems that minimize environmental impact.
- Enable students to apply sustainable thinking through case studies and real-world examples.

**COURSE OUTCOMES:**

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

**CO 1:** Describe the fundamentals of sustainability and system design principles.**CO 2:** Apply life cycle assessment (LCA) methods to evaluate environmental impact.**CO 3:** Design products/services using sustainable materials and eco-design strategies.**CO 4:** Analyze circular economy concepts and product-service systems for sustainability.**CO 5:** Solve real-world sustainability challenges using industry case studies and teamwork.**UNIT I:****(9 Periods)****Fundamentals of Sustainability and System Design:** Introduction to sustainability: principles and dimensions, Sustainable development goals (SDGs), Systems thinking in design, Evolution of sustainability in engineering.**UNIT II:****(9 Periods)****Life Cycle Thinking and Assessment:** Life Cycle Thinking (LCT) and product life cycle stages, Life Cycle Assessment (LCA) – goal, scope, inventory, impact, ISO 14040/44 standards, LCA tools and software (overview)**UNIT III:****(9 Periods)****Sustainable Product and Process Design:** Eco-design principles and strategies, Design for Environment (DfE), design for disassembly, Sustainable materials selection, Resource and energy-efficient manufacturing**UNIT IV:****(9 Periods)****Circular Economy and Product-Service Systems:** Circular economy: definition, principles, and strategies, Closed-loop design and industrial symbiosis, Product-Service System (PSS): types, examples, and implementation challenges.**UNIT V:****(9 Periods)****Case Studies and Practical Applications:** Industrial examples of sustainable products and systems, Policy and behavioral change for sustainability, Group project: Sustainable design proposal and presentation, Assessment and peer review.**Total Periods: 45****TEXT BOOKS:**

1. Michael Z. Hauschild, Ralph K. Rosenbaum, Stig I. Olsen, Life Cycle Assessment:

- Theory and Practice, Springer, 2018.
2. Thomas E. Graedel, Braden R. Allenby, Industrial Ecology and Sustainable Engineering, Pearson Education, 2010.

**REFERENCE:**

1. Marc A. Rosen, Engineering Sustainability: Fundamentals and Applications, CRC Press, 2020.
2. Carolynne Sherwin, Tracy Bhamra, Design for Sustainability: A Practical Approach, Gower Publishing, 2010.
3. Martin Charter, Ursula Tischner, Sustainable Solutions: Developing Products and Services for the Future, Greenleaf Publishing, 2001.
4. Arnold Tukker, Ursula Tischner, New Business for Old Europe, Greenleaf Publishing, 2006.
5. Josef Fresner, Helmut Schnitzer, Eco-Innovation Tools for Sustainable Product Development, Springer, 2012.

**ONLINE RESOURCES:**

1. System Design for Sustainability, NPTEL, IIT Guwahati.  
<https://nptel.ac.in/courses/107103081>
2. Sustainable Engineering Concepts and Life Cycle Analysis, NPTEL, IIT Kharagpur.  
<https://nptel.ac.in/courses/105105157>
3. Introduction to Sustainability, Coursera, University of Illinois.  
<https://www.coursera.org/learn/sustainability>

## III Year B. Tech – II Semester

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**(BA23AOE601) BUSINESS COMMUNICATION SKILLS****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Familiarize students with the foundational principles and process of effective business communication.
- Develop proficiency in professional writing, including business correspondence, email etiquette, and documentation.
- Enhance oral and interpersonal communication skills essential for group discussions, presentations, and public speaking.
- Improve understanding and application of non-verbal cues, workplace etiquette, and professional conduct.
- Prepare students for effective cross-cultural communication and collaboration in both physical and virtual business environments.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the fundamentals and process of effective business communication.
- CO 2:** Demonstrate writing skills in various business formats such as emails, reports, and proposals
- CO 3:** Exhibit professional speaking skills in presentations, group discussions, and interviews.
- CO 4:** Apply non-verbal communication and business etiquette in real-life contexts.
- CO 5:** Collaborate effectively in a team and communicate in cross-cultural settings.

**UNIT I:****(8 Periods)**

**Fundamentals of Business Communication:** Nature, purpose, and scope of communication, Communication process and elements, Types of communication: Verbal & Non-verbal, Barriers to effective communication, and 7Cs of effective communication.

**UNIT II:****(8 Periods)**

**Business Writing Skills:** Principles of business writing, Email etiquette & writing professional emails, Business letters (inquiry, complaint, cover letter, thank you note), Memo, notice, and circular, Resume and CV writing.

**UNIT III:****(10 Periods)**

**Oral & Interpersonal Communication:** Group discussion techniques, Presentation skills: structure, design, and delivery, Public speaking: body language, voice modulation, and handling questions, Business meetings: agenda, minutes, and participation.

**UNIT IV:****(9 Periods)**

**Report Writing & Documentation:** Types of business reports: informal, formal, progress, analytical, Structure: Title, TOC, Executive Summary, Findings, Conclusion, Proposals and technical documentation basics, Visual communication: charts, graphs, tables.

**UNIT V:****(10 Periods)**

**Cross-Cultural Communication & Etiquette:** Communication in global and multicultural teams, Workplace etiquette and ethics, Virtual communication & remote collaboration, Social media communication and professionalism.

**Total Periods: 45**

**TEXT BOOKS:**

1. Meenakshi Raman, Prakash Singh, Business Communication, Oxford University Press, 2<sup>nd</sup> Edition, 2012
2. Lesikar R. V., Pettit J. D., Flatley M. E., Basic Business Communication, Mcgraw Hill Education, 11<sup>th</sup> Edition, 2009

**REFERENCES:**

1. Courtland L. Bovee, John V. Thill, Business Communication Today
2. M. Ashraf Rizvi, Effective Technical Communication
3. Simon Sweeney, English for Business Communication
4. Sunita Mishra & C. Muralikrishna, Communication Skills for Engineers

**ONLINE RESOURCES:**

1. <https://owl.purdue.edu>
2. <https://www.coursera.org/courses?query=business%20communication>

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**(EG23AOE601) ENGLISH FOR COMPETITIVE EXAMINATIONS****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Enable the students to learn about the structure of competitive English
- Understand the grammatical aspects and identify the errors
- Enhance verbal ability and identify the errors
- Improve word power to answer competitive challenges
- Make them ready to crack competitive exams

**COURSE OUTCOMES:**

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

**CO 1:** Identify the basics of English grammar and its structures.**CO 2:** Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams**CO 3:** Analyze an unknown passage and reach conclusions about it.**CO 4:** Choose the appropriate form of verbs in framing sentences**CO 5:** Develop speed reading and comprehending ability thereby perform better in competitive exams**UNIT I:****(9 Periods)****Grammar 1:** Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite-Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage. Prepositions-usage-Tag Questions, types-identifying errors- Practice.**UNIT II:****(9 Periods)****Grammar 2:** Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause-Voice-active voice and passive voice- reported Speech-Agreement-subject and verb-Modals-Spotting Errors-Practices.**UNIT III:****(9 Periods)****Verbal Ability:** Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbled Sentences -Selecting the proper statement by reading a given paragraph.**UNIT IV:****(9 Periods)****Reading Comprehension and Vocabulary:** Competitive Vocabulary: Word Building – Memory techniques-Synonyms, Antonyms, Affixes-Prefix & Suffix-One word substitutes-Compound words-Phrasal Verbs-Idioms and Phrases-Homophones-Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering-Elimination methods-Competitive based Reading comprehension (Exercise).**UNIT V:****(9 Periods)****Writing for Competitive Examinations:** Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs- Essay writing-types.**Total Periods: 45****TEXT BOOKS:**

1. Wren & Martin, English for Competitive Examinations, S. Chand & Co, 2021

2. Hari Mohan Prasad, Uma Rani Sinha, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.

**REFERENCES:**

1. Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.
2. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016
3. Shalini Verma, Word Power Made Handy, S Chand Publications
4. Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.
5. Abhishek Jain, Vocabulary Learning Techniques Vol. I & II, RR Global Publishers 2013.
6. Michel Swan, Practical English Usage, Oxford, 2006.

**ONLINE RESOURCES:**

1. <https://www.grammar.cl/english/parts-of-speech.htm>
2. <https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech>
3. <https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active-passive-voice>
4. <https://languagetool.org/insights/post/verb-tenses/>
5. <https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council>
6. <https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx>

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**(MA23AOE601) MATHEMATICAL FOUNDATION OF QUANTUM  
TECHNOLOGIES  
(Open Elective-II)**

**COURSE OBJECTIVES:**

The objectives of this course are to:

- Develop critical problem-solving skills for analyzing mathematical formulations in AI/ML. To provide students with essential linear algebra foundations, including vector spaces, inner products, and operators for quantum mechanical applications.
- Develop an understanding of the transition from finite-dimensional systems to infinite-dimensional function spaces and Hilbert space concepts.
- Establish quantum mechanical formalism, including measurement theory, uncertainty relations, and time evolution principles.
- Enable students to apply quantum mechanical principles to solve problems in simple quantum systems and understand statistical interpretation.

**COURSE OUTCOMES:**

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

- CO 1:** Apply linear algebra concepts to function spaces and analyze the transition from finite to infinite-dimensional systems.
- CO 2:** Analyze quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.
- CO 3:** Apply quantum mechanical principles to solve problems in simple quantum systems and evaluate statistical interpretations.
- CO 4:** Evaluate advanced concepts in composite systems and synthesize understanding of measurement processes and modern quantum theory.
- CO 5:** Apply conceptual understanding of these topics to emerging technologies in quantum computation and quantum information science.

**UNIT I:****(8 Periods)**

**Linear Algebra Foundation for Quantum Mechanics:** Vector spaces definition and examples ( $R^2$ ,  $R^3$ , function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigenvalues, eigenvectors), Finite-dimensional examples ( $2 \times 2$  matrices, spin-1/2 systems), Dirac notation introduction ( $|\psi\rangle$ ,  $\langle\phi|$ ,  $\langle\phi|\psi\rangle$ ), Change of basis (transformations, unitary matrices).

**UNIT II:****(9 Periods)**

**From Finite to Infinite Dimensions:** Function spaces ( $L^2$  space, square-integrable functions), Inner products for functions ( $\int \psi^* \phi dx$ ), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions ( $d/dx$ , multiplication by  $x$ ).

**UNIT III:****(10 Periods)**

**Quantum Mechanical Formalism:** Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, unitary evolution).

**UNIT IV:****(8 Periods)**

**Applications and Statistical Interpretation:** Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).

**UNIT V: (10 Periods)**

**Advanced Topics in Quantum Technologies:** Composite systems (tensor products basic introduction), Reversibility and irreversibility (unitary evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

**Total Periods: 45**

**TEXT BOOKS:**

1. John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press, 1996.
2. Srinivas, M. D., Measurements and Quantum Probabilities, University Press, Hyderabad, 2001.

**REFERENCES:**

1. Leonard Schiff, Quantum Mechanics, Mc, Graw Hill (Education), 2010.
2. Parthasarathy. K. R., Mathematical Foundations of Quantum, Hindustan Book Agency, New Delhi.
3. Gerard Tesch, Mathematical Methods in Quantum Mechanics with application to Schrodinger operators, Graduate Studies in Mathematics, 99, AMS, Providence, 2009.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc19\\_cy31/preview](https://onlinecourses.nptel.ac.in/noc19_cy31/preview)
2. [https://qosf.org/learn\\_quantum/](https://qosf.org/learn_quantum/)
3. <https://www.nqcc.ac.uk/a-guide-to-online-resources-for-learning-quantum-computing/>
4. <https://mitpress.mit.edu/9780262539531/quantum-computing-for-everyone/>

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**(MA23ABS403) OPTIMIZATION TECHNIQUES****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide the basic knowledge about optimization, importance, application areas of in Industry, Linear programming.
- Impart different optimization models under typical situations in the business organization like transportation, assignment.
- Understand the process of sequencing in typical industry, different game strategies and develop networks of activities of projects.

**COURSE OUTCOMES:**

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

**CO 1:** Understanding Optimization and Formulation of Linear Programming Models.**CO 2:** Formulate and Solve Transportation & Assignment Models.**CO 3:** Apply simple problems of Sequencing and implement practical cases of decision making under different business environments.**CO 4:** Discuss the game theory and strategies.**CO 5:** Developing networks of activities and finding optimal mode of projects evaluation.**UNIT I:****(8 Periods)**

**Introduction:** Meaning, Nature, Scope & Significance of Optimization - Typical applications. The Linear Programming Problem – Introduction, Formulation of Linear Programming problem, Limitations of L.P.P, Graphical Method, Simplex Method: Maximization and Minimization model (exclude Duality problems), Big-M method and Two Phase method.

**UNIT II:****(9 Periods)**

**Transportation Problem:** Introduction, Transportation Model, Finding initial basic feasible solutions, moving towards optimality, Unbalanced Transportation problems, Transportation problems with maximization, Degeneracy.

**Assignment Problem:** Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Hungarian Algorithm, Multiple Solution, Unbalanced Assignment problems, Maximization in Assignment Model.

**UNIT III:****(10 Periods)**

Sequencing- Job sequencing, Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, n jobs through m machines, two jobs and m Machines Problems.

**UNIT IV:****(10 Periods)**

**Game Theory:** Concepts, Definitions and Terminology, Two Person Zero Sum Games, Pure Strategy Games (with Saddle Point), Principal of Dominance, Mixed Strategy Games (Game without Saddle Point), Significance of Game Theory in Managerial Application.

**UNIT V:****(8 Periods)**

**Project Management:** Network Analysis- Definition- objectives - Rules for constructing network diagram – Determining Critical Path –Earliest & Latest Times – Floats - Application of CPM and PERT techniques in Project Planning and Control – PERT Vs CPM (exclude Project Crashing).

**Total Periods: 45****TEXT BOOKS:**

1. R. Pannerselvam, Operations Research, PHI Publications.

2. S.D. Sharma, Operations Research, Kedarnath

**REFERENCES:**

1. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Operations Research Pearson Education.
2. S.S. Rao, Engineering Optimization: Theory and practice, New Age International (P) Limited.

**ONLINE RESOURCES:**

1. [https://onlinecourses.swayam2.qc.in/cec20\\_ma10/preview](https://onlinecourses.swayam2.qc.in/cec20_ma10/preview)
2. [https://onlinecourses.nptel.ac.in/noc20\\_ma23/preview](https://onlinecourses.nptel.ac.in/noc20_ma23/preview)
3. [https://onlinecourses.nptel.ac.in/noc19\\_ma29/preview](https://onlinecourses.nptel.ac.in/noc19_ma29/preview)

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**(PH23AOE601) PHYSICS OF ELECTRONIC MATERIALS AND DEVICES****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Make the students to understand the concept of crystal growth, defects in crystals and thin films.
- Provide insight into various semiconducting materials and their properties.
- Develop a strong foundation in semiconductor physics and device engineering.
- Elucidate excitonic and luminescent processes in solid-state materials.
- Understand the principles, technologies, and applications of modern display systems.

**COURSE OUTCOMES:**

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

**CO 1:** Understand crystal growth and thin film preparation**CO 2:** Summarize the basic concepts of semiconductors**CO 3:** Illustrate the working of various semiconductor devices**CO 4:** Analyze various luminescent phenomena and the devices based on these concepts**CO 5:** Explain the working of different display devices**UNIT I:****(9 Periods)****Fundamentals of Materials Science:** Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).**UNIT II:****(9 Periods)****Semiconductors:** Introduction, quantum confinement in semiconductors (qualitative), charge carriers in semiconductors, effective mass, Electron and Hole in quantum well, Diffusion and recombination, Diffusion length. Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects, optical absorption.**UNIT III:****(9 Periods)****Physics of Semiconductor Devices:** Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions and its applications in high speed devices, Transistors, MOSFETs.**UNIT IV:****(9 Periods)****Excitons and Luminescence:** Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials.**Photoluminescence:** General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot.**Electro-luminescence:** General Principles of electroluminescence, light emitting diode, diode laser.**UNIT V:****(9 Periods)****Display Devices:** LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

**Total Periods: 45**

**TEXT BOOKS:**

1. S. O. Kasap, Principles of Electronic Materials and Devices, McGraw-Hill Education, 4<sup>th</sup> Edition, 2021.
2. Donald A. Neamen, Semiconductor Physics and Devices: Basic principles, 4<sup>th</sup> Edition, McGraw Hill, 2012.

**REFERENCES:**

1. B. G. Streetman, S. Banerjee, Solid State Electronic Devices, PHI Learning, 6<sup>th</sup> Edition, 2005.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005.
3. Grover and Jamwal, Electronic Components and Materials, Dhanpat Rai And Co., New Delhi, 2012.
4. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, World Scientific Publishing Co. Pvt. Ltd., 2<sup>nd</sup> Edition, 2011.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/113/106/113106062/>
2. [https://onlinecourses.nptel.ac.in/noc20\\_ph24/preview](https://onlinecourses.nptel.ac.in/noc20_ph24/preview)

## III Year B. Tech – II Semester

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**(CH23AOE601) CHEMISTRY OF POLYMERS AND APPLICATIONS****(Open Elective-II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic principles of polymers.
- Understand natural polymers and their applications.
- Understand natural polymers and their applications.
- Enumerate the applications of hydro-gel polymers.
- Enumerate applications of conducting and degradable polymers in engineering.

**COURSE OUTCOMES:**

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

- CO 1:** Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer.
- CO 2:** Summarize the physical and chemical properties of natural polymers and Modified cellulosic.
- CO 3:** Illustrate Bulk, solution, Suspension and emulsion polymerization, describe fibers and elastomers, Identify the thermosetting and thermos polymers.
- CO 4:** Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery.
- CO 5:** Explain classification and mechanism of conducting and degradable polymers.

**UNIT I:****(9 Periods)**

**Polymers-Basics and Characterization:** Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, co-polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, poly dispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

**UNIT II:****(9 Periods)**

**Natural Polymers and Modified Cellulosic:** Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as natural rubber, cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

**Modified Cellulosic:** Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetyls, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

**UNIT III:****(9 Periods)**

**Synthetic Polymers:** Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers (PE, PAN), Butadiene polymers (Buna-S, Buna-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

**UNIT IV:****(9 Periods)**

**Hydrogels of Polymer Networks:** Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

**UNIT V: (9 Periods)**  
**Conducting and Degradable Polymers:** Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications.  
**Degradable Polymers:** Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications, De polymerization.

**Total Periods: 45**

**TEXT BOOKS:**

1. Billmayer, A Text book of Polymer Science, 3<sup>rd</sup> Edition, 2025.
2. G.S. Mishra, Polymer Chemistry, 4<sup>th</sup> Edition, 2025.

**REFERENCES:**

1. K.J. Saunders, Organic Polymer Chemistry, Chapman and Hall
2. B.Miller, Advanced Organic Chemistry, Prentice Hall
3. Premamoy Ghosh, Polymer Science and Technology, McGraw- Hill, 3<sup>rd</sup> Edition, 2010.

**ONLINE RESOURCES:**

1. <http://acl.digimat.in/nptel/courses/video/104105039/L31.html>
2. [https://archive.nptel.ac.in/content/syllabus\\_pdf/104105039](https://archive.nptel.ac.in/content/syllabus_pdf/104105039)

## IV Year B. Tech – I Semester

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**(CE23AOE701) BUILDING MATERIALS AND SERVICES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- Analyze the composition, manufacturing process, and properties of cement and admixtures.
- Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- Evaluate masonry, mortars, finishing techniques, and formwork systems.
- Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
- CO 2:** Analyze the composition, manufacturing process, and properties of cement and admixtures.
- CO 3:** Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
- CO 4:** Evaluate masonry, mortars, finishing techniques, and formwork systems.
- CO 5:** Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

**UNIT I:****(9 Periods)**

**Stones and Bricks, Tiles:** Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – Composition of Brick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, Paints and Plastics: Wood - Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI / Fibre – Reinforced Glass Bricks, Steel & Aluminum, Plastics

**UNIT II:****(10 Periods)**

Cement & Admixtures: Types of Cement - Ingredients of Cement – Manufacture – Chemical Composition – Hydration - Field & Lab Tests – Fineness – Consistency – Initial & Final Setting – Soundness. Admixtures – Mineral & Chemical Admixtures – Uses

**UNIT III:****(9 Periods)**

**Building Components:** Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors, Types of Roofs – Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types

**UNIT IV:****(9 Periods)**

Mortars, Masonry and Finishing's Mortars: Lime and Cement Mortars Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishers: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP. form Work: Types: Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.

**UNIT V:****(8 Periods)**

**Building Services:** Plumbing Services: Water Distribution, Sanitary – Lines & Fittings; Ventilations: Functional Requirements Systems of Ventilations. Air Conditioning – Essentials

and Types; Acoustics – Characteristic – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire-Resistant Materials and Constructions.

**Total Periods: 45**

**TEXT BOOKS:**

1. Arora and Bindra, Building Materials and Construction, Dhanpat Roy Publications.
2. G C Sahu, Joygopal Jena, Building Materials and Construction, McGraw Hill Pvt Ltd., 2015.

**REFERENCES:**

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Building Construction, Laxmi Publications (P) Ltd., New Delhi
2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015.
3. N. Subramanian, Building Materials Testing and Sustainability, Oxford Higher Education, 2019.
4. R. Chudley, Construction Technology, Longman Publishing Group, 1973.
5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019

## IV Year B. Tech – I Semester

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**(CE23APE502) ENVIRONMENTAL IMPACT ASSESSMENT****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the principles, methodologies, and significance of Environmental Impact Assessment (EIA).
- Analyze the impact of developmental activities on land use, soil, and water resources.
- Evaluate the impact of development on vegetation, wildlife, and assess environmental risks.
- Develop environmental audit procedures and assess compliance with environmental regulations.
- Understand and apply environmental acts, notifications, and legal frame works in EIA studies.

**COURSE OUTCOMES:**

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

**CO 1:** Apply various methodologies for conducting Environmental Impact Assessments.**CO 2:** Analyze the impact of land-use changes on soil, water, and air quality.**CO 3:** Evaluate the environmental impact on vegetation, wildlife, and conduct risk assessments.**CO 4:** Develop environmental audit reports and assess compliance with environmental policies.**CO 5:** Interpret and apply environmental acts and regulations related to EIA.**UNIT I:****(9 Periods)**

**Concepts and methodologies of EIA:** Initial Environmental Examination, Elements of EIA, - Factors Affecting E-I-A Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters- Criteria for The Selection of EIA Methodology, EIA Methods, Ad-Hoc Methods, Matrix Methods, Network Method Environmental Media Quality Index Method, Overlay Methods and Cost/Benefit Analysis.

**UNIT II:****(10 Periods)**

Impact of Developmental Activities and Land Use: Introduction and Methodology for The Assessment of Soil and Ground Water, Delineation of Study Area, Identification of Actives. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. E I Ain Surface Water, Air and Biological Environment: Methodology for The Assessment of Impacts on Surface Water Environment, Air Pollution Sources, Generalized Approach for Assessment of Air Pollution Impact.

**UNIT III:****(9 Periods)**

**Assessment of Impact on Vegetation, Wildlife and Risk Assessment:** Introduction - Assessment of Impact of Development Activities on Vegetation and Wildlife, Environmental Impact of Deforestation – Causes and Effects of Deforestation - Risk Assessment and Treatment of Uncertainty-Key Stages in Performing an Environmental Risk Assessment-Advantages of Environmental Risk Assessment.

**UNIT IV:****(9 Periods)**

**Environmental Audit:** Introduction - Environmental Audit & Environmental Legislation Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol, Stages of Environmental Audit, Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report

**UNIT V:**

**(8 Periods)**

**Environmental Acts and Notifications:** The Environmental Protection Act, The Water Preservation Act, The Air (Prevention & Control of Pollution Act), Wild Life Act - Provisions in The EIA Notification, Procedure for Environmental Clearance, Procedure for Conducting Environmental Impact Assessment Report- Evaluation of EIA Report. Environmental Legislation Objectives, Evaluation of Audit Data and Preparation of Audit Report. Post Audit Activities, Concept of ISO and ISO 14000.

**Total Periods: 45**

**TEXT BOOKS:**

1. Y. Anjaneyulu, Environmental Impact Assessment Methodologies, B S Publication-Hyderabad, 2<sup>nd</sup> Edition, 2011.
2. W Canter Larry, Environmental Impact Assessment, McGraw-Hill Education, Edition, 1996.

**REFERENCES:**

1. Peavy, H S Rowe, D. R, G Tchobanoglous, Environmental Engineering, Mc-Graw Hill International Editions, New York 1985.
2. Suresh K Dhaneja, Environmental Science and Engineering, S K Katania & Sons Publication, New Delhi.
3. J Glynn and Gary W Hein Ke, Environmental Science and Engineering, Prentice Hall Publishers.
4. H S Bhatia, Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_ar07/preview](https://onlinecourses.nptel.ac.in/noc22_ar07/preview)

## IV Year B. Tech – I Semester

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**(CE23AOE702) GEOSPATIAL TECHNOLOGIES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- Apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
- Evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

**COURSE OUTCOMES:**

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

- CO 1:** Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
- CO 2:** Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
- CO 3:** Apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
- CO 4:** Evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
- CO 5:** Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

**UNIT I:****(9 Periods)**

**Raster Data Exploration: Query Analysis - Local Operations:** Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations—Neighborhood - Operations: Aggregation, Filtering - Extended Neighborhood-Operations- Zonal Operations - Statistical Analysis - Cost-Distance Analysis-Least Cost Path.

**UNIT II:****(10 Periods)**

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance - topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection - Proximity Analysis: Buffering

**UNIT III:****(9 Periods)**

Network - Introduction - Network Data Model - Elements of Network - Building A Network Database - Geocoding - Address Matching - Shortest Path in A Network - Time and Distance Based Shortest Path Analysis - Driving Directions - Closest Facility Analysis - Catchment / Service Area Analysis-Location-Allocation Analysis

**UNIT IV:****(9 Periods)**

Surface Data - Sources of X, Y, Z Data - DEM, TIN - Terrain Analysis - Slope, Aspect, Viewshed, Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network, Spatial Interpolation: IDW, Spline, Kriging, Variogram.

**UNIT V:**

**(8 Periods)**

**Customization of GIS:** Need, Uses, Scripting Languages –Embedded Scripts – Use of Python Script - Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications- Location Based Services: Emergency and Business Solutions - Big Data Analytics.

**Total Periods: 45**

**TEXT BOOKS:**

1. Kang Tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 4<sup>th</sup> Edition, 2008.
2. Lo, C.P. and Yeung, Albert K.W., Concepts and Techniques of Geographic Information Systems Prentice Hall, 2002.

**REFERENCES:**

1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley, 2009
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasaraju, An Introduction to Geographical Information Systems, Pearson Education, 2<sup>nd</sup> Edition, 2007.
3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub., 2008

## IV Year B. Tech – I Semester

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**(CE23AOE703) SMART CITIES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts, scope, and global benchmarks of smart cities and sustainable urban development.
- Gain knowledge of urban planning principles relevant to the development of smart cities and the integration of infrastructure services.
- Analyze infrastructure development processes, policies, and financial models applicable to smart cities, including PPP frameworks.
- Explore modern transportation systems and sustainable mobility solutions for urban areas using intelligent transport systems (ITS).
- Evaluate the applications of Artificial Intelligence in smart city management across urban planning, transportation, energy, and public service domains.

**COURSE OUTCOMES:**

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

- CO 1:** Define the concept of smart cities and explain their importance, global standards, and performance indicators.
- CO 2:** Demonstrate an understanding of urban infrastructure planning and the role of planners in delivering sustainable services.
- CO 3:** Evaluate major infrastructure projects in smart cities with reference to policy frameworks, PPP models, and governance practices.
- CO 4:** Analyze urban transportation systems and propose intelligent and sustainable solutions for enhancing urban mobility.
- CO 5:** Apply AI-based approaches to address challenges in urban management including planning, transportation, energy, and public services.

**UNIT I:****(9 Periods)**

**Introduction to Smart Cities:** Introduction to smart cities - Definition, Scope - Importance - Global Standards and Performance Benchmarks - Practice Code - Principal stakeholders - key trends in smart cities developments - Concept of Sustainable cities

**UNIT II:****(10 Periods)**

Smart Cities Planning and Development: Planning for Urban Infrastructure - Introduction to city planning, key trends in smart cities developments, Sustainable features for smart cities - Role of Planner in the provision of urban networks for different services, Case Study.

**UNIT III:****(9 Periods)**

**Infrastructure Planning and Development for smart Cities:** Feasibility studies for infrastructure projects - planning for major infrastructure projects - Various Infrastructure Program and policies by MOUD, PPP (DBOOT, BOOT, etc.) in infrastructure projects - Dimension of smart cities, Financing smart cities development - Governance of smart cities - Smart Cities Regulations & Smart Techniques - Case Study.

**UNIT IV:****(9 Periods)**

Transportation System for Smart Cities: Urbanization and urban mobility - urban land use and transport - Concepts of sustainable mobility - public transportation - pedestrians and bicyclists and parking - fundamentals of the intelligent transportation systems (ITS) - Case Study.

**UNIT V:**

**(8 Periods)**

**AI in Smart City Management:** Introduction - Applications in Urban Planning - Transportation Management - Energy Management - Public Services - Case studies - Challenges and Future Directions.

**Total Periods: 45**

**TEXT BOOKS:**

1. Jo Beall, A City for all: Valuing Differences and Working with Diversity, Zed Books Limited, London, 1997, ISBN: 1 85649-477-2.
2. UN-Habitat, Inclusive and Sustainable Urban Planning: A Guide for Municipalities, Volume 3, Urban Development Planning, United Nations Human Settlements Programme, 2007, ISBN: 978- 92-1-132024-4.

**REFERENCES:**

1. Arup Mitra, Insights into Inclusive Growth, Employment and Wellbeing in India, Springer, New Delhi, 2013, ISBN: 978 81-322-0655-2.
2. Mission Statement & Guidelines on Smart City Scheme, Government of India, Ministry of Urban Development.
3. Anthony M. Townsend, Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia.
4. Stephen Lucci and Danny Kopec, Artificial Intelligence in the 21<sup>st</sup> Century.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/124107007>
2. <https://nptel.ac.in/courses/109105185>
3. [http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines\(1\).pdf](http://smartcities.gov.in/upload/uploadfiles/files/Smart%20City%20Guidelines(1).pdf)

## IV Year B. Tech – I Semester

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**(CE23AOE704) SOLID WASTE MANAGEMENT****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- Analyze engineering systems for solid waste collection, storage, and transportation.
- Apply resource and energy recovery techniques for sustainable solid waste management.
- Evaluate landfill design, construction, and environmental impact mitigation strategies.
- Assess hazardous waste management techniques, including biomedical and e-waste disposal.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
- CO 2:** Analyze engineering systems for solid waste collection, storage, and transportation.
- CO 3:** Apply resource and energy recovery techniques for sustainable solid waste management.
- CO 4:** Evaluate landfill design, construction, and environmental impact mitigation strategies.
- CO 5:** Assess hazardous waste management techniques, including biomedical and e-waste

**UNIT I:****(9 Periods)****Solid waste** – Definition, Classification, Types, Sources, Composition, Characteristics; Integrated Solid Waste Management (ISWM); SWM Rules (2016).**UNIT II:****(10 Periods)**

Engineering Systems for Solid Waste Management: Solid Waste Generation and Estimation; On-Site Handling and Storage; Collection of Solid Wastes; Stationary and Hauled Container Systems – Route Planning - Transfer and Transport

**UNIT III:****(9 Periods)****Engineering Systems for Resource and Energy Recovery:** Overview of Processing Techniques; Materials Recovery Facilities; Energy recovery from biological and thermal processes; Biological Conversion – Composting, Problems with Composting, Anaerobic Digestion; Thermal Conversion- Pyrolysis, Gasification, incineration, Refuse Derived Fuel (RDF)**UNIT IV:****(9 Periods)**

Landfills: Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills- Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

**UNIT V:****(8 Periods)****Hazardous Waste Management:** – Sources and Characteristics, Environmental and health impacts, Risk Assessment – Treatment and disposal methods – Secured Landfills, Incineration – Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear

Wastes, Industrial Waste Management.

**Total Periods: 45**

**TEXT BOOKS:**

1. Tchobanoglous G, Theisen H and Vigil SA, Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, Solid Waste Engineering, Brooks/Cole Thomson Learning Inc., 2002.

**REFERENCES:**

1. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, Environmental Engineering, McGraw Hill Inc., New York, 1985.
2. Qian X, Koerner RM and Gray DH, Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, 2002.

## IV Year B. Tech – I Semester

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**(CS23AOE701) INTRODUCTION TO DATA BASE MANAGEMENT SYSTEMS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques
- Provide an overview of Schema refinement and Transaction processing

**COURSE OUTCOMES:**

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

**CO 1:** Understand the basic concepts of database management systems**CO 2:** Analyze a given database application scenario to use ER model for conceptual design of the database**CO 3:** Utilize SQL proficiently to address diverse query challenges**CO 4:** Employ normalization methods to enhance database structure**CO 5:** Assess and implement transaction processing, concurrency control and database recovery protocols in databases**UNIT I:****(9 Periods)**

**Introduction:** Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**UNIT II:****(10 Periods)**

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

**UNIT III:****(9 Periods)**

**Relational Model:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

**UNIT IV:****(9 Periods)**

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non- updatable), relational set operations

**UNIT V:****(8 Periods)**

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate

key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

**Transaction Concept:** Transaction State, ACID properties, Concurrent Executions, Serializability

**Total Periods: 45**

**TEXT BOOKS:**

1. Raghurama Krishnan and Johannes Gehrke, Database Management Systems, Tata McGraw-Hill, 3<sup>rd</sup> Edition, 2003.
2. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, Tata McGraw-Hill, 5<sup>th</sup> Edition, 2006.

**REFERENCES:**

1. C. J. Date, *Introduction to Database Systems*, Pearson, 8<sup>th</sup> Edition, 2004.
2. Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, Pearson, 6<sup>th</sup> Edition, 2011.
3. Carlos Coronel, Steven Morris, and Peter Rob, *Database Principles: Fundamentals of Design, Implementation, and Management*, Cengage Learning, 2013.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/106/105/106105175/>
2. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_012758\\_06667282\\_022456\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758_06667282_022456_shared/overview)

## IV Year B. Tech – I Semester

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**(CS23APE604) QUANTUM COMPUTING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts of quantum mechanics and linear algebra as they apply to quantum computing.
- Explain quantum gates, circuits, and key algorithms that leverage quantum principles for computation.
- Familiarize students with quantum algorithmic strategies and computational complexity classes.
- Enable hands-on experience with quantum programming using tools like Qiskit and IBM Quantum Experience.
- Explore real-world applications, challenges, and the future landscape of quantum computing, including ethics and societal impact.

**COURSE OUTCOMES:**

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

- CO 1:** Understand and apply foundational concepts from quantum mechanics and linear algebra to model quantum computation.
- CO 2:** Analyze and construct quantum circuits using basic quantum logic gates and simulate quantum operations.
- CO 3:** Explain and implement fundamental quantum algorithms like Grover's and Shor's, and interpret their computational benefits.
- CO 4:** Develop and execute quantum programs using Qiskit and IBM Quantum platforms and interpret results from quantum hardware.
- CO 5:** Evaluate applications of quantum computing in cryptography, AI, and optimization, and discuss ethical and future challenges.

**UNIT I:****(9 Periods)**

**Fundamentals of Quantum Mechanics and Linear Algebra:** Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems

**UNIT II:****(10 Periods)**

Quantum Gates and Circuits: Quantum Logic Gates: Pauli, Hadamard, Phase, Controlled Gates and CNOT, Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits

**UNIT III:****(9 Periods)**

**Quantum Algorithms and Complexity:** Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA

**UNIT IV:****(9 Periods)**

Quantum Programming and Simulation Platforms: Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware.

**UNIT V:****(8 Periods)**

**Applications and Future of Quantum Computing:** Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization,

Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions.

**Total Periods: 45**

**TEXT BOOKS:**

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10<sup>th</sup> Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

**REFERENCES:**

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.

## IV Year B. Tech – I Semester

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**(AM23AOE701) AI PROMPT ENGINEERING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the principles and techniques of prompt engineering, including the designs of effective prompts.
- Explore the capabilities of large language models for text and image generations and to leverage the creation of engaging content.
- Gain practical experience in crafting prompts and generating text and images using AI tools and platforms.

**COURSE OUTCOMES:**

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

- CO 1:** Design clear, concise, and relevant prompts following the standard principles of prompt engineering.
- CO 2:** Utilize LLMs to generate text and image for designing more effective content and design.
- CO 3:** Analyze existing prompts and make strategic combinations for enhanced prompts.
- CO 4:** Demonstrate proficiency in generative AI techniques for text data generation.
- CO 5:** Develop skills in designing prompts for AI-driven image generation using diffusion models

**UNIT I:****(8 Periods)**

**Introduction to LLM and Prompting:** Introduction to Large Language Models (LLMs), Text Generation Models: Evolution and Importance, Architecture and Capabilities of LLMs, Market Landscape of LLMs: OpenAI, Anthropic, Cohere, etc.

**UNIT II:****(9 Periods)**

**Prompt Engineering Fundamentals:** Understanding Prompting and Prompt Techniques, Five Principles of Effective Prompting, Components of a Prompt: Instructions, Context, Input, and Output, Types of Prompts: Zero-shot, Few-shot, Chain-of-thought, Designing Prompt Personas and Personalities, Mix-and-Match Techniques for Strategic Prompt Combination.

**UNIT III:****(10 Periods)**

**Case Studies and Prompt Design Practices:** Case Studies: Successful Prompt Implementations in Industry, Challenges and Limitations of Prompting, Prompt Rewriting and Refinement, Tools for Prompt Experimentation and Testing, Ethical Use and Bias Mitigation in Prompt Design

**UNIT IV:****(10 Periods)**

**Text Data Generation with Generative AI:** Standard Practices for Text Generation, Generating Lists, Simplification Techniques, Text Translation and Rephrasing, Extractive and Generative Techniques, Role-Based Prompting and Context Awareness, Using AI for Content Creation: Copywriting, Social Media, Video Scripts, Personalized Messaging and Survey Generation, Hands-on Exercises in Prompt Design and Analysis.

**UNIT V:****(8 Periods)**

**Image Generation and AI Application Development:** Introduction to Image Generation with Diffusion Models, Overview of DALL-E, Mid Journey, Stable Diffusion, etc. Designing Prompts for Visual Outputs, Negative Prompting, Rewriting, and Prompt Chaining, Reverse Engineering Image Prompts, Building AI-powered Applications: Blog Writing, UI/UX Tools, ~~Text-Image Synthesis, Ethical Considerations in AI-Generated Media.~~

**Total Periods: 45**

**TEXT BOOKS:**

1. James Phoenix, Mike Taylor, Prompt Engineering for Generative AI, O'Reilly, 2024
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, 1<sup>st</sup> Edition, 1998.

**REFERENCES:**

1. Gilbert Mizrahi, Unlocking the Secrets of Prompt Engineering, 2024.
2. Michael Ferguson, Prompt Engineering: The Future of Language Generation, 2023.

**ONLINE RESOURCES:**

1. <https://www.promptingguide.ai/>
2. <https://developers.google.com/machine-learning/resources/prompt-eng>
3. <https://platform.openai.com/docs/guides/>

## IV Year B. Tech – I Semester

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**(AM23AOE702) ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Gain knowledge of Artificial Intelligence, focusing on intelligent agents, problem-solving techniques, and state-space search approaches.
- Understand and apply various problem-solving and search techniques, including uniform and heuristic search strategies in artificial intelligence.
- Explore and apply local search techniques for solving Constraint Satisfaction Problems (CSPs) and adversarial search strategies to make optimal decisions.
- Apply various statistical reasoning techniques for knowledge representation and reasoning in AI, as well as logic programming and reasoning methods.
- Become familiar with fundamental concepts of Machine Learning techniques, including classification, regression, clustering problems, and an introduction to neural networks and deep learning.

**COURSE OUTCOMES:**

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

- CO 1:** Design intelligent agents, define problems using state-space models, and apply AI techniques.
- CO 2:** Implement and compare different search algorithms (both uniform and heuristic), and apply appropriate strategies for solving AI problems.
- CO 3:** Solve CSPs using local search methods and implement adversarial search algorithms for optimal decisions in competitive game scenarios.
- CO 4:** Utilize statistical and logical reasoning methods to represent knowledge and perform forward/backward reasoning in AI applications.
- CO 5:** Understand and apply various machine learning techniques, including an introduction to neural networks and deep learning.

**UNIT I:****(8 Periods)**

**Introduction to Artificial Intelligence and Problem-Solving Agent:** Problems of AI, AI technique, Tic-Tac-Toe problem. Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

**UNIT II:****(9 Periods)**

**Search Techniques:** Problem solving agents, searching for solutions.  
**Uniform search strategies:** breadth-first search, depth-first search, depth-limited search, bidirectional search, comparing strategies.  
**Heuristic search strategies:** Greedy best-first search, A\* search, AO\* search.  
**Memory bounded heuristic search:** Local search algorithms & optimization problems: hill climbing, simulated annealing, local beam search.

**UNIT III:****(8 Periods)**

**Constraint Satisfaction Problems and Game Theory:** Local search for CSPs. Adversarial search, games, optimal decisions & strategies, minimax search, alpha-beta pruning, additional refinements, iterative deepening.

**UNIT IV:****(10 Periods)**

**Knowledge & Reasoning:** Statistical Reasoning: Probability, Bayes' Theorem, Certainty Factors, Rule-Based Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic.  
~~Knowledge representation: rule-based, procedural & declarative knowledge. Logic~~

programming: forward and backward reasoning.

**UNIT V: (10 Periods)**

**Introduction to Machine Learning:** Exploring ML as a sub-discipline of AI. Supervised learning, Unsupervised learning, Reinforcement learning. Classification, regression, clustering problems. Introduction to neural networks and deep learning.

**Total Periods: 45**

**TEXT BOOKS:**

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3<sup>rd</sup> Edition, 2015.
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, 1<sup>st</sup> Edition, 1998.

**REFERENCES:**

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGrawHill, 3<sup>rd</sup> Edition, 2017.
2. Patterson, Introduction to Artificial Intelligence & Expert System, Pearson, 1<sup>st</sup> Edition, 2015.

## IV Year B. Tech – I Semester

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**(AM23AOE703) INTRODUCTION TO DEEP LEARNING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental concepts, algorithms, and mathematical foundations of machine learning and deep learning.
- Train students in building, evaluating, and deploying ML/DL models using Python-based libraries and frameworks.
- Enable students to solve real-world problems across domains using supervised, unsupervised, and neural network-based models.

**COURSE OUTCOMES:**

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

- CO 1:** Understand and apply core machine learning algorithms for classification, regression, and clustering tasks.
- CO 2:** Design and train deep neural networks including CNNs, RNNs, and transfer learning models.
- CO 3:** Evaluate and improve ML/DL models using proper metrics and validation strategies.
- CO 4:** Develop practical solutions using ML/DL libraries such as Scikit-learn, TensorFlow, and Keras.
- CO 5:** Identify ethical considerations and limitations of AI systems.

**UNIT I:****(8 Periods)**

**Introduction to Machine Learning:** What is ML? Types of ML: Supervised, Unsupervised, Reinforcement, Basic concepts: hypothesis space, loss functions, over fitting, underfitting, Data preprocessing and feature engineering.

**UNIT II:****(9 Periods)**

**Supervised and Unsupervised Learning Algorithms:** Regression: Linear, Polynomial, Ridge, Lasso, Classification: k-NN, Decision Trees, Random Forest, Naive Bayes, SVM, Clustering: K-Means, Hierarchical, DBSCAN, Dimensionality reduction: PCA, t-SNE, Evaluation metrics: accuracy, precision, recall, F1-score, ROC-AUC.

**UNIT III:****(10 Periods)**

**Neural Networks and Deep Learning Foundations:** Basics of Artificial Neural Networks (ANN), Perceptron, activation functions, forward/backward propagation, Gradient descent and variants (SGD, Adam), Model optimization: loss functions, weight initialization, batch normalization, Frameworks: TensorFlow, Keras, PyTorch basics.

**UNIT IV:****(10 Periods)**

**Convolutional and Recurrent Neural Networks:** Convolutional Neural Networks (CNN): architecture, filters, pooling, Applications: Image classification, object detection, Recurrent Neural Networks (RNN), LSTM, GRU, Applications: Text classification, sequence prediction, Introduction to Attention and Transformers

**UNIT V:****(8 Periods)**

**Advanced Topics and Model Deployment:** Transfer learning with pretrained models (VGG, ResNet, BERT), Generative models: Autoencoders, GANs, Model deployment with Flask/Streamlit, Introduction to MLOps and model versioning, Ethics in ML/DL: fairness, bias, explainability

**Total Periods: 45**

**TEXT BOOKS:**

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.

**REFERENCES:**

1. Tom M. Mitchell, Machine Learning, McGraw Hill.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
3. François Chollet, Deep Learning with Python, Manning Publications.

## IV Year B. Tech – I Semester

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**(CY23AOE701) FUNDAMENTALS OF BLOCKCHAIN TECHNOLOGY****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental concepts of Blockchain and its core components.
- Explore Blockchain architecture, consensus mechanisms, and data structures such as Merkle trees and hashing.
- Design and deploy simple smart contracts and decentralized applications.
- Gain hands-on knowledge of Ethereum and Hyperledger platforms.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the principles, features, and evolution of Blockchain technology.
- CO 2:** Describe the technical components like blocks, consensus algorithms, tokens, and wallets.
- CO 3:** Analyze blockchain architectures, tokens, and deployment models to design.
- CO 4:** Analyze use cases and implement solutions using Ethereum and Hyperledger Fabric.
- CO 5:** Evaluate emerging block chain technologies and their integration with IoT, AI/ML, and cloud platforms.

**UNIT I:****(9 Periods)**

**Introduction to Blockchain:** Blockchain definition, characteristics, and real-world challenges; Centralized vs. Decentralized systems; History and evolution of blockchain; Types of Blockchain: public, private, consortium; Key stakeholders in the blockchain ecosystem.

**UNIT II:****(9 Periods)**

**Core Concepts of Blockchain:** Blocks and transactions, hashing and Merkle trees, consensus mechanisms (Proof of Work, Proof of Stake), mining, tokens and cryptocurrencies, wallets, Blockchain transaction lifecycle, peer-to-peer networks, types of nodes, risks in Blockchain systems.

**UNIT III:****(9 Periods)**

**Blockchain Architecture & Design:** Blockchain application types, enterprise Blockchain architecture, evaluation framework for Blockchain solutions, cryptographic tokens, design considerations for blockchain systems, typical architecture and deployment models.

**UNIT IV:****(9 Periods)**

**Ethereum Platform and Smart Contracts:** Ethereum basics, smart contracts and Solidity programming, Ethereum Virtual Machine (EVM), Truffle development framework, MetaMask, Ether wallets, decentralized applications, case study: Tuna Fish Tracking on Ethereum.

**UNIT V:****(9 Periods)**

**Hyperledger and Emerging Trends:** Hyperledger Fabric architecture and transaction flow, chain code development, use case: Car ownership tracking, advanced blockchain topics: IPFS, Oracles, Zero-Knowledge Proofs, Blockchain with IoT and AI, Initial Coin Offerings, Blockchain Cloud Platforms, Future trends.

**Total Periods: 45****TEXT BOOKS:**

1. Armadas, Arched Surfers A Riff, Sham, Block Chain for Enterprise Application Developersll, Wiley, 1<sup>st</sup> edition, 2020.
2. Andreas M. Antonopoulos, Mastering Bit coin: Programming the Open Block Chain, O'Reilly, 1<sup>st</sup> edition, 2017.

**REFERENCES:**

1. Joseph Barbara, Paul R. Allen, Block chain: A Practical Guide to Developing Business, Law, and Technology Solutions, Mc Grow Hill, 1<sup>st</sup> Edition, 2018.
2. Melanie Swan, Block chain: Blueprint for a New Economy, O'Reilly, 1<sup>st</sup> Edition, 2017.

**ONLINE RESOURCES:**

1. <https://github.com/blockchainedindia/resources>
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs44/preview](https://onlinecourses.nptel.ac.in/noc22_cs44/preview)

## IV Year B. Tech – I Semester

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**(CY23AOE702) FUNDAMENTALS OF CYBER SECURITY****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Develop a foundational comprehension of cyber security concepts, encompassing threats, vulnerabilities, and protective strategies.
- Identify and categorize common cyber threats, understand their propagation, and implement effective countermeasures.
- Explore techniques for ensuring data integrity, authentication, and data availability, while comprehending cryptographic controls.
- Develop skills to respond to cyber security incidents, execute disaster recovery plans, and enhance system availability.
- Analyze the ethical dimensions of cyber security, understand professional responsibilities, and uphold ethical standards in the field.

**COURSE OUTCOMES:**

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

- CO 1:** Demonstrate various cyber threats and vulnerabilities, understanding their potential impact on digital assets.
- CO 2:** Implement proactive measures to mitigate cyber threats and protect against common attack vectors.
- CO 3:** Apply cryptographic techniques to ensure data integrity, authenticity, and confidentiality.
- CO 4:** Develop incident response plans and disaster recovery strategies to minimize the impact of cyber security incidents.
- CO 5:** Understand to ethical principles and professional responsibilities while making informed decisions in the realm of cyber security

**UNIT I:****(9 Periods)**

**Cyber security Essentials and Cube:** The Cyber security World, Cyber Criminals versus Cyber security Specialists, Common Threats, Spreading Cyber security Threats, The Three Dimensions of the Cyber security Cube, CIA Triad, States of Data, Cyber security Countermeasures, IT Security Management Framework, Cybercrime, and Information Security

**UNIT II:****(9 Periods)**

**Cyber security Threats, Vulnerabilities, Attacks and Protecting Secrets:** Introduction, Governance, Managing Cloud Security Risk, Compliance, Legal Issues in Cloud, Audit, CSA Tools. Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

**UNIT III:****(9 Periods)**

**Data Integrity:** Types of Data Integrity Controls, Digital Signatures, Certificates, Database Integrity Enforcement.

**UNIT IV:****(9 Periods)**

**Tools and Methods Used in Cyber Crime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT-V:****(9 Periods)**

**Protecting a Cyber security Domain:** Defending Systems and Devices, Server Hardening, Network Hardening, Physical and Environmental Security, Cyber security Domains, Ethics of Working in Cyber security.

**Total Periods: 45**

**TEXT BOOKS:**

1. Dr. ErdalOzkaya, Cyber security: The Beginner's Guide, Packt Publishing Limited, 1<sup>st</sup> Edition, 2019.
2. Mike Chappell, James Michael Stewart, Darrel Gibson, CISSP (ISC)<sup>2</sup> Certified Information Systems Security Professional Official Study Guide, 9<sup>th</sup> Edition, 2021.

**REFERENCES:**

1. Charles J. Brooks, Christopher Grow, Philip Craig and Donald Short, Cyber security Essentials, Say box, 1<sup>st</sup> Edition, 2018.
2. William Stallings, Network Security Essentials, Pearson Education, 6<sup>th</sup> Edition, 2018.
3. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India, 1<sup>st</sup> Edition, 2011.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc25\\_cs116/preview](https://onlinecourses.nptel.ac.in/noc25_cs116/preview)

## IV Year B. Tech – I Semester

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**(CY23AOE703) FUNDAMENTALS OF ETHICAL HACKING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objective of this course is to:

- Ethical hacking, Network and computer attacks, Foot printing, Social engineering, Port scanning, System hacking, Sniffers, Denial of service, Hacking web servers, Wireless hacking, Cryptography, Network Protection System.

**COURSE OUTCOMES:**

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

- CO 1:** Demonstrate knowledge on the computer security, social engineering and the intent of ethical hacking.
- CO 2:** Learn TCP/IP basics and social engineering attacks.
- CO 3:** Select and apply foot printing and port scanning tools to discover vulnerabilities of the computer system.
- CO 4:** Investigate hacking techniques and tools to maintain computer security.
- CO 5:** Analyze cryptosystems and network protection systems for information security and intrusion prevention.

**UNIT I:****(9 Periods)**

**Ethical Hacking, Network and Computer Attacks:** The role of security and penetration testers, Penetration-Testing methodologies, what you can and cannot do legally. Network and Computer Attacks: Malicious software, Trojans, Backdoors, Viruses, and Worms, Protection against malware attacks, Intruder attacks on networks and computers, Addressing physical security.

**UNIT II:****(9 Periods)**

**TCP/IP Concepts and Social Engineering:** Overview of TCP/IP – Application layer, Transport layer, Internet layer; IP addressing – Planning IP address assignments, IPv6 addressing. Social Engineering: What is social engineering, what are the common types of attacks, understand insider attacks, understand identity theft, describe phishing attacks, understand online scams, Understand URL obfuscation, Social engineering countermeasures.

**UNIT III:****(9 Periods)**

**Footprinting and Port Scanning:** Foot printing: Using web tools for foot printing, conducting competitive intelligence, Using domain name system zone transfers. Port Scanning: Port scanning, using port scanning tools, conducting ping sweeps, Understanding scripting.

**UNIT IV:****(9 Periods)**

**System Hacking:** System hacking -Password cracking techniques, Types of passwords, Key loggers and other spyware technologies, Escalating privileges, Root kits, How to hide files, Steganography technologies, How to cover your tracks and evidences; Sniffers – Protocols susceptible to sniffing, Active and passive sniffing, ARP poisoning, Ethereal capture and display filters, MAC flooding, DNS spoofing techniques, Sniffing countermeasures; Denial of Service - Types of DoS attacks, How DDoS attacks work, How BOTs/BOTNETs work, Smurf attack, SYN flooding, DoS/DDoS counter measures; Session hijacking – Spoofing vs. hijacking, Types of session hijacking, Sequence prediction, Steps in performing session hijacking, Preventing session hijacking.

**UNIT V: (9 Periods)**  
**Cryptography, Network Protection Systems:** Cryptography: Understanding Cryptography basics, Symmetric and asymmetric algorithms, Public key infrastructure, Cryptography attacks. Network Protection Systems: Understanding routers, Firewalls, Honeypots.

**Total Periods: 45**

**TEXT BOOKS:**

1. Michael T. Simpson, Kent Backman, James E. Corley, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 3<sup>rd</sup> Edition, 2017.
2. Kimberly Graves, CEH: Official Certified Ethical Hacker Review Guide, Wiley, 1<sup>st</sup> Edition, 2007.

**REFERENCES:**

1. Michael Gregg, Certified Ethical Hacker (CEH) Cert Guide, Pearson, 3<sup>rd</sup> Edition, 2019.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc24\\_cs94/preview](https://onlinecourses.nptel.ac.in/noc24_cs94/preview)

## IV Year B. Tech – I Semester

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**(DS23AOE701) DATA ANALYSIS AND VISUALIZATION****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the principles and practices of Exploratory Data Analysis (EDA) using Python.
- Teach techniques for data cleaning, preprocessing, transformation, and visualization.
- Apply statistical techniques and visual methods to discover patterns and relationships.
- Gain experience using popular Python libraries such as NumPy, Pandas, Matplotlib.
- Prepare datasets for further machine learning and predictive modeling. Provide an overview of an exciting growing field of big data analytics.

**COURSE OUTCOMES:**

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

- CO 1:** Understand and apply key concepts of EDA and data pre-processing.
- CO 2:** Perform exploratory analysis using Python libraries and interpret results.
- CO 3:** Handle missing data, outliers, and categorical features effectively.
- CO 4:** Create meaningful visualizations to support data-driven insights.
- CO 5:** Use EDA as a foundation for data science workflows.

**UNIT I:****(10 Periods)**

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape).

**UNIT II:****(8 Periods)**

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting.

**UNIT III:****(8 Periods)**

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis.

**UNIT IV:****(10 Periods)**

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview).

**UNIT V:****(9 Periods)**

Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

**Total Periods: 45****TEXT BOOKS:**

1. ~~Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with~~

- Data, O'Reilly, 2016.
2. Wes McKinney, Python for Data Analysis, O'Reilly, 2<sup>nd</sup> Edition, 2018

**REFERENCES:**

1. Joel Grus, Data Science from Scratch, O'Reilly, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, O'Reilly, 2<sup>nd</sup> Edition, 2019.
3. Allen B. Downey, Think Stats: Probability and Statistics for Programmers, O'Reilly, 2014.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_cs69/preview](https://onlinecourses.nptel.ac.in/noc21_cs69/preview)
2. <https://www.coursera.org/specializations/data-science-python>

## IV Year B. Tech – I Semester

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**(DS23AOE702) FUNDAMENTALS OF DATA SCIENCE****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basics of data science.
- Summarize testable predictions for real-time data.
- Understand Data Scientist's Role in the analysis Process.

**COURSE OUTCOMES:**

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

- CO 1:** Describe the significance of data science and understand the Data Science process.
- CO 2:** Explain how data is collected, managed and stored for data science.
- CO 3:** Build, and prepare data for use with a variety of statistical methods and models
- CO 4:** Analyze Data using various Visualization techniques
- CO 5:** Choose contemporary models, such as machine learning, AI, techniques to solve practical problems

**UNIT I:****(10 Periods)**

**Introduction to Data Science:** Definition, Big Data and Data Science Hype, Datafication, Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process, A Data Scientist's Role in this Process.

**UNIT II:****(9 Periods)**

**Exploratory Data Analysis and the Data Science Process:** Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA.

**UNIT III:****(10 Periods)**

Spam Filter, Linear Regression and Spam Filter, K-NN and spam Filter, Naïve Bayes Algorithm, Spam Filter using Naïve Bayes, Laplace Smoothing, Comparing Naïve Bayes to K-NN, Scraping the Web, introduction to Logical Regression and M6D case study.

**UNIT IV:****(8 Periods)**

**Visualizing Data:** Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations.

**UNIT V:****(8 Periods)**

Data Engineering, Map reduce, Word Frequency Problem, Map Reduce Solution, Other Examples of Map Reduce, Pregel-An Introduction.

**Total Periods: 45****TEXT BOOKS:**

1. Cole Nussbaumer Knaflic, A Data Visualization Guide for Business Professionals, Wiley.
2. Ben Jones, Communicating Data with Tableau, O'Reilly.

**REFERENCES:**

1. Steven S. Skiena, The Data Science Design Manual, Springer 2017.
2. Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'Reilly.

**ONLINE LEARNING RESOURCES:**

1. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/>

## IV Year B. Tech – I Semester

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**(IT23APC501) CLOUD COMPUTING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Explain the evolving computer model called cloud computing.
- Introduce the various selves of services that can be achieved by cloud.
- Describe the security aspects in cloud.

**COURSE OUTCOMES:**

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

- CO 1:** Create cloud computing environment
- CO 2:** Design applications for cloud environment
- CO 3:** Design and develop back up strategies for cloud data based on features
- CO 4:** Use and examine different cloud computing services
- CO 5:** Learn about applications and issues in cloud

**UNIT I:****(9 Periods)****Basics of Cloud computing****Introduction to cloud computing:** Introduction, Characteristics of cloud computing, Cloud Models, Cloud Services Examples, Cloud Based services and applications.**Cloud concept and Technologies:** Virtualization, Load balancing, Scalability and Elasticity, Deployment, Replication, Monitoring, Software defined, Network function virtualization, Map Reduce, Identity and Access Management, services level Agreements, Billing.**Cloud Services and Plat forms:** Compute Services, Storage Services, Database Services, Application services, Content delivery services, Analytics Services Deployment and Management Services, Identity and Access Management services, Open Source Private Cloud software.**UNIT II: Hadoop and Python****(9 Periods)****Hadoop Map Reduce:** Apache Hadoop, Hadoop Map Reduce Job Execution, Hadoop Schedulers, Hadoop Cluster setup.**Cloud Application Design:** Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches.**Python Basics:** Introduction, Installing Python, Python data Types & Data Structures, Control flow, Function, Modules, Packages, File handling, Date/Time Operations, Classes**UNIT III: Python for Cloud computing****(9 Periods)****Python for Cloud:** Python for Amazon web services, Python for Google Cloud Platform, Python for windows Azure, Python for Map Reduce, Python package self-interest, Python web Application Frame work, Designing a Restful web API.**Cloud Application Development in Python:** Design Approaches, Image Processing APP, Document Storage App, Map Reduce App, Social Media Analytics App.**UNIT IV:****(9 Periods)****Big data, multimedia and Tuning Big Data Analytics:** Introduction, Clustering Big Data, Classification of Big data Recommendation of Systems.**Multimedia Cloud:** Introduction, Case Study: Live video Streaming App, Streaming Protocols, case Study: Video Transco ding App.**Cloud Application Benchmarking and Tuning:** Introduction, Workload Characteristics, Application Performance Metrics, Design Considerations for a Benchmarking Methodology, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection case Study, Hardtop benchmarking case Study.

**UNIT V: (9 Periods)**

**Applications and Issues in Cloud Security:** Introduction, CSA Cloud Security Architecture, Authentication, Authorization, Identity Access Management, Data Security, Key Management, Auditing.

**Cloud for Industry, Healthcare & Education:** Cloud Computing for Health care, Cloud computing for Energy Systems, Cloud Computing for Transportation Systems, Cloud Computing for Manufacturing Industry, Cloud computing for Education.

**Migrating into a Cloud:** Introduction, Broad Approach est. migrating into the cloud, the seven-step model of migration into a cloud.

**Organization area dines and Change Management in The Cloud Age:** Introduction, Basic concepts of Organizational Readiness.

**Drivers for changes:** A frame work to comprehend the competitive environment, common change management models, change management maturate models, Organization area dines self-assessment.

**Legal Issues Cloud Computing:** Introduction, Data Privacy and security Issues, cloud contracting models, Jurisdictional issues raised by virtualization and data location, commercial and business considerations, Special Topics.

**Total Periods: 45**

**TEXT BOOKS:**

1. Arshdeep Bahga, Vijay Marinetti, Cloud Computing a Hands on Approach, Universities Press, 2016.
2. Raj Kumar Buyya, James Bromberg, and razes Goscinski, Cloud Computing Principles and Paradigms, Wiley, 2016

**REFERENCES:**

1. Raj kumar Buyya, Christian Vecchiola, S Thamarai Selvi, Mastering Cloud Computing.
2. Arsh deep Bahga and Vijay Madi setti, Cloud computing A Hands On Approach.
3. Anthony Svelte, J.Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill, 2011.

**ONLINE RESOURCES:**

1. Cloud computing – Course (nptel.ac.in)

## IV Year B. Tech – I Semester

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**(IT23APE501) INTERNET OF THINGS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoT technology.
- Introduce some of the application areas where IoT can be applied.

**COURSE OUTCOMES:**

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

- CO 1:** Understand general concepts of Internet of Things.
- CO 2:** Apply design concept to IoT solutions.
- CO 3:** Analyze various M2M and IoT architectures.
- CO 4:** Evaluate design issues in IoT applications.
- CO 5:** Create IoT solutions using sensors, actuators and Devices.

**UNIT I:****(9 Periods)**

**Introduction to IoT:** Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates

**UNIT II:****(9 Periods)**

**Prototyping IoT Objects using Microprocessor/Microcontroller:** Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.

**UNIT III:****(9 Periods)**

**IoT Architecture and Protocols:** Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LowPAN, RPL, CoAP, MQTT, IoT frameworks- Thing Speak.

**UNIT IV:****(9 Periods)**

**Device Discovery and Cloud Services for IoT:** Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

**UNIT V:****(9 Periods)**

**UAV IoT:** Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defence, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller(ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study FlytBase.

**Total Periods: 45****TEXT BOOKS:**

1. Vijay Madiseti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), VPT, 1<sup>st</sup> Edition, 2014.
2. K Valavanis; George J Vachtsevanos, Handbook of Unmanned Aerial Vehicles, New York, Springer, Boston, Massachusetts: Credo Reference, 2014. 2016.

**REFERENCES:**

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligencell, Academic Press, 1<sup>st</sup> Edition, 2014.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.

**ONLINE RESOURCES:**

1. <https://www.arduino.cc/>
2. <https://www.raspberrypi.org/>
3. <https://nptel.ac.in/courses/106105166/5>
4. <https://nptel.ac.in/courses/108108098/4>

## IV Year B. Tech – I Semester

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**(EC23AOE701) FUNDAMENTALS OF DIGITAL IMAGE PROCESSING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce fundamentals of Image Processing
- Expose various relationships between pixels
- Describe various intensity transformations in spatial domains.
- Describe various spatial and frequency domains filters.
- Dissimilate various segmentation and compression techniques for image processing.

**COURSE OUTCOMES:**

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

- CO 1:** Understand fundamentals of digital image processing and apply engineering mathematics in processing of digital image.
- CO 2:** Compute the relationship between the pixels in image processing
- CO 3:** Analyze different image enhancement techniques in spatial domain.
- CO 4:** Describe various image spatial filters and Analyze different image enhancement techniques in frequency domain
- CO 5:** Analyze various techniques in image segmentation and apply various algorithms to perform image compression

**UNIT I:****(9 Periods)****Fundamentals of Image Processing – I:** Introduction, A simple image model, Components of image processing system, Fundamental Steps in digital image processing, image sensing and acquisition, Applications of image processing.**UNIT II:****(9 Periods)****Fundamentals of Image Processing – II:** Image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures, mathematical operations in image processing.**UNIT III:****(9 Periods)****Image Enhancement in Spatial Domain:** Introduction to gray level transformations, Point processing - Image negative, contrast stretching, intensity slicing, Bit plane slicing and grey level slicing, Histogram Processing, Histogram equalization and Specifications.**UNIT IV:****(9 Periods)****Image Enhancement in Frequency Domain:** Spatial Filtering, smoothing filters, sharpening filters, Enhancement in Frequency domain –image smoothing, image sharpening and Homomorphic filtering.**UNIT V:****(9 Periods)****Image Segmentation and Compression:** Point, Line and Edge Detection, Fundamentals of Compression, Image compression model, Types of Redundancy – Coding, Inter pixel and Psycho visual, Lossless compression – Huffman coding, Shannon-Fano coding.**Total Periods:45****TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E woods and Steven L. Eddins, Digital Image processing using MATLAB, Tata McGraw Hill, 2010.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, Digital Image processing, Tata

McGraw Hill.

**REFERENCES:**

1. Milan Sonka, Vaclav Hlavac, Roger Boule, Image Processing, Analysis, and Machine Vision, Cengage Learning, 3<sup>rd</sup> Edition, 2016.
2. William K. Pratt, Digital Image Processing, John Wiley, 3<sup>rd</sup> Edition, 2004

## IV Year B. Tech – I Semester

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**(EC23APC504) MICROPROCESSORS AND MICROCONTROLLERS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Learn the fundamental architectural concepts of microprocessors.
- Gain knowledge about assembly language programming concepts.
- Get familiar about 8086 interfacing.
- Understand the fundamentals of the 8051 Microcontroller.
- Learn interfacing with the 8051 Microcontroller.

**COURSE OUTCOMES:**

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

- CO 1:** Learn the fundamental architectural concepts of microprocessors.
- CO 2:** Gain knowledge about assembly language programming concepts.
- CO 3:** Understand the concepts of 8086 interfacing.
- CO 4:** Learn the fundamentals of the 8051 Microcontroller.
- CO 5:** Know the interfacing with the 8051 Microcontroller.

**UNIT I:****(9 Periods)**

**8086 Architecture:** Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

**UNIT II:****(9 Periods)**

**8086 Programming:** Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

**UNIT III:****(9 Periods)**

**8086 Interfacing:** Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

**UNIT IV:****(9 Periods)**

**Microcontroller:** Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V:****(9 Periods)**

**Interfacing Microcontroller:** - Programming 8051 Timers - Serial Port Programming Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

**Total Periods: 45****TEXT BOOKS:**

1. Douglas V Hall, SSSP Rao, Microprocessors and Interfacing – Programming and Hardware, Tata McGraw Hill Education Private Limited, 3<sup>rd</sup> Edition, 1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, McGraw Hill Education, 3<sup>rd</sup> Edition, 2017.

3. Raj Kamal, *Microcontrollers: Architecture, Programming, Interfacing and System Design*, Pearson, 2<sup>nd</sup> Edition, 2012.

**REFERENCES:**

1. Ramesh S Gaonkar, *Microprocessor Architecture Programming and Applications with the 8085*, Penram International Publishing, 6<sup>th</sup> Edition, 2013.
2. Kenneth J. Ayala, *The 8051 Microcontroller*, Cengage Learning, 3<sup>rd</sup> Edition, 2004.

## IV Year B. Tech – I Semester

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**(EC23AOE702) TRANSDUCERS AND SENSORS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand characteristics of Instrumentation System and the operating principle of motion transducers.
- Explore working principles, and applications of different temperature transducers and Piezo-electric sensors.
- Provide knowledge on flow transducers and their applications.
- Study the working principles of pressure transducers.

**COURSE OUTCOMES:**

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

- CO 1:** Understand characteristics of Instrumentation System and the operating principle of motion transducers.
- CO 2:** Explore working principles, and applications of different temperature transducers and Piezo-electric sensors.
- CO 3:** Gain knowledge on flow transducers and their applications.
- CO 4:** Learn the working principles of pressure transducers.
- CO 5:** Understand the working principle and applications of force and sound transducers.

**UNIT I:****(9 Periods)**

**Introduction:** General Configuration and Functional Description of measuring instruments, Static and Dynamic Characteristics of Instrumentation System, Errors in Instrumentation System, Active and Passive Transducers and their Classification.

**Motion Transducers:** Resistive strain gauge, LVDT, RVDT, Capacitive transducers, Piezo-electric transducers, seismic displacement pick-ups, vibrometers and accelerometers.

**UNIT II:****(9 Periods)**

**Temperature Transducers:** Standards and calibration, fluid expansion and metal expansion type transducers - bimetallic strip, Thermometer, Thermistor, RTD, Thermocouple and their characteristics. Hall effect transducers, Digital transducers, Proximity devices, Bio-sensors, Smart sensors, Piezo-electric sensors.

**UNIT III:****(9 Periods)**

**Flow Transducers:** Bernoulli 's principle and continuity, Orifice plate, Nozzle plate, Venture tube, Rotameter, Anemometers, Electromagnetic flow meter, Impeller meter and Turbid flow meter.

**UNIT IV:****(9 periods)**

**Pressure Transducers:** Standards and calibration, different types of manometers, elastic transducers, diaphragm bellows, bourdon tube, capacitive and resistive pressure transducers, high- and low-pressure measurement.

**UNIT V:****(9 Periods)**

**Force and Sound Transducers:** Proving ring, hydraulic and pneumatic load cell, dynamometer and gyroscopes. Sound level meter, sound characteristics, Microphone.

**Total Periods:45****TEXT BOOKS:**

1. A.K. Sawhney, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai & Co. 3<sup>rd</sup> Edition, Delhi, 2010.

2. Rangan C.S, Sarma G.R and Mani V S V, Instrumentation Devices and Systems, TATA McGraw Hill Publications, 2007.

**REFERENCES:**

1. Doebelin. E. O, Measurement Systems Application and Design, McGraw-Hill International, New York, 2004.
2. Nakra B.C and Chaudhary K.K, Instrumentation Measurement and Analysis, Tata McGraw-Hill Publication Ltd., 2<sup>nd</sup> Edition, 2006.

## IV Year B. Tech – I Semester

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**(EE23AOE701) ELECTRIC VEHICLES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals, components, and environmental aspects of electric vehicle systems.
- Learn the propulsion system configurations and motor selection for electric vehicles.
- Study the operation and characteristics of fuel cells and hybrid electric systems.
- Explore battery charging methods and control strategies for electric vehicles.
- Understand various energy storage technologies and their integration in power systems.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the configuration, parameters, and environmental impact of electric vehicle systems.
- CO 2:** Analyze propulsion architectures and motor choices used in electric vehicle applications.
- CO 3:** Evaluate fuel cell models, characteristics, and hybrid system configurations in EVs.
- CO 4:** Design control strategies for battery charging and electric vehicle performance optimization.
- CO 5:** Assess energy storage technologies and their application in smart grid and EV integration.

**UNIT I: (10 Periods)**

**Introduction to EV Systems and Energy Sources:** Past, Present and Future of EV - EV Concept- EV Technology- State-of-the Art of EVs- EV configuration- EV system- Fixed and Variable gearing- Single and multiple motor drive- In-wheel drives- EV parameters: Weight, size, force and energy, performance parameters. Electro mobility and the environment- History of Electric power trains- Carbon emissions from fuels- Green houses and pollutants- Comparison of conventional, battery, hybrid and fuel cell electric systems.

**UNIT II: (9 Periods)**

**EV Propulsion and Dynamics:** Choice of electric propulsion system- Block diagram- Concept of EV Motors- Single and multi- motor configurations- Fixed and variable geared transmission- In-wheel motor configuration- Classification - Electric motors used in current vehicle applications - Recent EV Motors- Vehicle load factors- Vehicle acceleration.

**UNIT III: (8 Periods)**

**Fuel Cells:** Introduction of fuel cells- Basic operation- Model - Voltage, power and efficiency- Power plant system - Characteristics- Sizing - Example of fuel cell electric vehicle - Introduction to HEV- Brake specific fuel consumption - Comparison of Series-Parallel hybrid systems- Examples.

**UNIT IV: (9 Periods)**

**Battery charging:** Basic requirements- Charger architecture- Charger functions- Wireless charging- Power factor correction.

**Control:** Introduction- Modelling of electro mechanical system- Feedback controller design approach- PI controller's designing- Torque-loop, Speed control loop compensation- Acceleration of battery electric vehicle.

**UNIT V: (9 Periods)**

**Energy Storage Technologies:** Role of Energy Storage Systems- Thermal- Mechanical- Chemical- Electrochemical- Electrical - Efficiency of energy storage systems- Super Capacitors-Superconducting Magnetic Energy Storage (SMES)- SOC- SOH -fuel cells - G2V- V2G- Energy storage in Micro-grid and Smart grid- Energy Management with storage systems.

**Total Periods: 45**

**TEXT BOOKS:**

1. C.C Chan, K.T Chau, Modern Electric Vehicle Technology, Oxford University Press Inc., New York, 1<sup>st</sup> Edition, 2001
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 1<sup>st</sup> Edition, 2017.

**REFERENCES:**

1. Iqbal Husain, Electric and Hybrid Vehicles Design Fundamentals, CRC Press, 3<sup>rd</sup> Edition, 2021.
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, Energy Storage in Power Systems, Wiley Publication, ISBN: 978-1-118-97130-7, 1<sup>st</sup> Edition, 2016.
3. A.G.Ter-Gazarian, Energy Storage for Power Systems, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919-219-4), 2<sup>nd</sup> Edition, 2011.
4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 1<sup>st</sup> Edition, 2004.
1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2<sup>nd</sup> Edition, 2003.

**ONLINE RESOURCES:**

2. <https://nptel.ac.in/courses/108/102/108102121/>
3. <https://nptel.ac.in/syllabus/108103009>

## IV Year B. Tech – I Semester

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**(EE23AOE702) ENERGY AUDIT, CONSERVATION AND MANAGEMENT****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the principles and procedures of energy auditing and management in various sectors.
- Learn the fundamentals of energy conservation and the current global and national energy scenarios.
- Study energy-efficient motor and lighting systems and their audit procedures.
- Explore energy measuring instruments and perform economic analysis of energy systems.
- Understand demand-side management techniques and promote energy conservation awareness.

**COURSE OUTCOMES:**

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

- CO 1:** Describe energy audit methods, tools, and management practices used in industries and buildings.
- CO 2:** Explain energy conservation principles and assess the energy scenario in India and globally.
- CO 3:** Analyze energy-efficient motors and lighting systems and conduct related audits.
- CO 4:** Use energy instruments and apply economic analysis methods for energy-saving investments.
- CO 5:** Apply DSM techniques and organize energy conservation awareness programs.

**UNIT I:****(10 Periods)**

**Energy Audit and Management Principles:** Energy audit – definitions, concept, types of audit, energy index-cost index, pie charts, Sankey diagrams, load profiles, energy audit in industries, energy saving potential, energy audit of process industry, thermal power station, building energy audit, case study. IE rules and regulations for energy audit.

Energy management – Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting.

**UNIT II:****(8 Periods)**

**Energy Conservation Principles:** Energy scenario in India and world. Rules for efficient energy conservation; technologies for energy conservation. Principles of energy conservation, current energy consumption in India, roles and responsibilities of energy managers in industries.

**UNIT III:****(9 Periods)**

**Energy Efficient Motors and Lighting:** Energy efficient motors - factors affecting efficiency, loss distribution, constructional details, characteristics, variable speed, variable duty cycle systems, motor energy audit. Lighting -Good lighting system design and practice, lighting control, lighting energy audit.

**UNIT IV:****(9 Periods)**

**Energy Instruments and Economic Analysis:** Energy Instruments— Infrared thermometer, data loggers, thermo-couples, pyrometers, Lux meters, tongue testers, power quality analyzer, and PLC applications.

Energy Economic Analysis— The time value of money concept. Cash flow models, payback analysis, depreciation, taxes and tax credit - numerical problems.

**UNIT V:****(9 Periods)**

**Demand Side Management:** Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, and time of day models for planning, load management, load priority technique. Management and organization of energy conservation awareness programs.

**Total Periods: 45**

**TEXT BOOKS:**

1. W.R. Murphy, G. McKay, Energy Management, Butter worth- Heinemann Publications, 2<sup>nd</sup> Edition, 2016.
2. Albert Thumann, William J. Younger, Handbook of Energy Audits, Taylor & Francis Ltd, 7<sup>th</sup> Edition, 2008.

**REFERENCES:**

1. Umesh Rathore, Energy management, S.K. Kataria & Sons, 2<sup>nd</sup> Edition, 2014.
2. W.C.Turner, Stevedoty, Energy Management Hand Book, CRC press, 6<sup>th</sup> Edition, 2006.
3. D.P. Sen, K.R. Padiyar, Indrane Sen, M.A. Pai, Recent Advances in Control and Management of Energy Systems, Interline Publisher, Bangalore, 1993.
4. Ashok V. Desai, Wiley Eastern, Energy Demand - Analysis, Management and Conservation Hand Book on Energy Auditing - TERI (Tata Energy Research Institute), 2005.
5. Craig B. Smith, Kelly E. Parmenter, Energy Management Principles Applications, Benefits, Savings, Elsevier Inc (Pergamon Press), 1<sup>st</sup> Edition, 2016.

**ONLINE RESOURCES:**

1. <https://beeindia.gov.in/sites/default/files/1Ch3.pdf>
2. <https://www.youtube.com/watch?v=M1zijCmeXJg>
3. <https://www.youtube.com/watch?v=FTpMWXMBSyM>
4. [https://www.youtube.com/watch?v=\\_T1Au\\_P5bnQ](https://www.youtube.com/watch?v=_T1Au_P5bnQ)
5. <https://www.youtube.com/watch?v=ENLzwTVjxms>
6. <https://www.youtube.com/watch?v=7hDyLuFJ0c8>
7. <https://www.youtube.com/watch?v=lkNIuFkzxBk>

## IV Year B. Tech – I Semester

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**(EE23AOE703) SMART GRID TECHNOLOGIES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the concept, structure, and evolution of smart grids.
- Analyze wide area monitoring systems and synchrophasor technology.
- Apply smart metering and advanced metering infrastructure (AMI) concepts.
- Evaluate information and communication technology (ICT) systems in smart grids.
- Design smart grid applications with a focus on cyber security measures.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the evolution, architecture, and enabling technologies of Smart Grid and assess its implementation in India and globally.
- CO 2:** Analyze the structure, functions, and applications of synchrophasor technology and Wide Area Monitoring Systems using PMUs and PDCs.
- CO 3:** Describe the functions, specifications, and benefits of smart meters and evaluate their role in demand-side management and AMI.
- CO 4:** Compare various communication technologies and protocols used in Smart Grid systems.
- CO 5:** Evaluate Smart Grid applications including renewable integration, energy storage systems, electric vehicles, and cyber security challenges.

**UNIT I:****(10 Periods)**

**Introduction to Smart Grid:** Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in Smart Grid deployment efforts – Smart Grid road map for India – Smart Grid Architecture.

**UNIT II:****(9 Periods)**

**Wide Area Monitoring System:** Fundamentals of Synchro Phasor Technology – concept and benefits of Wide Area Monitoring System – Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU.

**UNIT III:****(8 Periods)**

**Smart Meters:** Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management.

**UNIT IV:****(9 Periods)**

**Information and Communication Technology:** Overview of Smart Grid Communication system – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid

**UNIT V:****(9 Periods)**

**Smart Grid Applications and Cyber Security:** Applications : Overview and concept of Renewable Integration – Introduction to distributed generation - Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow battery – Fuel cell – SMES – Super capacitors – Plug- in Hybrid electric Vehicles - Cyber Security: ~~Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management~~

Systems – Approach to assessment of smart grid cyber security risks – Methodologies.  
Cyber Security requirements – Smart Grid Information Model.

**Total Periods: 45**

**TEXT BOOKS:**

1. James Momoh, SMART GRID: Fundamentals of Design and Analysis, John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid: Technology and Applications, John Wiley & Sons, New Jersey, 2012.

**REFERENCES:**

1. Power Grid Corporation of India Limited, Smart Grid Primer, Power Grid Corporation of India Limited, Bangalore, India, 1<sup>st</sup> Edition, 2013.
2. Fereidoon. P.Sioshansi, Smart Grid – Integrating Renewable, Distributed and Efficient Energy, Academic Press, USA, 1<sup>st</sup> Edition, 2011.
3. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press Publication, England, 1<sup>st</sup> Edition, 2013.
4. Phadke A G, Thorp J S, Synchronized Phasor Measurements and Their Applications, Springer, Newyork, 1<sup>st</sup> Edition, 2012.

## IV Year B. Tech – I Semester

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**(ME23AOE701) 3D PRINTING TECHNOLOGIES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Know the importance of 3D printing in Manufacturing
- Know the different 3D Printing Technologies
- Select a suitable material for 3D Printing
- Observe the different methods for Post-processing of 3D Printing parts
- Understand the applications of 3D Printing in Automobile, Aerospace, Bio-medical etc.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the importance of 3D printing in modern manufacturing and its advantages over traditional methods.
- CO 2:** Compare different 3D printing technologies based on process type, resolution, material compatibility, and end-use.
- CO 3:** Select suitable materials for 3D printing applications considering mechanical, thermal, and chemical properties.
- CO 4:** Demonstrate various post-processing methods for improving surface finish, strength, and functionality of 3D printed parts
- CO 5:** Evaluate the applications of 3D printing in various sectors and its impact on product design and manufacturing.

**UNIT I:****(9 Periods)**

**Introduction and Basic Principles:** 3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies

Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World

**UNIT II:****(9 Periods)**

**3D Printing Process Chain & Photopolymerization Processes:** Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, Design for 3D PRINTING. Introduction to Photopolymerization Processes: Photopolymerization Materials, Reaction Rates, Vector Scan SL, SL Resin Curing Process, SL Scan Patterns, Vector Scan Micro stereolithography, Mask Projection Photopolymerization Technologies and Processes, Two-Photon SL.

**UNIT III:****(9 Periods)**

**Powder Bed Fusion Processes & Extrusion-Based Systems:** Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceramic Part Creation, Variants of Powder Bed Fusion Processes, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials - Capabilities and Limitations.

Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bio-extrusion, Other Systems.

**UNIT IV:****(9 Periods)**

**Design, Guidelines for Process Selection & Software Issues:** Design for 3D Printing - ~~Design for Manufacturing and Assembly, Core DFM for 3D Printing Concepts and Objectives,~~

3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection - Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control. Software Issues for 3D Printing - Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist 3D Printing

**UNIT V: (9 Periods)**

**Medical Applications & Future Directions for 3D Printing:** Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions.

**Total Periods: 45**

**TEXT BOOKS:**

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
2. Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific, 2003.

**REFERENCES:**

1. Ali K. Kamrani, Emand Abouel Nasr, Rapid Prototyping: Theory & Practice, Springer, 2006.
2. D. T. Pham, S. S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.

**ONLINE RESOURCES:**

1. Fundamentals of Additive Manufacturing Technologies - IIT Guwahati  
<http://nptel.ac.in/courses/112103306>
2. 3D Printing and Additive Manufacturing Specialization, Coursera  
<https://www.coursera.org/specializations/3d-printing-additive-manufacturing>
3. <https://www.youtube.com/watch?v=ICjQ0UzE2Ao>

## IV Year B. Tech – I Semester

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**(ME23APE706) AUTOMATION AND ROBOTICS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamentals of industrial automation, its types, components, and strategies across manufacturing systems.
- Explain the working of automated flow lines and the methods used in assembly line balancing and flexible automation.
- Impart knowledge about industrial robots, their configurations, anatomy, and applications in manufacturing processes.
- Develop an understanding of manipulator kinematics, homogeneous transformations, actuators, and sensors used in robotics.
- Analyze manipulator dynamics and apply trajectory planning techniques for robotic motion and obstacle avoidance.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the need, types, and elements of automation systems and analyze different levels of automation strategies in industry.
- CO 2:** Demonstrate the operation of automated flow lines and apply methods for assembly line balancing and optimization.
- CO 3:** Identify robotic components and describe their configuration, degrees of freedom, and industrial applications in various processes.
- CO 4:** Apply transformation techniques and Denavit–Hartenberg (D-H) notation to solve problems in robot kinematics and evaluate actuator and sensor selection.
- CO 5:** Analyze robot dynamics using Jacobians and Euler formulations and develop suitable trajectories for obstacle-free motion.

**UNIT I:****(9 Periods)**

**Introduction to Automation:** Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

**UNIT II:****(9 Periods)**

**Automated flow lines:** Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines.

**Assembly line balancing:** Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**UNIT III:****(9 Periods)**

**Introduction to Industrial Robotics:** Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

**Robot actuators and Feedback components:** Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors – potentiometers, resolvers, encoders – velocity sensors, Tactile sensors, Proximity sensors.

**UNIT IV:****(9 Periods)**

**Manipulator Kinematics:** Manipulator Kinematics, Homogeneous transformations as applicable to rotation and translation – D-H notation, Forward inverse kinematics.

~~**Manipulator Dynamics:** Differential transformations, Jacobians, Lagrange-Euler and~~

Newton–Euler formations.

**Trajectory Planning:** Trajectory Planning and avoidance of obstacles, path planning, skew motion, joint integrated motion, straight line motion.

**UNIT V:**

**(9 Periods)**

**Robot Programming:** Robot Programming, Methods of programming – requirements and features of programming languages, software packages. Problems with programming languages.

**Robot Application in Manufacturing:** Material Transfer – Material handling, loading and unloading – Process – spot and continuous arc welding & spray painting – Assembly and Inspection.

**Total Periods: 45**

**TEXT BOOKS:**

1. M. P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson Education, 4<sup>th</sup> Edition, 2016.
2. M. P. Groover, Industrial Robotics, Tata McGraw Hill, 1996.

**REFERENCES:**

1. K. S. Fu, Robotics, 4th Edition, McGraw Hill, 2010.
2. P. Coiffet and M. Chaironze, An Introduction to Robot Technology, Kogan Page Ltd., London, 1983.
3. Richard D. Klafter, Robotic Engineering, Prentice Hall.
4. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 1<sup>st</sup> Edition, 2006.
5. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill.

**ONLINE RESOURCES:**

1. Introduction To Robotics, NPTEL, IIT Madras. <https://nptel.ac.in/courses/107106090>
2. Robotics, NPTEL, IIT Bombay. <https://nptel.ac.in/courses/112101098>

## IV Year B. Tech – I Semester

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**(ME23APE710) TOTAL QUALITY MANAGEMENT****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Familiarize the basic concepts of Total Quality Management.
- Describe and interpret the principles of Deming's philosophy and other quality approaches.
- Gain Knowledge on quality control and its applications to real time.
- Understand the extent of customer satisfaction by the application of various quality concepts.
- Demonstrate the importance of Quality standards in Production

**COURSE OUTCOMES:**

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

- CO 1:** Define and develop on quality Management philosophies and analyze quality costs frameworks.
- CO 2:** Understanding of the historical development of Total Quality Management (TQM), implementation, and real-world applications through case studies.
- CO 3:** Evaluate the cost of poor quality, process effectiveness and efficiency to analyze areas for improvement.
- CO 4:** Apply benchmarking and business process reengineering to improve management processes.
- CO 5:** Demonstrate the set of indications to evaluate performance excellence of an organization

**UNIT I:****(8 Periods)**

**Introduction:** Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

**UNIT II:****(9 Periods)**

**Historical Review:** Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

**UNIT III:****(10 Periods)**

**TQM Principles:** Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures Basic Concepts, Strategy, Performance Measure Case studies.

**UNIT IV:****(10 Periods)**

**TQM Tools:** Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

**UNIT V:****(8 Periods)**

**Quality Systems:** Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System Elements, Implementation of Quality System, Documentation, Quality Auditing,

QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

**Total Periods: 45**

**TEXT BOOKS:**

1. Dale H. Besterfield, Total Quality Management, Pearson Education, 4<sup>th</sup> Edition, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata McGraw-Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, CRC Press, 3<sup>rd</sup> Edition, 2017.

**REFERENCES:**

1. Narayana V. and Sreenivasan N. S., Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L. Flood, Beyond TQM, John Wiley & Sons Ltd., 1<sup>st</sup> Edition, 1993.
3. Richard S. Leavenworth and Eugene Lodewick Grant, Statistical Quality Control, Tata McGraw-Hill, 7<sup>th</sup> Edition, 2015.
4. Samuel Ho, TQM – An Integrated Approach, Kogan Page Ltd., USA, 1995.

**ONLINE RESOURCES:**

1. Total Quality Management - I, NPTEL, IIT Kanpur.  
<https://nptel.ac.in/courses/110104080>
2. Total Quality Management - II, NPTEL, IIT Kanpur.  
<https://nptel.ac.in/courses/110104085>

## IV Year B. Tech – I Semester

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**(BA23AOE701) BUSINESS DEVELOPMENT****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide an understanding of the role of business development in startups, SMEs, and large corporations.
- Teach strategies for identifying and pursuing growth opportunities.
- Equip students with skills in market research, lead generation, and partnership building.
- Develop an understanding of sales cycles, client management, and negotiation.
- Introduce digital tools and platforms used in business development.

**COURSE OUTCOMES:**

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

**CO 1:** Explain the principles, scope, and objectives of business development.**CO 2:** Identify and evaluate new business opportunities using structured research.**CO 3:** Develop effective sales strategies and communication approaches.**CO 4:** Apply techniques for client acquisition, relationship building, and strategic alliances.**CO 5:** Use CRM and digital tools for lead tracking, data analysis, and business growth**UNIT I:****(9 Periods)****Fundamentals of Business Development:** Definition, scope, and goals of business development, Difference between business development, marketing, and sales, Business growth models: organic and inorganic-Roles and skills of a business development professional.**UNIT II:****(9 Periods)****Market Research and Opportunity Analysis:** Market segmentation, targeting, and positioning, Competitor analysis and SWOT, Customer profiling and need identification, Identifying growth opportunities in new and existing markets.**UNIT III:****(7 Periods)****Lead Generation and Sales Strategies:** Lead generation: online and offline methods, Cold calling, referrals, email campaigns, and networking, B2B and B2C sales approaches, Building and managing a sales pipeline.**UNIT IV:****(10 Periods)****Client Relationship & Partnership Management:** Customer relationship management (CRM) fundamentals, Client on boarding and lifecycle management, Strategic partnerships and alliances, Negotiation techniques and conflict resolution.**UNIT V:****(10 Periods)****Digital Tools & Tech for Business Development:** Overview of CRM tools: HubSpot, Zoho, Sales force, LinkedIn and social selling, Sales analytics, dashboards, KPIs, Business development metrics and reporting.**Total Periods: 45****TEXT BOOKS:**

1. Andreas Ramos, Business Development for Dummies, Wiley, 1<sup>st</sup> Edition, 2014
2. Michael W. Johnson, Sales and Business Development, Routledge, 1<sup>st</sup> Edition, 2017

**REFERENCES:**

1. Neil Rackham, SPIN Selling
2. Sean Ellis & Morgan Brown, Hacking Growth
3. LinkedIn Learning: Business Development & Sales Strategy Courses
4. Hub Spot Academy (Free CRM and Sales Certifications)

**ONLINE RESOURCES:**

1. <https://hbr.org>
2. <https://www.coursera.org/courses?query=business%20development>

## IV Year B. Tech – I Semester

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**(BA23AOE702) TECHNO MARKETING****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the concepts and strategies of marketing in the digital and technology-driven era.
- Equip students with the skills to analyze and apply technology in marketing functions such as promotion, sales, and customer engagement.
- Familiarize students with tools like digital platforms, social media, data analytics, and CRM systems.
- Explore how product innovation, e-commerce, and technology influence consumer behavior.
- Promote interdisciplinary thinking combining engineering knowledge with marketing insights.

**COURSE OUTCOMES:**

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

- CO 1:** Understand the fundamentals of techno-marketing and its impact on modern business.
- CO 2:** Apply technology-driven strategies in digital marketing and sales.
- CO 3:** Use analytical tools and CRM platforms for marketing decision-making.
- CO 4:** Analyze consumer behavior using tech-based data insights.
- CO 5:** Design marketing campaigns integrating engineering innovations with business needs.

**UNIT I:****(9 Periods)**

**Introduction to Techno-Marketing:** Definition and evolution of techno-marketing, Role of technology in marketing decision-making, Components of marketing mix with a tech perspective, B2B vs. B2C techno-marketing, Case studies on successful tech-based marketing.

**UNIT II:****(7 Periods)**

**Digital & Social Media Marketing:** Digital marketing channels: SEO, SEM, Email, Mobile-Social media platforms and strategies, Content marketing and influencer marketing, Website and app-based marketing tools, Introduction to performance marketing.

**UNIT III:****(9 Periods)**

**E-Commerce & Technology Applications:** E-commerce models and platforms, Marketing automation tools - AI, AR/VR, and chatbot applications in marketing, IoT and product personalization, Use of QR codes and virtual stores.

**UNIT IV:****(10 Periods)**

**Marketing Analytics & CRM:** Role of data analytics in marketing, Customer segmentation and targeting using data, Key Performance Indicators (KPIs) and dashboards, CRM systems: Sales force, Zoho, Hub Spot basics, Predictive marketing and A/B testing.

**UNIT V:****(10 Periods)**

**Consumer Behavior in the Tech Era:** Understanding tech-savvy consumers, Buyer decision process in digital contexts, Ethics and data privacy in tech marketing, Cross-cultural marketing in global tech platforms, Trends: Green marketing, mobile-first consumers, phygital experiences.

**Total Periods: 45**

**TEXT BOOKS:**

1. Philip Kotler, Gary Armstrong, Principles of Marketing, Pearson Education, 18<sup>th</sup> Edition, 2020
2. V. Rajesh, The Phenomenal Rise of E-Commerce in India: Techno Marketing Strategies, SAGE Publications, 1<sup>st</sup> Edition, 2016.

**REFERENCES:**

1. Philip Kotler, Marketing 5.0: Technology for Humanity
2. Seema Gupta, Digital Marketing
3. Google Digital Garage & HubSpot Academy (Free Online Resources)
4. Boone & Kurtz, Contemporary Marketing

**ONLINE RESOURCES:**

1. <https://academy.hubspot.com/courses/digital-marketing>
2. <https://www.coursera.org/specializations/digital-marketing>

## IV Year B. Tech – I Semester

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**(EG23AOE701) EMPLOYABILITY SKILLS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Encourage all round development of the students by focusing on productive skills
- Make the students aware of Goal setting and writing skills
- Enable them to know the importance of presentation skills in achieving desired goals.
- Help them develop organizational skills through group activities
- Function effectively with heterogeneous teams

**COURSE OUTCOMES:**

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

- CO 1:** Understand the importance of goals and try to achieve them
- CO 2:** Apply the knowledge of writing skills in preparing eye-catching resumes
- CO 3:** Analyze various forms of Presentation skills
- CO 4:** Judge the group behavior appropriately
- CO 5:** Develop skills required for employability.

**UNIT I:****(9 Periods)**

**Goal Setting and Self-Management:** Definition, importance, types of Goal Setting – SMART Goal Setting – Advantages-Motivation – Intrinsic and Extrinsic Motivation – Self-Management – Knowing about self – SWOC Analysis.

**UNIT II:****(9 Periods)**

**Writing Skills:** Definition, significance, types of writing skills – Resume writing Vs CV Writing – E-Mail writing, Cover Letters – E-Mail Etiquette –SoP (Statement of Purpose).

**UNIT III:****(9 Periods)**

**Technical Presentation Skills:** Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics – Anxiety in Public speaking (Glossophobia)- PPT & Poster Presentation.

**UNIT IV:****(9 Periods)**

**Group Presentation Skills:** Body Language – Group Behaviour – Team Dynamics – Leadership Skills – Personality Manifestation- Group Discussion-Debate –Corporate Etiquette.

**UNIT V:****(9 Periods)**

**Job Cracking Skills:** Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for success – Job searching skills – STAR method – FAQs- Answering Strategies – Mock Interviews.

**Total Periods: 45****TEXT BOOKS:**

1. Sabina Pillai, Agna Fernandez. Soft Skills & Employability Skills, Cambridge Publisher, 2014.
2. Alka Wadkar. Life Skills for Success, Sage Publications, 2016.

**REFERENCES:**

1. Gangadhar Joshi. Campus to Corporate Paperback, Sage Publications. 2015
2. ~~Sherfield Montgomery Moody, Cornerstone, Developing Soft Skills, Pearson~~

- Publications. 4<sup>th</sup> Edition, 2008
3. Shikha Kapoor. Personality Development and Soft Skills - Preparing for Tomorrow, Wiley, 1<sup>st</sup> Edition, 2017.
  4. M. Sen Gupta, Skills for Employability, Innovative Publication, 2019.
  5. Steve Duck and David T McMahan, The Basics for Communication Skills a Relational Perspective, Sage Press, 2012.

**ONLINE RESOURCES:**

1. [https://youtu.be/DUIsNJtg2L8?list=PLLy\\_2iUCG87CQhELCyvXh0E\\_y-bOO1\\_q](https://youtu.be/DUIsNJtg2L8?list=PLLy_2iUCG87CQhELCyvXh0E_y-bOO1_q)
2. [https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHIsQFwJZel\\_j2PUy0pwjVUgj7KIj](https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHIsQFwJZel_j2PUy0pwjVUgj7KIj)
3. <https://youtu.be/-Y-R9hDI7IU>
4. <https://youtu.be/gkLsn4ddmTs>
5. <https://youtu.be/2bf9K2rRWwo>
6. <https://youtu.be/FchfE3c2jzc>
7. <https://www.businessstrainingworks.com/training-resource/five-free-business-etiquette-training-games/>
8. [https://onlinecourses.nptel.ac.in/noc24\\_hs15/preview](https://onlinecourses.nptel.ac.in/noc24_hs15/preview)
9. [https://onlinecourses.nptel.ac.in/noc21\\_hs76/preview](https://onlinecourses.nptel.ac.in/noc21_hs76/preview)

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**(EG23AOE702) LIFE SKILLS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Develop one's personality by being aware of the self.
- Make the students aware of critical thinking and problem-solving skills.
- Acquaint students with the social and inter-personal skills that will enable them to cope with the constantly changing environment.
- Enhance the employability and maximize the potential of the students.

**COURSE OUTCOMES:**

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

**CO 1:** Define and Identify different life skills required in personal and professional life**CO 2:** Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.**CO 3:** Explain the basic mechanics of effective communication and demonstrate these through presentations.**CO 4:** Take part in group discussions**CO 5:** Understand the basics of teamwork and leadership**UNIT I:****(9 Periods)****Life Skills:** Meaning and significance of life skills, Life skills identified by WHO: Self awareness, Empathy, Critical thinking, Creative thinking, Quantum thinking Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.**Activity:** Role Play/What if scenario.**UNIT II:****(9 Periods)**

Intrapersonal Communication: definition, need for self-awareness; Coping with Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

**Emotions:** Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques. Morals, Values and**Ethics:** Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self- Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.**Activity:** Moral story narration.**UNIT III:****(9 Periods)****21<sup>st</sup> Century Skills:** Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.**Activity:** Case Study.**UNIT IV:****(9 Periods)****Group and Team Dynamics:** Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Entrepreneurship.**Activity:** Debate/Mock Assembly.

**UNIT V:**

**(9 Periods)**

**Leadership:** Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs. Transformational Leaders, Leadership Grid, Effective Leaders.

**Activity:** Group Discussion/Step into others' shoe.

**Total Periods: 45**

**TEXT BOOKS:**

1. Remesh S., Vishnu R.G., Life Skills for Engineers, Ridhima Publications, 1<sup>st</sup> Edition, 2016.
2. Larry James, The First Book of Life Skills, Embassy Books, 1<sup>st</sup> Edition, 2016.

**REFERENCES:**

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, Personality Development & Soft Skills, Oxford Publishers, 3<sup>rd</sup> Impression, 2017.
3. Ramesh.s, Vishnu R.G., Life Skills for Engineers, McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership, John Wiley & Sons, 2004.
5. Kalyana, Soft Skill for Managers, Wiley Publishing Ltd, 1<sup>st</sup> Edition, 2015.
6. Shalini Verma, Development of Life Skills and Professional Practice, Sultan Chand (G/L) & Company, 1<sup>st</sup> Edition, 2014.
7. Daniel Goleman, Emotional Intelligence, Bantam, 2006.
8. Butterfield Jeff, Soft Skills for Everyone, Cengage Learning India Pvt Ltd, 1<sup>st</sup> Edition, 2011.
9. Stephen P. Robbins, Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6<sup>th</sup> Edition, 2015.
10. Gopala Swamy Ramesh, Mahadevan Ramesh, The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education, 1<sup>st</sup> Edition, 2013.

## IV Year B. Tech – I Semester

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**(EG23AOE703) LITERARY VIBES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Inculcate passion for aesthetic sense and reading skills.
- Encourage respecting others experiences and creative writing.
- Explore emotions, communication skills and critical thinking.
- Educate how books serve as the reflection of history and society.
- Provide practical wisdom and duty of responding to events of the times.

**COURSE OUTCOMES:**

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

- CO 1:** Identify genres, literary techniques and creative uses of language in literary texts.
- CO 2:** Explain the relevance of themes found in literary texts to contemporary, personal and cultural values and to historical forces.
- CO 3:** Apply knowledge and understanding of literary texts when responding to others' problems and their own and make evidence-based arguments.
- CO 4:** Analyze the underlying meanings of the text by using the elements of literary texts.
- CO 5:** Evaluate their own work and that of others critically.

**UNIT I:****(7 Periods)****Poetry:**

8. Ulysses- Alfred Lord Tennyson
9. Ain't I woman?-Sojourner Truth
2. The Second Coming-W.B. Yeats
3. Where the Mind is Without Fear - Rabindranath Tagore

**UNIT II:****(7 Periods)****Drama: Twelfth Night- William Shakespeare:**

1. Shakespeare -life and works
2. Plot & sub-plot and Historical background of the play
3. Themes and Criticism
4. Style and literary elements
4. Characters and characterization

**UNIT III:****(10 Periods)****Essay and Short Story:**

1. The Luncheon - Somerset Maugham
2. The Happy Prince-Oscar Wild
3. Three Questions – Leo Tolstoy
4. Grief –Antony Chekov

**UNIT IV:****(10 Periods)****Prose: Essay and Autobiography:**

1. My struggle for an Education-Booker T Washington
2. The Essentials of Education-Richard Livingston
3. The story of My Life-Helen Keller
4. Student Mobs-JB Priestly

**UNIT V:****(11 Periods)****Novel: Hard Times- Charles Dickens:**

1. Charles Dickens-Life and works

2. Plot and Historical background of the novel
3. Themes and criticism
4. Style and literary elements
5. Characters and characterization

**Total Periods: 45**

**TEXT BOOKS:**

1. Charles Dickens, *Hard Times*, (Sangam Abridged Texts) Vantage Press, 1983
2. DENT JC. William Shakespeare. *Twelfth Night*. Oxford University Press, 2016.

**REFERENCES:**

1. WJ Long. *History of English Literature*, Rupa Publications India, 1<sup>st</sup> Edition.
2. RK Kaushik And SC Bhatia. *Essays, Short Stories and One Act Plays*, Oxford University Press, 2018.
3. Dhanvel, SP. *English and Soft Skills*, Orient Blackswan, 2017.
4. Mohit Bhattacharya, *New Horizon*, Pearson publications, New Delhi, 2014
5. Vimala Ramarao, *Explorations Volume-II*, Prasaraanga Bangalore University, 2014.
6. Dev Neira, Anjana & Co. *Creative Writing: A Beginner's Manual*. Pearson India, 2008.

**ONLINE RESOURCES:**

1. <https://www.litcharts.com/poetry/alfred-lord-tennyson/ulysses>
2. <https://www.litcharts.com/lit/ain-t-i-a-woman/summary-and-analysis>
3. <https://englishliterature.education/articles/poetry-analysis/the-second-coming-by->
4. <https://sirjitutorials.com/where-the-mind-is-without-fear-poem-notes-explanation/>
5. <https://www.litcharts.com/lit/twelfth-night/themes>
6. <https://smartenglishnotes.com/2021/11/28/the-luncheon-summary-characters-themes-and-irony/>

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**(MA23AOE701) FINANCIAL MATHEMATICS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide mathematical foundations for financial modelling, risk assessment and asset pricing.
- Introduce stochastic models and their applications in pricing derivatives and interest rate modelling.
- Develop analytical skills for fixed-income securities, credit risk, and investment strategies.
- Equip students with computational techniques for pricing financial derivatives.

**COURSE OUTCOMES:**

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

- CO 1:** Explain fundamental financial concepts, including arbitrage, valuation, and risk.
- CO 2:** Apply stochastic models, including Brownian motion and Stochastic Differential Equations (SDEs), in financial contexts.
- CO 3:** Analyze mathematical techniques for pricing options and financial derivatives.
- CO 4:** Evaluate interest rate models and bond pricing methodologies.
- CO 5:** Utilize computational techniques such as Monte Carlo simulations for financial modeling.

**UNIT I:****(9 Periods)**

**Asset Pricing and Risk Management Fundamental financial concepts:** Returns, arbitrage, valuation, and pricing. Asset/Liability management, investment income, capital budgeting, and contingent cash flows. One-period model: Securities, payoffs, and the no-arbitrage principle. Option contracts: Speculation and hedging strategies, CAP Model, Efficient market hypothesis.

**UNIT II:****(10 Periods)**

**Stochastic Models in Finance:** Random Walks and Brownian Motion. Introduction to Stochastic Differential Equations (SDEs): Drift and diffusion. Ito calculus: Ito's Lemma, Ito Integral, and Ito Isometry.

**UNIT III:****(8 Periods)**

**Interest Rate and Credit Modelling:** Interest rate models and bond markets. Short-rate models: Vasicek, Cox-Ingersoll-Ross (CIR), Hull & White models, Credit risk modelling: Hazard function and hazard rate.

**UNIT IV:****(9 Periods)**

**Fixed-Income Securities and Bond Pricing: Characteristics of fixed-income products:** Yield, duration, and convexity. Yield curves, forward rates, and zero-coupon bonds. Stochastic interest rate models and bond pricing PDE. Yield curve fitting and calibration techniques, Mortgage Backed Securities.

**UNIT V:****(9 Periods)**

**Exotic Options and Computational Finance:** Stochastic volatility models and the Feynman-Kac theorem. Exotic options: Barriers, Asians, and Lookbacks. Monte Carlo methods for derivative pricing, Black-Scholes-Merton model: Derivation and applications.

**Total Periods: 45**

**TEXT BOOKS:**

1. Ales Cerny, Mathematical Techniques in Finance: Tools for Incomplete Markets, Princeton University Press.
2. S.R. Pliska, Introduction to Mathematical Finance: Discrete-Time Models, Cambridge University Press.

**REFERENCES:**

1. Ioannis Karatzas & Steven E. Shreve, Methods of Mathematical Finance, Springer, New York.
2. John C. Hull, Options, Futures, and Other Derivatives, Pearson.

**ONLINE RESOURCES:**

1. MIT- Mathematics for Machine Learning <https://ocw.mit.edu>
2. Coursera – Financial Engineering and Risk Management (Columbia University) <https://www.coursera.org/>
3. National Stock Exchange (NSE) India – Financial Derivatives <https://www.nseindia.com/>

## IV Year B. Tech – I Semester

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**(MA23AOE702) WAVELET TRANSFORMS: THEORY AND APPLICATIONS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic principles and mathematical foundations of wavelets, including scaling functions and mother wavelets.
- Analyze the limitations of Fourier transforms and how wavelet transforms overcome them, especially in non-stationary signal analysis.
- Apply wavelets in signal processing, image compression, denouncing, and other engineering and scientific applications.

**COURSE OUTCOMES:**

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

- CO 1:** Understand wavelets and wavelet basis and characterize continuous and discrete wavelet transforms.
- CO 2:** Illustrate the multi resolution analysis and scaling functions.
- CO 3:** Implement discrete wavelet transforms with multi-rate digital filters.
- CO 4:** Understand multi resolution analysis and identify various wavelets and evaluate their time- frequency resolution properties.
- CO 5:** Design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields.

**UNIT I:****(9 Periods)**

**Wavelets:** Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets - effectiveness of Wavelet Analysis -The Discrete Wavelet Transform- The Discrete-Time and Continuous Wavelet Transforms.

**UNIT II:****(8 Periods)**

**A Multiresolution Formulation of Wavelet Systems:** Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

**UNIT III:****(10 Periods)**

**Filter Banks and the Discrete Wavelet Transform:** Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - Different Points of View.

**UNIT IV:****(9 Periods)**

**Time-Frequency and Complexity:** Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

**UNIT V:****(9 Periods)**

**Bases and Matrix Examples:** Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

**Total Periods: 45**

**TEXT BOOKS:**

1. C. Sidney Burrus, Ramesh A. Gopinath, —Introduction to Wavelets and Wavelets Transforms, Prentice Hall, (1997).
2. James S. Walker, —A Primer on Wavelets and their Scientific Applications, CRC Press, (1999).

**REFERENCES:**

1. Raghuveer Rao —Wavelet Transforms, Pearson Education, Asia
2. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

**ONLINE RESOURCES:**

1. <http://users.rowan.edu/~polikar/WAVELETS/WTtutorial.html>
2. <http://www.wavelet.org/>
3. <http://www.math.hawaii.edu/~dave/Web/Amara's%20Wavelet%20Page.htm>
4. <https://jqichina.wordpress.com/wp-content/uploads/2012/02/ten-lectures-of-waveletsefbc88e5b08fe6b3a2e58d81e8aeb2efbc891.pdf>

## IV Year B. Tech – I Semester

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**(PH23AOE701) INTRODUCTION TO QUANTUM MECHANICS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamental differences between classical and quantum mechanics.
- Study wave-particle duality, uncertainty principle, and their implications.
- Learn and apply Schrödinger equations to basic quantum systems.
- Use operator formalism and mathematical tools in quantum mechanics.
- Explore angular momentum, spin and their quantum mechanical representations.

**COURSE OUTCOMES:**

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

**CO 1:** Explain the key principles of quantum mechanics and wave-particle duality**CO 2:** Apply Schrödinger equations to solve one-dimensional quantum problems**CO 3:** Solve quantum mechanical problems using operator and matrix methods.**CO 4:** Evaluate quantum states using Dirac notation and expectation values.**CO 5:** Analyze angular momentum and spin systems using Pauli matrices and operators.**UNIT I:****(9 Periods)**

**Principles of Quantum Mechanics:** Introduction: Limitations of classical Mechanics, Difficulties with classical theories of black body radiation and origin of quantum theory of radiation. Wave-particle duality: de Broglie wavelength, Heisenberg uncertainty principle. Schrödinger time independent and time dependent wave equation, Solution of the time dependent Schrödinger equation, Concept of stationary states, Physical significance of wave function ( $\psi$ ), Orthogonal, Normalized and Orthonormal functions

**UNIT II:****(9 Periods)**

**One Dimensional Problems and Solutions:** Potential step – Reflection and Transmission at the interface. Potential well: Square well potential with rigid walls, Square well potential with finite walls. Potential barrier: Penetration of a potential barrier (tunneling effect). Periodic potential and Harmonic oscillator, Energy eigen functions and eigen values.

**UNIT III:****(9 Periods)**

**Operator Formalism:** Operators, Operator Algebra, Eigen values and Eigen vectors, Postulates of quantum mechanics, Matrix representation of wave functions and linear operators.

**UNIT IV:****(9 Periods)**

**Fundamental Tools in Quantum Mechanics:** The concept of row and column matrices, Matrix algebra, Hermitian operators – definition. Dirac's bra and ket notation, Expectation values, Heisenberg (operator) representation of harmonic oscillator, Ladder operators and their significance.

**UNIT V:****(9 Periods)**

**Angular Momentum and Spin:** Angular momentum operators: Definition. Eigen functions and Eigen values of AM operators. Matrix representation of angular momentum operators, System with spin half ( $1/2$ ), Spin angular momentum, Pauli's spin matrices. Clebsch-Gordon coefficients. Rigid Rotator: Eigen functions and Eigen values.

**Total Periods: 45****TEXT BOOKS:**

1. P. M. Mathews, K. Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill, New Delhi, 1976.
2. S. L. Gupta, V. Kumar, H. V. Sharma, R. C. Sharma, Quantum Mechanics, Jai Prakash Nath and Company, Meerut, 1996.

**REFERENCES:**

1. L.I. Schiff, Quantum Mechanics, McGraw Hill Book Co., Tokyo, 1968.
2. Richard L. Liboff, Introduction to Quantum Mechanics, Pearson Education Ltd, 4<sup>th</sup> Edition, 2003.
3. A. Messaia Noth, Quantum Mechanics. Volume 1, Holland Publishing Company, Amsterdam, 1961.
4. R. H. Dicke and J. P. Witke, Introduction to Quantum Mechanics. Addison-Wisley Pub. Co. Inc., London, 1960.

**ONLINE RESOURCES:**

1. <https://archive.nptel.ac.in/courses/115/101/115101107/>
2. <https://archive.nptel.ac.in/courses/122/106/122106034/>
3. <https://nptel.ac.in/courses/115106066>

IV Year B. Tech – I Semester

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**(PH23AOE702) SENSORS AND ACTUATORS FOR ENGINEERING****APPLICATIONS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide exposure to various kinds of sensors and actuators and their engineering applications.
- Impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
- Explain the operating principles of various sensors and actuators
- Educate the fabrication of sensors
- Explain the required sensor and actuator for interdisciplinary application

**COURSE OUTCOMES:**

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

**CO 1:** Classify different types of Sensors and Actuators along with their characteristics**CO 2:** Summarize various types of Temperature and Mechanical sensors**CO 3:** Illustrates various types of optical and mechanical sensors**CO 4:** Analyze various types of Optical and Acoustic Sensors**CO 5:** Interpret the importance of smart materials in various devices**UNIT I:****(9 Periods)****Introduction to Sensors and Actuators:** Sensors: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.**Actuators:** Functional diagram of actuators, Types of actuators and their basic principle of working: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive actuators, Applications of Actuators.**UNIT II:****(9 Periods)****Temperature and Mechanical Sensors:** Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors**Mechanical Sensors:** Types of Mechanical sensors and their basic principle of working: Force sensors: Strain gauges, Tactile sensors, Pressure sensors: Piezoresistive, Variable Reluctance Sensor (VRP).**UNIT III:****(9 Periods)****Optical and Acoustic Sensors:** Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo resistors based sensors, Photomultipliers, Infrared sensors: thermal, Passive Infra-Red, Fiber based sensors and Thermopiles**Acoustic Sensors:** Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones**UNIT IV:****(9 Periods)****Magnetic and Electromagnetic Sensors:** Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magnetostrictive sensors and actuators.**UNIT V:****(9 Periods)****Chemical and Radiation Sensors:** Chemical Sensors: Principle and working of Electro-

chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

**Total Periods: 45**

**TEXT BOOKS:**

1. Clarence W. de Silva, Sensors and Actuators, CRC Press, 2<sup>nd</sup> Edition, 2015.
2. D. A. Hall and C. E. Millar, Sensors and Actuators, CRC Press, 1999.

**REFERENCES:**

1. D. Patranabhis, Sensors and Transducers, Prentice Hall of India Pvt. Ltd., 2003.
2. John G. Webster, Measurement, Instrumentation, And Sensors Handbook, CRC press, 1999.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_ee32/preview](https://onlinecourses.nptel.ac.in/noc21_ee32/preview)

## IV Year B. Tech – I Semester

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**(PH23AOE703) SMART MATERIALS AND DEVICES****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide exposure to smart materials and their engineering applications.
- Impart knowledge on the basics and phenomenon behind the working of smart materials
- Explain the properties exhibited by smart materials
- Educate various techniques used to synthesize and characterize smart materials
- Identify the required smart material for distinct applications/devices

**COURSE OUTCOMES:**

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

- CO 1:** Identify key discoveries that led to modern applications of shape memory materials, describe the two phases in shape memory alloys.
- CO 2:** Describe how different external stimuli (light, electricity, heat, stress, and magnetism) influence smart material properties.
- CO 3:** Summarize various types of synthesis of smart materials
- CO 4:** Analyze various characterization techniques used for smart materials
- CO 5:** Interpret the importance of smart materials in various devices

**UNIT I:****(9 Periods)****Introduction to smart nanomaterials:** Historical account of the discovery and development of smart materials, Shape memory materials, chromoactive materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).**UNIT II:****(9 Periods)****Properties of Smart Materials:** Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.**UNIT III:****(9 Periods)****Synthesis of Smart Materials:** Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying and Thin film deposition techniques: Chemical etching, Spray pyrolysis.**UNIT IV:****(9 Periods)****Characterization Techniques (Qualitative treatment):** Powder X-ray diffraction, Raman spectroscopy (RS), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).**UNIT V:****(9 Periods)****Device Technology & Applications:** Devices based on smart materials: Shape memory alloys in robotic hands, piezoelectric based devices, MEMS and intelligent devices.**Total Periods: 45****TEXT BOOKS:**

1. Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017
2. E. Zschech, C. Whelan, T. Mikolajick, Materials for Information Technology: Devices, Interconnects and Packaging Springer, Verlag London Limited, 2005.

**REFERENCES:**

1. P. Gauenzi, Smart Structures, Wiley, 2009.
2. Mahmood Aliofkhaezai, Handbook Of functional nanomaterials, Volume (1&2), Nova Publishers, 2014.
3. Chaudhery Mustansar Hussain, Paolo Di Sia, Handbook of Smart Materials, Technologies, And Devices: Applications of Industry 4.0, Springer, 2022.
4. Mohsen Shahinpoor, Fundamentals of Smart Materials, Royal Society of Chemistry, 2020.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc22\\_me17/preview](https://onlinecourses.nptel.ac.in/noc22_me17/preview)

## IV Year B. Tech – I Semester

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**(CH23AOE701) BIOLOGY FOR ENGINEERS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Provide basic understanding about life and life Process. Animal and plant systems.
- Understand what biomolecules, are, their structures are functions. Application of certain biomolecules in Industry. Brief introduction about human physiology and bioengineering.
- Understand hereditary units, i.e. DNA (genes) and RNA and their synthesis in living organism.
- How biology Principles can be applied in our daily life using different technologies. Brief introduction to the production of transgenic microbes, Plants and animals.

**COURSE OUTCOMES:**

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

- CO 1:** Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- CO 2:** Explain about biomolecules, their structure and function and their role in the living organisms. How biomolecules are useful in Industry.
- CO 3:** Illustrate briefly about human physiology.
- CO 4:** Describe about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
- CO 5:** Know about application of biological Principles in different technologies for the production of medicines and Pharmaceutical molecules through transgenic microbes, plants and animals.

**UNIT I:****(9 Periods)**

**Introduction to Basic Biology:** Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cells. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Characteristics of living organisms.

**UNIT II:****(9 Periods)**

**Introduction to Biomolecules:** Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, bio molecular interactions. Large scale production of enzymes by Fermentation.

**UNIT III:****(9 Periods)**

**Human Physiology:** Nutrition: Nutrients or food substances. Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle. Excretory system.

**UNIT IV:****(9 Periods)**

**Introduction to Molecular Biology and Recombinant DNA Technology:** Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. DNA technology. Introduction to gene cloning.

**UNIT V:****(9 Periods)**

**Application of Biology:** Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Antibiotics, Vaccines and antibodies. Basics of biosensors, biochips, Bio fuels, and Bio Engineering. Basics of Production of Transgenic plants and animals.

**Total Periods: 45**

**TEXT BOOKS:**

1. P.K. Gupta, Cell and Molecular Biology, 6<sup>th</sup> Revised Edition, 2020.
2. U. Satyanarayana, Biotechnology, Books & Allied Ltd., 5<sup>th</sup> Edition, 2021

**REFERENCES:**

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, Biology: A Global Approach, Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology Panima Publications, 2<sup>nd</sup> Edition.
4. David Hames, Instant Notes in Biochemistry, 2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology, 2014.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc19\\_ge31/preview](https://onlinecourses.nptel.ac.in/noc19_ge31/preview)

## IV Year B. Tech – I Semester

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**(CH23AOE702) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS****(Open Elective-III and IV)****COURSE OBJECTIVES:**

The objective of this course are to:

- Understand basics and characterization of Nanomaterials.
- Understand synthetic methods of Nanomaterials.
- Apply various techniques for characterization of Nanomaterials.
- Understand Studies of Nano-structured Materials
- Enumerate the applications of advanced Nanomaterials in engineering

**COURSE OUTCOMES:**

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

- CO 1:** Classify the nanostructure materials; describe scope of nanoscience and importance technology.
- CO 2:** Utilize various top-down and bottom-up synthetic techniques to fabricate nanomaterials and evaluate their applicability based on process principles, material requirements, and desired nanostructure properties.
- CO 3:** Use appropriate characterization techniques such as diffraction, spectroscopy, electron microscopy to determine the structural, morphological, and particle size properties of nanomaterials.
- CO 4:** Apply knowledge of synthesis methods, properties, and functional characteristics of advanced nanomaterials to identify their suitable technological and industrial applications.
- CO 5:** Demonstrate nanostructures like nanoparticles, nanorods, and nanowires in analyzing their applications across water treatment, sensors, electronics, healthcare, engineering, agriculture, food, and environmental remediation.

**UNIT I:****(9 Periods)**

**Basics and Characterization of Nanomaterials:** Introduction, Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, properties of nanomaterials, importance of nanomaterials.

**UNIT II:****(9 Periods)**

**Synthesis of Nanomaterials:** Top-Down approach, Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapor deposition method, electrodeposition method, high energy ball milling method. Synthetic Methods: Bottom-Up approach, Sol-gel synthesis, micro emulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**UNIT III:****(9 Periods)**

**Techniques for Characterization:** Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials (SEM, TEM), BET method for surface area analysis, dynamic light scattering for particle size determination.

**UNIT IV:****(9 Periods)**

**Studies of Nano-Structured Materials:** Synthesis, properties and applications of the following nanomaterials -fullerenes, carbon nanotubes, 2D-nanomaterial (Graphene), core-shell, magnetic nanoparticles, thermoelectric materials, non-linear optical materials.

**UNIT V:****(9 Periods)**

**Advanced Engineering Applications of Nanomaterials:** Applications of Nano Particle, nano rods, nano wires, Water treatment, sensors, electronic devices, medical domain, civil

engineering, chemical engineering, metallurgy, defense and mechanical engineering, food science, agriculture, pollutants degradation.

**Total Periods: 45**

**TEXT BOOKS:**

1. T Pradeep, NANO: The Essentials: McGraw-Hill, 1<sup>st</sup> Edition, 2007.
2. B S Murty, P Shankar, BaldevRai, BB Rath and James Murday, Textbook of Nanoscience and Nanotechnology, Univ. Press, 1<sup>st</sup> Edition, 2012.

**REFERENCE BOOKS:**

1. Ludovico Cademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Concepts of Nanochemistry, Wiley-VCH, 2011.
2. Guozhong Cao, Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Imperial College Press, 2007.

**ONLINE RESOURCES:**

1. <https://nptel.ac.in/courses/118104008>
2. [https://onlinecourses.nptel.ac.in/noc24\\_mm38/preview](https://onlinecourses.nptel.ac.in/noc24_mm38/preview)
3. [https://onlinecourses.swayam2.ac.in/cec24\\_cy02/preview](https://onlinecourses.swayam2.ac.in/cec24_cy02/preview)

IV Year B. Tech – I Semester

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## (CH23AOE703) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT

(Open Elective-III and IV)

### COURSE OBJECTIVES:

The objectives of this course are to:

- Understand principle and concepts of green chemistry.
- Understand the types of catalysis and industrial applications.
- Apply green solvents in chemical synthesis.
- Enumerate different sourced of green energy.
- Apply alternative greener methods for chemical reactions

### COURSE OUTCOMES:

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

- CO 1:** Apply the Green Chemistry Principles for day to day life as well as synthesis.
- CO 2:** Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis
- CO 3:** Utilize the concept of green solvents and apply tools and techniques for solvent selection and ionic liquids, along with strategies for their recycling in sustainable chemical processes.
- CO 4:** Apply Green Chemistry for Sustainable Development.
- CO 5:** Use the principles of photochemical, photo-redox, microwave-assisted, and sonochemical reactions to illustrate their mechanisms, advantages, challenges, and real-world applications through relevant examples.

### UNIT I: (9 Periods)

**Principles and Concepts of Green Chemistry:** Introduction, Green chemistry Principles, sustainable development and green chemistry, E factor, atom economy, atom economic reactions: Rearrangement and addition reactions and atom un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

### UNIT II: (9 Periods)

**Catalysis and Green Chemistry:** Introduction, Types of catalysis, Heterogeneous catalysis: Basics of Heterogeneous Catalysis, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, and Phase transfer catalysis, Bio- catalysis and Photo-catalysis with examples.

### UNIT III: (9 Periods)

**Green Solvents in Chemical Synthesis:** Green Solvents: Concept, Tools and techniques for solvent selection, supercritical fluids: Super critical carbon dioxide, super critical water, Polyethylene glycol (PEG), Ionic liquids, Recycling of green solvents.

### UNIT IV: (9 Periods)

**Emerging Greener Technologies:** Biomass as renewable resource, Energy: Energy from Biomass, Solar Power, Chemicals from Renewable Feedstock's, Chemicals from Fatty Acids, Polymers from Renewable Resources, Alternative Economies: The Syngas Economy, The Bio refinery, Design for energy efficiency, Mechano chemical synthesis.

### UNIT V: (9 Periods)

**Alternative Greener Methods:** Photochemical Reactions - Examples, Advantages and

Challenges, Photo redox catalysis, single electron transfer reactions (SET), Examples of Photochemical Reactions, Microwave- assisted Reactions and Sonochemical reactions, examples and applications.

**Total Periods: 45**

**TEXT BOOKS:**

1. M. Lancaster, Green Chemistry an Introductory Text, Royal Society of Chemistry, 2<sup>nd</sup> Edition, 2016.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, Oxford University Press, USA, 4<sup>th</sup> Edition, 1998.

**REFERENCES:**

1. Sanjay K. Sharma and AckmezMudhoo, Green Chemistry for Environmental Sustainability, CRC Press, 1<sup>st</sup> Edition, 2010.
2. Edited by AlvisPerosa and Maurizio Selva, Hand Book of Green chemistry Volume 8: Green Nanoscience, Wiley-VCH, 2013.

**ONLINE RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_mg85/preview](https://onlinecourses.nptel.ac.in/noc21_mg85/preview)

# **HONORS DEGREE**

**III Year B.Tech. ECE – I Semester**

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**(EC23AHN501) ADAPTIVE SIGNAL PROCESSING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of adaptive systems and their applications in signal processing.
- Analyze the response of LTI systems to stochastic processes and model unknown systems.
- Learn and implement key adaptive filtering algorithms such as LMS, NLMS, RLS, and Steepest Descent.
- Understand the principles and applications of linear prediction and lattice filter structures.
- Compare the performance and convergence of different adaptive algorithms.

**COURSE OUTCOMES:**

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

- CO 1:** Model and identify systems in environments with unknown or changing characteristics.
- CO 2:** Analyze and interpret the behaviour of stochastic processes and their impact on LTI systems.
- CO 3:** Derive and apply the Wiener filter using MSE minimization techniques.
- CO 4:** Design and implement linear prediction systems using Levinson-Durbin and lattice-based algorithms.
- CO 5:** Develop adaptive filters using the LMS and RLS algorithms, and assess their performance and convergence.

**UNIT I:****(9 periods)**

Adaptive Systems and Signal Analysis Signal Processing in unknown environments: System identification and Linear prediction Stochastic Processes-Responses of LTI system to stochastic processes.

**UNIT II:****(9 periods)**

The Mean Square Error (MSE) Performance Criteria, Introduction to Mean Square Error (MSE) and MSE Surface-Properties of the MSE Surface: The Normal Equations- Geometrical Properties of the Error Surfaces - Wiener filter.

**UNIT III:****(9 periods)**

Linear Prediction and the Lattice Structure, Levinson Durbin's Algorithm - Lattice Derivation-Forward and backward prediction-Adaptive lattice structures.

The Method of Steepest Descent Iterative Solution of the Normal Equations- Weight Vector Solutions –Convergence Properties of Steepest Descent - Mean Square Error Propagation

**UNIT IV:****(9 periods)**

The Least Mean Squares (LMS) Algorithm Effects of Unknown Signal Statistics- Derivation of the LMS Algorithm- Convergence of the LMS Algorithm - LMS Mean Square Error Propagation-Normalized LMS Algorithm

**UNIT V:****(9 periods)**

Recursive Least Squares Signal Processing Recursive Least squares (RLS) Adaptive Algorithms-Performance of RLS Adaptive Algorithms-Convergence of RLS versus LMS-QR RLS Algorithm. Unsupervised Adaptive filters Blind Equalizers –Sato Algorithm –Godard algorithms

**Total Periods:45**

**TEXT BOOKS:**

1. Bernard Widrow, Samuel D. Stearns, Adaptive signal processing, 2012, Pearson Education, 1<sup>st</sup> Edition, New Delhi, India.
2. Simon Haykin, Adaptive Filter Theory, 2012, Pearson Education, 4<sup>th</sup> Edition, New Delhi,

**III Year B.Tech. ECE – I Semester**

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**(EC23AHN502) DIGITAL DESIGN THROUGH VERILOG****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce students to Verilog Hardware Description Language (HDL) for digital system modeling and simulation.
- Explain the structure of Verilog modules, levels of abstraction, and test bench development.
- Analyze the functionality and simulation results of Verilog-based digital designs.
- Evaluate performance and synthesis suitability of designs for FPGA/CPLD implementations.
- Develop Verilog models for real-time applications using tasks, functions, and user-defined primitives.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the structure and syntax of Verilog HDL, including keywords, data types, modules, and simulation tools
- CO 2: Model digital circuits** at various abstraction levels (gate-level, dataflow, and behavioral).
- CO 3: Design sequential and combinational circuits**, including FSMs, using Verilog HDL and simulate their functionality.
- CO 4:** Understand the digital design flow for FPGA and VLSI using HDL, including behavior, logic, and physical synthesis.
- CO 5:** Utilize tasks, functions, and User-Defined Primitives (UDP) to modularize complex designs.

**UNIT I:****(9 periods)**

**INTRODUCTION TO VERILOG:** Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches. LANGUAGE CONSTRUCTS AND CONVENTIONS: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

**UNIT II:****(9 periods)**

**GATE LEVEL MODELING :** Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.

**DATA FLOW LEVEL MODELING:** Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

**UNIT III:****(9 periods)**

**BEHAVIORAL MODELING :** Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow. If and if-else constructs, assign-de assign construct, repeat construct, for loop, the disable construct, while loop, forever loop, parallel blocks, force-release construct, Event.

**UNIT IV:****(9 periods)**

**FUNCTIONS, TASKS, AND USER-DEFINED PRIMITIVES :** Introduction, Function, Tasks, User-Defined Primitives (UDP), FSM Design (Moore and Mealy Machines). SYSTEM TASKS, FUNCTIONS AND COMPILER DIRECTIVES: Introduction, Parameters, Path Delays,

Module Parameters, System Tasks and Functions, File-Based Tasks and Functions, Compiler Directives, Hierarchical Access, General Observations. VERILOG MODELS FOR MEMORIES AND BUSES: Static RAM Memory, A simplified 486 Bus Model, UART Design.

**UNIT V: (9 periods)**

**DESIGNING WITH FIELD PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC DEVICES:** Xilinx 3000 Series FPGAs, Designing with FPGAs, Using a One-Hot State Assignment, Altera Complex Programmable Logic Devices (CPLDs), Altera FLEX 10K Series CPLDs

**Total Periods:45**

**TEXT BOOKS:**

1. T.R. Padmanabhan and B. Bala Tripura Sundari, Design through Verilog HDL, WSE, IEEE Press 2008.
- 2.J. Bhaskar, A Verilog Primer', BSP, 2<sup>nd</sup> Edition 2003.

**REFERENCES:**

- 1.Samir Palnitkar, Verilog HDL, Pearson Education, 2<sup>nd</sup> Edition,2003.
2. Thomas and Moorby, The Verilog Hardware Description Language, kluwer academic publishers, 5<sup>th</sup> Edition, 2002.
3. Stephen Brown and Zvonko Vranesic, Fundamentals of Logic Design with Verilog, TMH publications, 2007.

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**(EC23AHN503) INTELLIGENT COMMUNICATION SYSTEMS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Describe the structure and operation of microwave and satellite communication systems.
- Explain the working principles of optical fibers, light sources, and detection methods in optical communication.
- Analyze the transmission methods, switching techniques, and network models in computer communication.
- Design basic satellite and optical link budgets by applying system parameters like G/T ratio and signal dispersion.
- Compare different communication system architectures based on performance, coverage, and modulation techniques.

**COURSE OUTCOMES:**

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

**CO 1:** Explain satellite orbits, link design parameters, and noise considerations.

**CO 2:** Analyze signal dispersion, modulation, and detection in optical communication systems including OFDM and MIMO.

**CO 3:** Evaluate coverage, interference, and handoff mechanisms in cellular systems.

**CO 4:** Differentiate between switching methods and network models (OSI and TCP/IP).

**CO 5:** Design basic communication system models and simulate their performance.

**UNIT I:****(9 periods)**

**Microwave and Satellite Communication Systems:** Microwave communication systems - transmitters - receivers - line of sight propagation; Orbits of satellite - orbital effects on communication system's performance - satellite earth stations - satellite antennas and earth coverage - system noise temperature and G/T ratio - design of downlinks - uplink design - link design for specified C/N - VSAT systems.

**UNIT II:****(9 periods)**

**Optical Communication System :** Historical perspective - light sources - photodiodes - fiber losses - signal dispersion - pulse propagation - multichannel propagation - signal propagation - modulation schemes; OFDM for optical communications - MIMO optical communications - Detection Schemes; Coherent optical OFDM detection - optical MIMO detection

**UNIT III:****(9 periods)**

**Cellular Communication System:** Uniqueness of mobile radio environment - basic cellular system - analog and digital cellular systems - cell coverage - frequency reuse - channel interferences - cell splitting and handoffs - mobile antennas.

**UNIT IV:****(9 periods)**

**Computer Communication:** Transmission modes - serial and parallel transmission - asynchronous - synchronous - simplex - half duplex - full duplex communication. Switching: circuit switching and packet switching - Networks: Network criteria - physical structures - network models - categories of networks - Interconnection of Networks: Internetwork - Network models: Layered tasks - OSI model - Layers in OSI model - TCP/IP protocol suite.

**UNIT V:****(9 Periods)**

**Instructional Activity:** Performance analysis of minimum of four communication systems through simulation using related platforms.

**Total Periods:45**

**TEXT BOOKS:**

1. Rappaport T S, Wireless Communications: Principles and Practice, 2<sup>nd</sup> Edition, Pearson India, 2010.
2. Keiser G, Optical Fiber Communication, Mc Graw Hill, 3<sup>rd</sup> Edition, 2003.

**REFERENCES:**

1. Pratt T, Bostian C W and Allnut J E, Satellite Communications, John Willey and Sons, 2<sup>nd</sup> Edition, 2003.
2. Andrew S.Taneubauw and David J. Wethrall, Computer Networks, Prentice Hall, 5<sup>th</sup> Edition,2011.

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**(EC23AHN601) FPGA ARCHITECTURES****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the evolution, architecture, and applications of programmable devices like FPGAs and CPLDs
- Describe the FPGA design flow and compare different FPGA vendors and technologies.
- Analyze the internal structure and components of FPGAs/CPLDs including CLBs, routing, and I/O blocks.
- Evaluate the impact of architectural and routing decisions on performance and delay in FPGA systems.
- Explain various routing strategies and switching structures used in FPGA architectures.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the steps in FPGA design flow and summarize FPGA applications in digital systems.
- CO 2:** Design and implement logic modules like memory, barrel shifters, and multipliers using PLDs.
- CO 3:** Analyze and compare commercial FPGA families from vendors such as Xilinx, Altera, and Actel.
- CO 4:** Explain the internal components like CLBs, routing structures, and I/O blocks of FPGAs/CPLDs.
- CO 5:** Evaluate how routing architectures and switch block topologies affect timing and performance.

**UNIT I:****(9 Periods)**

**Introduction to FPGAs:** Evolution of programmable devices, FPGA Design flow, Applications of FPGAs.

**UNIT II:****(9 Periods)**

**Design Examples using PLDs:** Design of Universal block, Memory, Floating point multiplier, Barrel shifter.

**UNIT III:****(9 Periods)**

**FPGAs/CPLDs:** Programming Technologies, commercially available FPGAs, Xilinx's Vertex and Spartan, Actel's FPGA, Altera's FPGA/CPLD.

**UNIT IV:****(9 Periods)**

**Building blocks of FPGAs/CPLDs:** Configurable Logic block functionality, Routing structures, Input/output Block, Impact of logic block functionality on FPGA performance, Model for measuring delay.

**UNIT V:****(9 Periods)**

**Routing Architectures:** Routing terminology, general strategy for routing in FPGAs, routing for row – based FPGAs, introduction to segmented channel routing, routing for symmetrical FPGAs, example of routing in a symmetrical FPGA, general approach to routing in symmetrical FPGAs, independence from FPGA routing architectures, FPGA routing structures. FPGA architectural assumptions, the logic block, the connection block, connection block topology, the switch block, switch block topology, architectural assumptions for the FPGA

**Total Periods:45**

**TEXT BOOKS:**

1. Stephen M. Trimberger, Field-Programmable Gate Array Technology, Springer Science & Business Media, 1994
2. Charles H. Roth Jr. & Lizy Kurian John, Digital Systems Design Using VHDL, Cengage Learning, Latest Edition.

**III Year B.Tech. ECE – II Semester**

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**(EC23AHYN602) REAL TIME EMBEDDED SYSTEM DESIGN****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the architecture and components of embedded automatic systems including processors, memory, and SoCs
- Explore and compare different development platforms such as Arduino, Raspberry Pi, and Beagle Bone.
- Apply Python programming basics to develop and control embedded system behavior.
- Explain and use RTOS concepts such as tasks, semaphores, and inter-process communication in embedded applications.
- Design and implement simple embedded projects involving automation and real-time control.

**COURSE OUTCOMES:**

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

- CO 1:** Describe the key architectural components of embedded automatic systems and SoC memory addressing.
- CO 2:** Compare functionalities and applications of Arduino, Raspberry Pi, and Beagle Bone devices.
- CO 3:** Explain common communication protocols like I2C, SPI, UART, Bluetooth, and ZigBee.
- CO 4:** Implement RTOS features like task management, semaphores, queues, and interrupt routines.
- CO 5:** Develop embedded system prototypes such as RFID attendance systems or home automation using SOC platforms.

**UNIT I: (9 Periods)**

**Introduction to Embedded Automatic Systems:** Embedded Automatic Systems (EAC): Overview - architecture; Components of the system: Processors-memories and interconnects - processor architectures - memory and addressing: SOC memory examples - addressing.

**UNIT II: (9 Periods)**

**System On Chip:** Introduction to Arduino: Types of Arduino devices - common Arduino shields - Beagle Bone; Introduction to Raspberry Pi

**UNIT III: (9 Periods)**

**Communication Interfaces and Python Basics:** Communication interfaces: I2C- SPI Bus- UART- RS-232- RS-485- USB- IEEE 139.4 (Firewire) - Infrared (IRDA) - Bluetooth - Wi-Fi - ZigBee - GPRS; Python basics: Introduction - variables - displaying output - reading user input - arithmetic - operations on strings - running commands conditionally - comparing values - logical operators- loops.

**UNIT IV: (9 Periods)**

**RTOS Programming:** Tasks and Task states - semaphores - shared data - message queues - mail boxes and pipes - memory management - interrupt routines - encapsulating semaphore and queues - task management - inter task communication - process input/output.

**UNIT V: (9 Periods)**

**Instructional Activity:** RFID based attendance management system - embedded video processing - home automation systems using Raspberry Pi/ Arduino /any other SOC. 63

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**Total Periods:45**

**TEXT BOOKS:**

1. Michael J F and Wayne L. Computer System Design: System-on-Chip, John Wiley and Sons, 2011.
2. Hughes M J, Arduino: A Technical Reference, O'REILY, 1<sup>st</sup> Edition, 2016.
3. David E S, An Embedded software premier, Pearson Education, 1999.

**REFERENCES:**

1. Shibu, Introduction to Embedded Systems, Tata McGraw Hill, 1<sup>st</sup> Edition, 2009.
2. Simon M, Raspberry Pi Cookbook, O'REILY, 2<sup>nd</sup> Edition, 2014.
3. Richardson M and Shawn W, Make: Getting Started with Raspberry Pi, O'REILY, 3<sup>rd</sup> Edition, 2016.

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**(EC23AHN603) TESTING AND VERIFICATION****Course Objectives:**

The objectives of this course are to:

- Explain different types of faults, defects, and fault models used in VLSI.
- Apply fault simulation and ATPG techniques for both combinational and sequential circuits.
- Analyze the performance of various test generation algorithms (D-algorithm, PODEM, FAN).
- Evaluate different design-for-testability (DFT) techniques and BIST architectures
- Design testable circuits and memory modules using DFT and scan-based methods

**COURSE OUTCOMES:**

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

- CO 1:** Explain fault models, types of testing, and levels of abstraction in VLSI testing.  
**CO 2:** Apply ATPG techniques and fault simulation algorithms for combinational and sequential circuits.  
**CO 3:** Analyze scan chain structures and distinguish between functional and structural testing methods.  
**CO 4:** Evaluate and compare fault diagnosis algorithms like D-algorithm, PODEM, and FAN.  
**CO 5:** Design for testability using scan-based and BIST techniques for logic and memory Components.

**UNIT I:****(9 Periods)**

Role of testing in VLSI Design flow, Testing at different levels of abstraction, Fault, error, defect, diagnosis, yield, Types of testing, Rule of Ten, Defects in VLSI chip. Modelling basic concepts, Functional modelling at logic level and register level, structure models, logic simulation, delay models. Various types of faults, Fault equivalence and Fault dominance in combinational sequential circuits.

**UNIT II:****(9 Periods)**

Fault simulation applications, General fault simulation algorithms- Serial, and parallel, Deductive fault simulation algorithms.

**UNIT III:****(9 Periods)**

Combinational circuit test generation, Structural Vs Functional test, ATPG, Path sensitization methods. Difference between combinational and sequential circuit testing, five and eight valued algebra, and Scan chain-based testing method.

**UNIT IV:****(9 Periods)**

D-algorithm procedure, Problems, PODEM Algorithm. Problems on PODEM Algorithm. FAN Algorithm. Problems on FAN algorithm, Comparison of D, FAN and PODEM Algorithms. Design for Testability, Ad- hoc design, Generic scan-based design.

**UNIT V:****(9 Periods)**

Classical scan-based design, System level DFT approaches Test pattern generation for BIST, Circular BIST. BIST Architectures. Testable memory design-Test algorithms- Test generation for Embedded RAMs.

**Total Periods:45****TEXT BOOKS:**

1. 1.M. Abramovici, M. Breuer, and A. Friedman, –Digital Systems Testing and Testable Design, IEEE Press, 1990.
2. 2.M. Bushnell and V. Agrawal, Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits, Kluwer Academic Publishers, 2000

**REFERENCES:**

1. 1.Stroud, A Designer 's Guide to Built-in Self-Test, Kluwer Academic Publishers,2002
2. 2.V.Agrawal and S.C. Seth, Test Generation for VLSI Chips, Computer Society Press.1989

**IV Year B.Tech. ECE – I Semester**

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**(EC23AHN701) SYSTEM DESIGN USING EMBEDDED PROCESSORS****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals and categories of embedded systems and their application domains.
- Explain the ARM Cortex-M3 architecture and register operations.
- Apply ARM Cortex programming using C, CMSIS, and Assembly.
- Analyze interrupt handling, exception mechanisms, and pipeline behavior in Cortex-M3
- Evaluate development and debugging tools used in embedded system design.

**COURSE OUTCOMES:**

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

- CO 1:** Describe the features, categories, and application areas of embedded systems.
- CO 2:** Explain ARM Cortex-M3 architecture, including registers, modes, and instruction set.
- CO 3:** Apply programming techniques using C, Assembly, and CMSIS for ARM Cortex-M3/M4.
- CO 4:** Develop exception handlers and implement software/hardware interrupts.
- CO 5:** Evaluate microcontroller features, clock systems, and development/debugging tools used in embedded design.

**UNIT I:****(9 Periods)**

Introduction to embedded systems, Application areas, Categories of embedded systems, Overview of embedded system architecture, Specialities of embedded systems, Recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, software architecture, application software, development and debugging tools, back ground of ARM architecture.

**UNIT II:****(9 Periods)**

**Overview of Cortex – M3 Cortex – M3 basics:** Registers, Stack pointer, link register, program counter, special registers, operation mode, interrupts, stack memory operations, reset sequence, instruction sets.

**UNIT III:****(9 Periods)**

**Cortex – M3 implementation overview:** Pipeline, Block diagram, bus interfaces on Cortex – M3, I-Code bus, D – Code bus, System bus, External PPB and DAP bus, Exceptions. Interrupt behaviour: Interrupt/Exception sequences, exception exists, Nested interrupts, Tail chaining interrupts

**UNIT IV:****(9 Periods)**

**Cortex – M3/M4 Programming:** Overview, typical development flow, using C, CMSIS (cortex microcontroller software interface standard), using Assembly. Exception Programming: Using Interrupts, Exception /Interrupt handlers, Software Interrupts, Vector table Relocation

**UNIT V:****(9 Periods)**

**Cortex – M3/M4 Micro Controller :** ARM Cortex M3/M4 Micro Controller: memory and Bus Architecture, power control, Reset and clock control, Development and Debugging tools

**Total Periods:45****TEXT BOOKS:**

1. 1.The definite guide to ARM Cortex M3, Joseph Yiu, Elsevier,2<sup>nd</sup> Edition, Inc2010
2. 2.Embedded /Real time concepts, design and programming block book, Prasad KVK

**IV Year B.Tech. ECE – I Semester**

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**(EC23AHN702) UNDERWATER COMMUNICATION****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic principles of underwater acoustics, sound propagation, and the marine environment
- Analyze the operation of sonar systems and sensor arrays used in underwater detection and communication
- Identify and evaluate the various underwater sensors and their applications in shallow and deep waters.
- Classify and distinguish different types of underwater noise and understand their impact on acoustic systems.
- Simulate and assess underwater wireless communication models using open-source tools.

**COURSE OUTCOMES:**

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

- CO 1:** Explain the fundamentals of underwater sound propagation and acoustic environment.
- CO 2:** Apply sonar equations and evaluate the characteristics of active and passive sonar systems.
- CO 3:** Analyze the design and functioning of underwater sensors like hydrophones, MBES, AUVs, etc.
- CO 4:** Classify different underwater noise sources and assess their influence on communication systems.
- CO 5:** Simulate underwater communication scenarios and interpret performance metrics like data rate.

**UNIT I:****(9 Periods)**

**Fundamentals of Underwater Acoustics:** The ocean acoustic environment - measuring sound level - sound velocity in sea water - sources and detectors - relevant units; sound propagation in the Ocean-; characteristic of sound propagation paths-deep water and shallow water; Range dependent environment - sound attenuation in sea water - surface bottom loss and volume scattering - Snell's law for range dependent Ocean.

**UNIT II:****(9 Periods)**

**Characteristics of Sonar Systems :** Sonar systems - active and passive sonar equations - transducers and their directivities; Sensor array characteristics: array gain - receiving directivity index - beam patterns - shading and super directivity - adaptive beamforming

**UNIT III:****(9 Periods)**

**Underwater Sensors:** Sonars - hydrophones - DAS - ROV - AUV - Side scan sonar - Echo sounder - MBEC - Sub bottom profiler - magnetometer - dredger - sensors application in shallow water and deep water.

**UNIT IV:****(9 Periods)**

**Underwater Noises:** Basic Concept of noises in underwater - Types of Noises: natural - man made - ambient noise types - seismic - wind - biological - lobsters - dolphin - shipping, turbulence noise - rain etc. - Study on location based noises - Comparison between various noises in underwater.

**UNIT V:****(9 Periods)**

**Instructional Activity:** Study the performance analysis of underwater communication ~~wireless model for different types of noise effects/ simulate the underwater wireless~~

communication model for nodes placed in different positions and determine its data rate using open source software tool.

**Total Periods:45**

**TEXT BOOKS:**

1. Robert J Urick, Principles of Underwater Sound, Peninsula Publications, 3<sup>rd</sup> Edition, 2013
2. L.M. Brekhovskikh & Yu. P. Lysanov, Fundamental of ocean acoustics, Springer, 2002.

**REFERENCES:**

1. Gross M.G., Principles of Oceanography, Prentice-Hall, 7<sup>th</sup> Edition, 1995.
2. Ask T., Handbook of Marine Surveying, Sheridan House, 2007.