

R23 ACADEMIC REGULATIONS
COURSE STRUCTURE AND SYLLABI
of
B.TECH. ELECTRICAL AND ELECTRONICS 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 ELECTRICAL AND ELECTRONICS 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 Electrical and Electronics Engineering****Vision**

To prepare the learners globally competent, dynamic and multi-talented young leaders with skill set & knowledge in Electrical and Electronics Engineering field with a focus on higher education, professional practice, research and technical consultancy competence ethical concern.

Mission

- M 1:** To prepare the learners professionally deft and intellectually adept in the field of Electrical and Electronics Engineering with an excellent infrastructure, core values and qualified & experienced teaching faculty.
- M 2:** To inculcate skill, knowledge and behaviour to cater the dynamic requirements in the field of Electrical and Electronics Engineering.
- M 3:** To motivate and prepare the learners for career guidance, placements and higher education with a focus on MoUs with premier institutes and industries.



PROGRAM EDUCATIONAL OBJECTIVES

- PEO1:** Solve challenging technological issues in the field of Electrical and Electronics Engineering for the betterment of the living standards of the society as valuable and productive engineers.
- PEO2:** Improve the efficiency and effectiveness of the existing methodologies by adapting out-of-the-box rationalized thinking.
- PEO3:** Function ethically and communicate professionally as a team member within multidisciplinary teams.
- PEO4:** Continue the process of lifelong learning to cater the dynamically changing requirements in the field of Electrical and Electronics Engineering.



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 consideration.
- 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

A graduate of the Electrical & Electronics Engineering Program will be able to:

PSO 1: Design and develop innovative projects using the domain knowledge of control systems, power electronics, electrical machines, microprocessors and microcontrollers.

PSO 2: Learn the constantly varying technological developments in their problem-solving process.

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 (Artificial Intelligence and Machine Learning)
4	Computer Science and Engineering (Cyber Security)
5	Computer Science and Engineering (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.
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	Elective courses which include

S. No.	Broad Course Classification	Course Category	Description
		(OE)	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) (Non-credit Courses with Internal Examination)	Covering courses of developing desired attitude and awareness among the learners
		Audit Courses (AC) (Non-credit Courses without Internal Examination but with Formative Assessments)	Covering value added courses

12. Program Pattern

- Total duration of the of B.Tech (Regular) Program is four academic years.
- Each academic year of study is divided into two semesters.
- Minimum number of instructional days in each semester is 90 days.
- 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.
- Health/wellness/yoga/sports and NSS / NSS / Scouts & Guides / Community service activities are made mandatory as credit courses for all the under graduate students.
- Courses like Environmental Sciences, Indian Constitution, Technical Paper Writing & IPR are offered as non-credit mandatory courses for all the undergraduate students.
- Audit courses are offered as non-credit mandatory courses covering value added courses, without internal examination but with formative assessments.
- Design Thinking for Innovation & Tinkering Labs are made mandatory as credit courses for all the undergraduate students.
- A mandatory one-week domain-specific workshop shall be organized during VI semester
- It is mandatory for every student to undertake a minimum of one industrial visit during any semester between the V and VIII semesters
- Department should conduct one domain-specific expert lecture in every semester from the V semester to VII semester.
- Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 04 Open Elective courses.
- 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.
- 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
Total	100

- 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 1 mark.
 - 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
Total	100

- 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)	-

- 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.
- 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:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 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.

- The candidate should have completed the 4 years of B.Tech. course work and obtained examinations results from I semester to VIII semester.
- He/she should have passed all the courses for which the internal evaluation marks secured are more than 50%
- 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.
- 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).
- 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. (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. 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. Otherwise, the candidate is debarred for two consecutive semesters from class

S. No.	Nature of Malpractices/ Improper Conduct	Punishment
		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. If the imposter is an outsider, he will be handed over to the police and a case is registered against him/her.
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.

S. No.	Nature of Malpractices/ Improper Conduct	Punishment
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 clause 6 to 8 .	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.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Principal for	

S. No.	Nature of Malpractices/ Improper Conduct	Punishment
	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)

(a) SGPA Calculations: One Academic Year							
Semester (Odd :I, Even: II)	Course Code	Credits (C_i)	Marks	Grade	Grade Points (G_i)	Credit Points ($C_i \times G_i$)	SGPA (S_i)
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	$0.5 \times 9 = 4.5$	
$\sum_{i=1}^n C_i$		19.5 (19.5*)	678#	Total		$\sum_{i=1}^n (C_i \times G_i) = 145$	
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	$0.5 \times 9 = 4.5$	
$\sum_{i=1}^n C_i$		20.5 (17*)	520#	Total		$\sum_{i=1}^n (C_i \times G_i) = 136.5$	
* 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	$1.5 \times 6 = 9$	
$\sum_{i=1}^n C_i$		20.5 (20.5*)	605\$	Total		150.5	
\$ Total marks obtained after clearing all backlog courses							

(b) CGPA Calculation of the Program									
Semester	I	II	III	IV	V	VI	VII	VIII	TOTAL
Semester Credits (C_i)	19.5	20.5	20	21	23	26	21	12	163
Total Max. Marks	1000	1000	800	900	1000	1000	750	300	6750
Total Marks Obtained	678	605	755	735	678	628	638	187	4904
SGPA (S_i)	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
For Regular Students	$CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i} = \frac{1286.50}{163} = 7.89$						$\begin{aligned} &\text{Percentage of Marks} \\ &= \frac{\text{Total Marks Obtained}}{\text{Total Max. Marks}} * 100 \\ &= \frac{4904}{6750} * 100 = 72.65 \end{aligned}$		
For Lateral Entry Students	$CGPA = \frac{\sum_{i=1}^n (C_i \times S_i)}{\sum_{i=1}^n C_i} = \frac{991}{123} = 8.06$						$\begin{aligned} &\text{Percentage of Marks} \\ &= \frac{\text{Total Marks Obtained}}{\text{Total Max. Marks}} * 100 \\ &= \frac{3621}{4750} * 100 = 76.23 \end{aligned}$		

In Course Code:

For Example: BB23APC501

BB- Correspond to Branch

Branch	Short Code (BB)
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	EG23AHS101	Communicative English	HS	2	-	-	2	2	30	70	100
3	PH23ABS101	Engineering Physics	BS	3	-	-	3	3	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	EG23AHS102	Communicative English Lab	HS	-	-	2	2	1	30	70	100
7	CS23AES102	Computer Programming Lab	ES	-	-	3	3	1.5	30	70	100
8	EE23AES102	Electrical & Electronics Engineering Workshop	ES	-	-	3	3	1.5	30	70	100
9	PH23ABS102	Engineering Physics Lab	BS	-	-	2	2	1	30	70	100
10	CH23ABS105	Health and Wellness, Yoga and Sports	BS	-	-	1	1	0.5	100	--	100
Total				14	-	11	25	19.5	370	630	1000

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 & Mechanical Engineering	ES	3	-	-	3	3	30	70	100
2	MA23ABS201	Differential Equations & Vector Calculus	BS	3	-	-	3	3	30	70	100
3	EE23APC201	Electrical Circuit Analysis-I	PC	3	-	-	3	3	30	70	100
4	CH23ABS101	Chemistry	BS	3	-	-	3	3	30	70	100
5	ME23AES102	Engineering Graphics	ES	1	-	4	5	3	30	70	100
6	EE23APC202	Electrical Circuit Analysis-I Lab	PC	-	-	3	3	1.5	30	70	100
7	CH23ABS102	Chemistry Lab	BS	-	-	2	2	1	30	70	100
8	ME23AES103	Engineering Workshop	ES	-	-	3	3	1.5	30	70	100
9	CS23AES103	IT Workshop	ES	-	-	2	2	1	30	70	100
10	CH23ABS106	NSS/NCC/Scouts & Guides/Community Service	BS	-	-	1	1	0.5	100	--	100
Total				13	-	15	28	20.5	370	630	1000

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	MA23ABS301	Complex Variables and Numerical Methods	BS	3	-	-	3	3	30	70	100
2	EE23AES301	Electromagnetic Field Theory	ES	3	-	-	3	3	30	70	100
3	BA23AHS302	Universal Human Values	HS	3	-	-	3	3	30	70	100
4	EE23APC301	DC Machines and Transformers	PC	3	-	-	3	3	30	70	100
5	EE23APC302	Electrical Circuit Analysis-II	PC	3	-	-	3	3	30	70	100
6	EE23APC303	DC Machines and Transformers Lab	PC	-	-	3	3	1.5	30	70	100
7	EE23APC304	Electrical Circuit Analysis-II and Simulation Lab	PC	-	-	3	3	1.5	30	70	100
8	CS23ASC201	Data Structures	SC	-	1	2	3	2	30	70	100
9	CH23AMC301	Environmental Science	MC	2	-	-	2	-	30	--	30
Total				17	1	8	26	20	270	560	830

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	EC23AES401	Analog Circuits	ES	3	-	-	3	3	30	70	100
2	BA23AHS403	Managerial Economics and Financial Analysis	HS	2	-	-	2	2	30	70	100
3	EE23APC401	Control Systems	PC	3	-	-	3	3	30	70	100
4	EE23APC402	Induction and Synchronous Machines	PC	3	-	-	3	3	30	70	100
5	EE23APC403	Power Systems-I	PC	3	-	-	3	3	30	70	100
6	CS23AES301	Design Thinking and Innovation	ES	1	-	2	3	2	30	70	100
7	EE23APC404	Control Systems Lab	PC	-	-	3	3	1.5	30	70	100
8	EE23APC405	Induction and Synchronous Machines Lab	PC	-	-	3	3	1.5	30	70	100
9	CS23ASC302	Python Programming	SC	-	1	2	3	2	30	70	100
Total				15	1	10	26	21	270	630	900
Mandatory Community Service Project Internship of 08 Weeks Duration During Summer Vacation											

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	EC23APC503	Digital Circuits	PC	3	-	-	3	3	30	70	100
3	EE23APC501	Power Electronics	PC	3	-	-	3	3	30	70	100
4	EE23APC502	Power Systems-II	PC	3	-	-	3	3	30	70	100
5	EE23APE501	Professional Elective-I Electrical Safety and Risk Management	PE								
	EC23APE505	Signals and Systems		3	-	-	3	3	30	70	100
	EE23APE502	Utilization of Electrical Energy									
6		Open Elective-I	OE	3	-	-	3	3	30	70	100
7	EE23APC503	Power Electronics and Simulation Lab	PC	-	-	3	3	1.5	30	70	100
8	EC23APC505	Analog and Digital Circuits Lab	PC	-	-	3	3	1.5	30	70	100
9	EG23ASC401	Soft Skills	SC	-	1	2	3	2	30	70	100
10	EE23ACS501	Community Service Project	CS	-	-	-	-	2	--	100	100
Total				18	1	8	27	25	270	730	1000
Note: 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	EE23APC601	Electrical Measurements and Instrumentation	PC	3	-	-	3	3	30	70	100
2	EC23APC504	Microprocessors and Microcontrollers	PC	3	-	-	3	3	30	70	100
3	EE23APC602	Power System Analysis	PC	3	-	-	3	3	30	70	100
4	EE23APE601	Professional Elective-II AI and ML for Electrical Engineering	PE								
	EE23APE602	Programmable Logic Controllers		3	-	-	3	3	30	70	100
	EE23APE603	Switchgear and Protection									
5	EC23APE605	Professional Elective-III Communication Systems	PE								
	EE23APE604	Electric Drives		3	-	-	3	3	30	70	100
	EE23APE605	Renewable and Distributed Energy Technologies									
6		Open Elective-II	OE	3	-	-	3	3	30	70	100
7	EC23AES501	Tinkering Lab	ES	-	-	2	2	1	30	70	100
8	EE23APC603	Electrical Measurements and Instrumentation Lab	PC	-	-	3	3	1.5	30	70	100
9	EC23APC507	Microprocessors and Microcontrollers Lab	PC	-	-	3	3	1.5	30	70	100
10	EE23ASC601	Applications of Soft Computing Tools in Electrical Engineering	SC	-	1	2	3	2	30	70	100
11	CS23AMC601	Technical Paper Writing and IPR	MC	2	-	-	2	-	30	--	30
Total				20	1	10	31	24	330	700	1030
Mandatory Industry Internship of 08 Weeks Duration During Summer Vacation Note: 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 BA23AHS702 BA23AHS703	Management Course Business Ethics and Corporate Governance E-Business Management Science	HS	2	-	-	2	2	30	70	100
2	EE23APC701	Power System Operation and Control	PC	3	-	-	3	3	30	70	100
3	EC23APC601 EE23APE701 EE23APE702	Professional Elective-IV Digital Signal Processing Electric Vehicle Technology HVDC and FACTS	PE	3	-	-	3	3	30	70	100
4	EE23APE703 EE23APE704 EE23APE705	Professional Elective-V Electrical Distribution System Modern Control Theory Switched Mode Power Conversion	PE	3	-	-	3	3	30	70	100
5		Open Elective-III	OE	3	-	-	3	3	30	70	100
6		Open Elective-IV	OE	3	-	-	3	3	30	70	100
7	EE23ASC701	Power Systems and Simulation Lab	SC	-	1	2	3	2	30	70	100
8	BA23AAC701	Gender Sensitization	AC	2	-	-	2	-	--	--	--
9	EE23AIP701	Industry Internship	IP	-	-	-	-	2	--	50	50
Total				19	1	2	22	21	210	540	750
Note: 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	EE23AIP801	Internship	IP	-	-	-	-	4	--	100	100
2	EE23APW801	Project	PW	-	-	-	-	8	60	140	200
Total				-	-	-	-	12	60	240	300

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 DEGREE IN ELECTRICAL AND ELECTRONICS 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 (2 Theory)	EE23AHN501	Adaptive Control Systems	3	-	-	3	3	30	70	100
2		EE23AHN502	Battery Management Systems	3	-	-	3	3	30	70	100
3		EE23AHN503	Restructured Power Systems	3	-	-	3	3	30	70	100
4	III-II (2 Theory)	EE23AHN601	AC Drives	3	-	-	3	3	30	70	100
5		EE23AHN602	EV Charging Technologies	3	-	-	3	3	30	70	100
6		EE23AHN603	Power System Wide Area Monitoring and Control	3	-	-	3	3	30	70	100
7	IV-I (1 Theory)	EE23AHN701	Computer Aided Design of Electrical Machines	3	-	-	3	3	30	70	100
8		EE23AHN702	Grid Interface of Electric Vehicles	3	-	-	3	3	30	70	100
9	IV-I	EE23AHN703	Honors Capstone Project	-	-	-	-	3	50	50	100
Total				15	-	-	15	18	200	400	600

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	Ποστ Δεπαρτεμεντ	Τιτλε οφ τηε Μινορ	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

For complete information on course structures and syllabi, please refer to the Minor Degree Syllabi Book.

Note: Students who have already completed any course listed under the Minor Degree as part of their regular curriculum are not eligible to opt for the same course(s) again under the Minor Degree program. It is the student's responsibility to ensure that all necessary prerequisites are completed prior to registering for a course under the Minor Degree.

I Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(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, 1st Edition, 2019.
2. P. V. Gupta, M. L. Soni, U. S. Bhatnagar, A. Chakrabarti, Power System Engineering, Dhanpat Rai & Co., 2013.

REFERENCES:

1. D. P. Kothari, I. J. Nagrath, Basic Electrical Engineering, McGraw Hill, 4th Edition, 2019.
2. Rajendra Prasad, Fundamentals of Electrical Engineering, PHI Publishers, 3rd Edition, 2014.

3. V. K. Mehta, Principles of Power Systems, S. Chand Technical Publishers, 2020.
4. T. K. Nagsarkar, M. S. Sukhija, Basic Electrical Engineering, Oxford University Press, 2017.
5. S. K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Publications, 2nd 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 Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, 11th Edition, 2021.
2. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition, 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 and Circuits – Conventional Flow Version, Pearson Education, 2009.

I Year B.Tech. – I Semester

L	T	P	C
2	-	-	2

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

The objectives of this course are to:

- Facilitate effective listening, Reading, Speaking and Writing skills among the students.
- Enhance the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary.
- 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, 1st 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, Fourth 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
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. www.eslpod.com/index.html
4. <https://www.learngrammar.net/>
5. <https://english4today.com/english-grammar-online-with-quizzes/>
6. <https://www.talkenglish.com/grammar/grammar.aspx>

Vocabulary:

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

I Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(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, and T. V. S. Arun Murthy, A Textbook of Engineering Physics, S. Chand Publications, 11th Edition, 2019.
2. D. K. Bhattacharya and Poonam Tandon, Engineering Physics, Oxford University Press, 2015.

REFERENCES:

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

ONLINE RESOURCES:

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

I Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(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, Cengage Learning, 3rd Edition, 2007.
2. M. T. Somashekara, Problem Solving with C, PHI Learning, 2009.

REFERENCES:

1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, Pearson, 5th Edition, 2007.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall, 2nd Edition, 1988.
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. – I Semester

L	T	P	C
3	-	-	3

(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, 44th Edition, 2017
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2011

REFERENCES:

1. R. K. Jain, S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd., 3rd Edition, 2002
2. George B. Thomas, Maurice D. Weir, Joel Hass, Thomas Calculus, Pearson Publishers, 13th Edition, 2013
3. Glyn James, Advanced Modern Engineering Mathematics, Pearson Publishers, 4th 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. – I Semester

L	T	P	C
-	-	2	1

(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.
- Train students 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

TEXT BOOKS:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication Oxford Press.2018.
2. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India, 2016.

REFERENCES:

1. Hewing's, Martin. Cambridge Academic English (B2). CUP, 2012.
2. J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle, 2013

ONLINE RESOURCES:**Spoken English:**

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. <https://www.britishcouncil.in/english/online>
5. <http://www.letstalkpodcast.com/>
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. <https://www.youtube.com/c/ArnelsEverydayEnglish/featured>

8. <https://www.youtube.com/c/engvidAdam/featured>
9. <https://www.youtube.com/c/EnglishClass101/featured>
10. <https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists>
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

VOICE 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
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

I Year B.Tech. – I Semester

L	T	P	C
-	-	3	1.5

(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, 2nd Edition, 2010
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill, 3rd Edition, 2010

REFERENCES:

1. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India, 2nd Edition, 1988
2. Forouzan, Gilberg, Prasad, C Programming: A Problem-Solving Approach, Cengage, 2nd Edition, 2010

I Year B.Tech. – I Semester

L	T	P	C
-	-	3	1.5

(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

TEXT BOOKS:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition.
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.

REFERENCES:

1. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition.

Note: Minimum Six Experiments to be performed.

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

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 & 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.

TEXT BOOKS:

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

REFERENCES:

1. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

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

I Year B.Tech. – I Semester

L	T	P	C
-	-	2	1

(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.

TEXT BOOKS:

1. S. Balasubramanian, M.N. Srinivasan, A Textbook of Practical Physics, S. Chand Publishers, 1st Edition, 2017.
2. D.K. Bhattacharya, Poonam Tandon, Engineering Physics, Oxford University Press, 1st Edition, 2015.

REFERENCES:

1. M.R. Srinivasan, Engineering Physics, New Age International Publishers, 1st Edition, 2009.
2. Sanjay D. Jain, D. Sahasrabudhe, Girish, Engineering Physics, University Press, 1st Edition, 2010.

ONLINE RESOURCES:

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

I Year B.Tech. – I Semester

L	T	P	C
-	-	1	0.5

(CH23ABS105) HEALTH AND WELLNESS, YOGA AND SPORTS**COURSE OBJECTIVES:**

The objectives of this course are 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 programmes 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.

TEXT BOOKS:

1. Gordon Edlin, Eric Golanty, Health and Wellness, Jones & Bartlett Learning, 14th Edition, 2022.
2. T.K.V. Desikachar, The Heart of Yoga: Developing a Personal Practice, Inner Traditions, 1st Edition, 1995.

REFERENCES:

1. Archie J. Bahm, Yoga Sutras of Patanjali, Jain Publishing Company, 1993.
2. John Lofty Wiseman, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere, William Morrow Paperbacks, 3rd Edition, 2014.
3. Thomas Hanlon, The Sports Rules Book, Human Kinetics, 3rd Edition, 2014.

I Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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 McGraw Hill Publications (India) Pvt. Ltd., 4th Edition.
2. S.S. Bhavikatti, Introduction to Civil Engineering, New Age International Publishers, 1st Edition, 2022.

REFERENCES:

1. Surveying, Vol I and Vol II, S.K. Duggal, Tata McGraw Hill Publishers, 2019, 5th Edition.
2. Satheesh Gopi, Basic Civil Engineering, Pearson Publications, 1st Edition, 2009.

3. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi, 2016.
4. Irrigation Engineering and Hydraulic Structures, Santosh Kumar Garg, Khanna Publishers, Delhi, 2023, 38th Edition.
5. Highway Engineering, S.K. Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications, 2019, 10th Edition.
6. Indian Standard DRINKING WATER — SPECIFICATION IS 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., 4th Edition, 2012.
2. S. S. Rattan, Theory of Machines, Tata McGraw Hill Publications (India) Pvt. Ltd., 4th Edition, 2014.

REFERENCES:

1. Appuu Kuttan K. K., Robotics, I.K. International Publishing House Pvt. Ltd., Vol-I, 2007.
2. Jonathan Wickert, Kemper Lewis, An Introduction to Mechanical Engineering, Cengage

- Learning India Pvt. Ltd., 4th Edition, 2016.
3. L. Jyothish Kumar, Pulak M. Pandey, 3D Printing & Additive Manufacturing Technology, Springer Publications, 2019.
 4. Mahesh M. Rathore, Thermal Engineering, Tata McGraw Hill Publications (India) Pvt. Ltd., 2nd Edition, 2010.
 5. G. Shanmugam, M. S. Palanisamy, Basic Civil and Mechanical Engineering, Tata McGraw Hill Publications (India) Pvt. Ltd., 2009.

I Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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, 44th Edition, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th 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, 2nd Edition, 2018.
3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, Pearson Publishers, 13th Edition, 2013.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd., 3rd 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. – II Semester

L	T	P	C
3	-	-	3

(EE23APC201) ELECTRICAL CIRCUIT ANALYSIS-I**COURSE OBJECTIVES:**

The objectives of this course are to:

- Basic characteristics of R, L, C parameters, their Voltage and Current Relations and network reduction techniques.
- Basic knowledge about the Magnetic circuits, electromagnetism, self and mutual inductances.
- The Single Phase AC circuits and concepts of real power, reactive power, complex power, phase angle and phase difference.
- Study of Series and parallel resonances, bandwidth, current locus diagrams
- Network theorems and their applications

COURSE OUTCOMES:

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

- CO 1:** Apply the knowledge of basic circuit laws and simplify the dc networks using reduction techniques.
- CO 2:** Analyse magnetically coupled circuits and concept of inductance.
- CO 3:** Evaluate the performance of given electrical circuit with AC excitation.
- CO 4:** Understand the concept of Resonance, Locus diagrams for R-L, R-C and R-L-C.
- CO 5:** Apply the network theorems suitably to analyze complex circuits with DC and AC excitation.

UNIT I:**(8 Periods)**

Introduction to Electrical Circuits: Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

UNIT II:**(12 Periods)**

Magnetic Circuits: Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

UNIT III:**(8 Periods)**

Single Phase Circuits: Characteristics of periodic functions, Average value, R.M.S. value, form factor, representation of a sine function, concept of phasor, phasor diagrams, node and mesh analysis. Steady state analysis of R, L and C circuits to sinusoidal excitations-response of pure resistance, inductance, capacitance, series RL circuit, series RC circuit, series RLC circuit, parallel RL circuit, parallel RC circuit.

UNIT IV:**(9 Periods)**

Resonance and Locus Diagrams: Series Resonance: Characteristics of a series resonant circuit, Q-factor, selectivity and bandwidth, expression for half power frequencies; Parallel resonance: Q-factor, selectivity and bandwidth; Locus diagram: RL, RC, RLC with R, L and C variables.

UNIT V:**(8 Periods)**

Network Theorems (DC & AC Excitations): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

Total Periods: 45

TEXT BOOKS:

1. Jack Kemmerly, William Hayt, Steven Durbin, Engineering Circuits Analysis, Tata McGraw Hill Education, 6th Edition, 2005
2. M. E. Van Valkenburg, Network Analysis, Pearson Education, Revised 3rd Edition, 2019

REFERENCES:

1. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electrical Circuits, McGraw Hill Education (India), 5th Edition, 2013
2. Mahmood Nahvi, Joseph Edminister, K. Rao, Electric Circuits (Schaum's Outline Series), McGraw Hill Education, 5th Edition, 2017
3. David A. Bell, Electric Circuits, Oxford University Press, 7th Edition, 2009
4. Robert L. Boylestad, Introductory Circuit Analysis, Pearson Publications, 14th Edition, 2023
5. A. Chakrabarti, Circuit Theory: Analysis and Synthesis, Dhanpat Rai & Co., 7th Revised Edition, 2018

I Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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:

At the end of the course, the 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 Ψ and Ψ^2 , molecular orbital theory – bonding in homo- and hetero nuclear diatomic molecules – energy level diagrams of O₂ 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, Dhanpat Rai, 16th Edition, 2013.
2. Peter Atkins, Julio de Paula, and James Keeler, Atkins' Physical Chemistry, Oxford University Press, 10th Edition, 2010.

REFERENCES:

1. Skoog and West, Principles of Instrumental Analysis, Thomson, 6th Edition, 2007.
2. Vogel's, Quantitative Chemical Analysis, 6th Edition, 2009.
3. J.D. Lee, Concise Inorganic Chemistry, Wiley Publications, Feb. 5th Edition, 2008.
4. Fred W. Billmayer Jr., Textbook of Polymer Science, 3rd Edition.
5. K.N. Jayaveera, G.V. Subba Reddy, and C. Rama Chandraiah, Chemistry, Mc Graw Hill.

I Year B.Tech. – II Semester

L	T	P	C
1	-	4	3

(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, 54th 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, 4th Edition, 2004.
4. Basant Agarwal and C.M. Agarwal, Engineering Drawing, Tata McGraw-Hill, 2nd Edition, 2013.

I Year B.Tech. – II Semester

L	T	P	C
-	-	3	1.5

(EE23APC202) ELECTRICAL CIRCUIT ANALYSIS-I LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Impart hands on experience in verification of circuit laws and network reduction techniques.
- Impart hands on experience in verification of theorems
- Gain the knowledge about measurement of circuit parameters
- Know the concept of resonance and locus diagrams.
- Gain practical exposure to the usage of different circuits with different conditions.

COURSE OUTCOMES:

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

- CO 1:** Understand the concepts of network theorems, node and mesh networks, series and parallel resonance and Locus diagrams.
- CO 2:** Apply various theorems to compare practical results obtained with theoretical calculations.
- CO 3:** Determine self, mutual inductances and coefficient of coupling values, parameters of choke coil
- CO 4:** Analyse different circuit characteristics with the help of fundamental laws and various configurations
- CO 5:** Create locus diagrams of RL, RC series circuits and examine series and parallel resonance.

List of Experiments:

1. Verification of Kirchhoff's circuit laws.
2. Verification of node and mesh analysis.
3. Verification of network reduction techniques.
4. Determination of cold and hot resistance of an electric lamp
5. Determination of Parameters of a choke coil.
6. Determination of self, mutual inductances, and coefficient of coupling
7. Series and parallel resonance
8. Locus diagrams of R-L (L Variable) and R-C (C Variable) series circuits
9. Verification of Superposition theorem
10. Verification of Thevenin's and Norton's Theorems
11. Verification of Maximum power transfer theorem
12. Verification of Compensation theorem
13. Verification of Reciprocity and Millman's Theorems

Note: Minimum of 10 experiments should be performed

TEXT BOOKS:

1. Jack Kemmerly, William Hayt, Steven Durbin, Engineering Circuit Analysis, Tata McGraw Hill Education, 6th Edition, 2005.
2. M. E. Van Valkenburg, Network Analysis, Pearson Education, Revised 3rd Edition, 2019.

I Year B.Tech. – II Semester

L	T	P	C
-	-	2	1

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

The objective of this course is to:

- Verify the fundamental concepts with experiments.

COURSE OUTCOMES:

At the end of the course, the 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

TEXT BOOKS:

1. J. Mendham, R.C. Denney, J.D. Barnes, B. Sivasankar, Vogel's Quantitative Chemical Analysis, Pearson Publications, 6th Edition, 2009.
2. P.L. Soni, P.L. Fulekar, Experiments in Physical Chemistry, S. Chand & Co., 1st Edition, 2010.

REFERENCES:

1. Y.R. Sharma, Instrumental Methods of Chemical Analysis, Goel Publishing House, 23rd Edition, 2018.
2. O.P. Pandey, Organic Spectroscopy, New Age International, 2nd Edition, 2012.

I Year B.Tech. – II Semester

L	T	P	C
-	-	3	1.5

(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 woodworking.
- 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, 5th Edition, 2015.

REFERENCES:

1. S.K. Hajra Choudhury & Others, Elements of Workshop Technology, Vol. I, Media Promoters and Publishers, 14th Edition, 2007.
2. H.S. Bawa, Workshop Practice, Tata McGraw Hill, 2004.
3. P.M. Soni, P.A. Upadhyay, Wiring Estimating, Costing and Contracting, Atul Prakashan, 2021-22.
4. B.S. Raghuwanshi, A Course in Workshop Technology Vol I & II, Dhanpat Rai & Co., 2015 & 2017.

I Year B.Tech. – II Semester

L	T	P	C
-	-	2	1

(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 sorter, 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."

TEXT BOOKS:

1. Vikas Gupta, Comdex Information Technology Course Tool Kit, WILEY Dreamtech.
2. Cheryl A. Schmidt, The Complete Computer Upgrade and Repair Book, WILEY Dreamtech, 3rd Edition.

REFERENCES:

1. ITL Education Solutions Limited, Introduction to Information Technology, Pearson Education.
2. Kate J. Chase, PC Hardware: A Handbook, PHI (Microsoft).
3. Leslie Lamport, LaTeX Companion, PHI/Pearson.
4. David Anfinson, Ken Quamme, IT Essentials PC Hardware and Software Companion Guide, CISCO Press, Pearson Education, 3rd Edition.
5. Patrick Regan, IT Essentials PC Hardware and Software Labs and Study Guide, CISCO Press, Pearson Education, 3rd Edition.

I Year B.Tech. – II Semester

L	T	P	C
-	-	1	0.5

(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.

TEXT BOOKS:

1. Nirmalya Kumar Sinha, Surajit Majumder, A Text Book of National Service Scheme, Vol I, Vidya Kutir Publication, 2021.
2. Directorate General of NCC, Ministry of Defence, Red Book – National Cadet Corps: Standing Instructions, Vol I & II, New Delhi.

REFERENCES:

1. M. L. Davis, D. A. Cornwell, Introduction to Environmental Engineering, McGraw Hill, 4th Edition, 2008.
2. G. M. Masters, Joseph K., R. Nagendran, Introduction to Environmental Engineering and Science, Pearson Education, 2nd Edition, 2007.
3. Ram Ahuja, Social Problems in India, Rawat Publications, New Delhi.

II Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(MA23ABS301) COMPLEX VARIABLES AND NUMERICAL METHODS**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.
- Introduce numerical methods for solving algebraic and transcendental equations.
- Introduce the numerical solutions of ordinary differential equations.

COURSE OUTCOMES:

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

- CO 1:** Analyze the behavior of a complex function and understand Cauchy-Riemann equation in testing the analytic functions
- CO 2:** Apply Cauchy integral theorem, formula and residue theorem to evaluating the complex integrals.
- CO 3:** Apply numerical methods to solve algebraic and transcendental equations.
- CO 4:** Derive interpolating polynomials using interpolation formulae.
- CO 5:** Solve differential equations and integrals using numerically.

UNIT I:**(9 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 II:**(9 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, Laurent's series, singularities, Residues, Cauchy Residue theorem (without proof). Evaluation of definite Integral involving sine and cosine.

UNIT III:**(9 periods)**

Solution of Algebraic, Transcendental Equations and Interpolation: Induction-Bisection Method, Regula-falsi method, Iterative method and Newton Raphson method.

Interpolation: Finite Differences-Newton's forward and backward interpolation formulae – Lagrange's formulae.

UNIT IV:**(9 periods)**

Numerical differentiation, Integration and Curve fitting: Numerical differentiation and **Integration:** Numerical differentiation based on Newton's interpolation, Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule.

Curve fitting: Fitting of straight line, second-degree and Exponential curve by method of least squares

UNIT V:**(9 periods)**

Solution of Initial value problems in Ordinary differential equations: Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of Successive Approximations - Euler's and modified Euler's methods - Runge-Kutta method of fourth order

Total Periods: 45

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. SS Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.

REFERENCES:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2018.
2. B.V. Ramana, Higher Engineering Mathematics, by Mc Graw Hill publishers
3. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd, 5th Edition, 2021.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. https://onlinecourses.nptel.ac.in/noc20_ma50/preview
3. <http://nptel.ac.in/courses/111105090>.

II Year B.Tech. – I Semester

L	T	P	C
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(EE23AES301) ELECTROMAGNETIC FIELD THEORY**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the basic mathematical concepts related to electromagnetic vector fields
- Impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- Impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.
- Impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations.
- Impart knowledge on the concepts of Concepts of electromagnetic waves

COURSE OUTCOMES:

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

- CO 1:** Apply vector algebra and calculus to solve problems involving electric field intensity and potential in various coordinate systems.
- CO 2:** Analyze the behaviour of dielectrics and conductors in electric fields, and determine the capacitance for different configurations.
- CO 3:** Evaluate the magnetic field intensity and forces on current-carrying conductors using Biot-Savart's law and Ampere's law.
- CO 4:** Synthesize knowledge of self and mutual inductance to design and analyze inductive components in electrical circuits.
- CO 5:** Understand and explain Faraday's laws of electromagnetic induction and their implications in time-varying electromagnetic fields.

UNIT I:**(10 periods)**

Vector Analysis: Scalar and Vector operations, Coordinate Systems, Del operator, Gradient of a scalar, Divergence of a vector and Divergence theorem (definition only). Curl of a vector and Stoke's theorem (definition only).

Electrostatics: Coulomb's law and Electric field intensity (EFI) – EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (Second Maxwell's equation for static electric fields), Potential gradient, Laplace's and Poisson's equations.

UNIT II:**(9 periods)**

Conductors – Dielectrics and Capacitance: Electric dipole and dipole moment – Potential and EFI due to an electric dipole, Torque on an Electric dipole placed in an electric field, Current density-conduction and convection current densities, Ohm's law in point form, Continuity equation, Behaviour of conductors in an electric field, Polarization, dielectric constant and strength, Boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space, Capacitance of parallel plate, coaxial and spherical capacitors, Energy stored and density in a static electric field.

UNIT III:**(9 periods)**

Magneto statics, Ampere's Law and Force in magnetic fields: Biot-Savart's law and its applications viz. Straight current carrying filament and circular current carrying wire – Magnetic flux density and Maxwell's second Equation, Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation.

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, Magnetic dipole, Magnetic torque, and dipole moment.

UNIT IV: (8 periods)

Self and mutual inductance: Self and mutual inductance – determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

UNIT V: (9 periods)

Time Varying Fields: Faraday's laws of electromagnetic induction, Maxwell's fourth equation integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector.

Total Periods: 45

TEXT BOOKS:

1. Matthew N O Sadiku, Elements of Electromagnetics, Oxford Publications, 7th edition, 2018.
2. William H. Hayt and John, Engineering Electromagnetics, A. Buck Mc. Graw-Hill, 7th Edition, 2006.

REFERENCES:

1. D J Griffiths, Introduction to Electro Dynamics, Prentice-Hall of India Pvt. Ltd, 2nd Edition.
2. Yaduvir Singh, Electromagnetic Field Theory, Pearson India, 1st Edition, 2011.
3. Sunil Bhooshan, Fundamentals of Engineering Electromagnetics, Oxford University Press, 2012.
4. Joseph A. Edminister, Schaum's Outline of Electro magnetics, Mahamood Navi, 4th Edition, 2014.

ONLINE RESOURCES:

1. <https://archive.nptel.ac.in/courses/108/106/108106073/>
2. <https://nptel.ac.in/courses/117103065>

II Year B.Tech. – 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:**(10 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:**(9 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:**(9 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:**(8 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:**(9 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: 45**TEXT BOOKS:**

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

REFERENCES:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathy, Human Values, The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi, New Age International Publishers, 2003.
3. E G Seebauer & Robert L. Berry, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press, 2000.
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, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, 2004, 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-professionaethics/62490385>
2. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

II Year B.Tech. – I Semester

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(EE23APC301) DC MACHINES AND TRANSFORMERS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the construction, operation, and characteristics of DC machines, including excitation techniques, EMF equations, and applications.
- Analyze DC motor characteristics, efficiency, starting methods, speed control techniques, and testing procedures.
- Understand the construction, operation, and performance analysis of single-phase transformers, including phasor diagrams, equivalent circuits, and efficiency.
- Perform transformer tests and parallel operation and comparisons of transformers.
- Analyze three-phase transformer connections, harmonics, parallel operations, and Scott connection.

COURSE OUTCOMES:

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

- CO 1:** Understand the construction, operation, principles of DC machines and their applications.
- CO 2:** Analyze the starting, speed control, and testing methods for DC machines.
- CO 3:** Obtain the equivalent circuit of single-phase transformer and determine its efficiency and regulation.
- CO 4:** Apply various testing methods for transformers.
- CO 5:** Analyze various configurations of three-phase transformers.

UNIT I:**(9 Periods)**

DC Machines: Construction and principle of operation of DC machines – Types – EMF equation for generator – Excitation techniques – Armature reaction and commutation, characteristics of DC generators – applications of DC Generators, – Back-emf and torque equations of DC motor.

UNIT II:**(9 Periods)**

Starting, Speed Control and Testing of DC Machines: Characteristics of DC motors – losses and efficiency – applications of DC motors. Necessity of a starter – starting by 3-point and 4-point starters – speed control by armature voltage and field current control – testing of DC machines – brake test, Swinburne's test – Hopkinson's test – Field Test.

UNIT III:**(9 Periods)**

Single-phase Transformers: Introduction to single-phase Transformers (Construction and principle of operation) – emf equation – operation on no-load and on load – lagging, leading and unity power factors – loads – Phasor diagrams – equivalent circuit – regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency, Applications.

UNIT IV:**(9 Periods)**

Testing of Transformers: Open Circuit and Short Circuit tests – Sumpner's test – separation of losses – Parallel operation with equal and unequal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT V:**(9 Periods)**

Three-Phase Transformers: Polyphase connections – Y/Y, Y/ Δ , Δ /Y, Δ / Δ , open Δ and Vector groups – third harmonics in phase voltages – Parallel operation – three winding transformers – transients in switching – off load and on load tap changers – Scott connection.

Total Periods: 45

TEXT BOOKS:

1. Dr. P S Bimbhra, Electrical Machinery, Khanna Publishers, New Delhi, 7th Edition, 1995.
2. M.G. Say, Performance and analysis of AC machines, CBS, 2002.

REFERENCES:

1. D. P.Kothari, I .J .Nagarth, Electrical MachinesM McGraw Hill Publications, 5th Edition
2. Stephen J Chapman, Electrical Machinery Fundamentals, McGraw Hill education 2011.
3. Dr. P S Bimbhra, Generalized Theory of Electrical Machines, Khanna Publishers, 7th Edition, 2021.
4. J.B.Gupta, Theory and Performance of Electrical Machines, S.K.Kataria and Sons, 2007.
5. Fitzgerald, A.E., Kingsley, Jr., C., and Umans, S. D, Electric Machinery, McGraw-Hill Education, 7th Edition, 2014.

ONLINE RESOURCES:

1. nptel.ac.in/courses/108/105/108105112
2. nptel.ac.in/courses/108/105/108105155

II Year B.Tech. – I Semester

L	T	P	C
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(EE23APC302) ELECTRICAL CIRCUIT ANALYSIS-II**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand and analyze three-phase circuits, including how to measure power and use different connection techniques.
- Learn how to use Laplace transforms to solve problems in basic electrical circuits.
- Get familiar with network parameters and how to analyze simple two-port networks.
- Learn how to use Fourier series to analyze periodic waveforms and their effects on circuits.
- Understand the basics of designing and classifying different types of filters.

COURSE OUTCOMES:

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

- CO 1:** Apply the concepts of phase sequence, star and delta connections, and power measurement to analyze balanced and unbalanced three-phase circuits.
- CO 2:** Analyze transient responses of R-L, R-C, and R-L-C circuits using differential equations and Laplace transforms for both DC and sinusoidal excitations.
- CO 3:** Evaluate and convert various network parameters (impedance, admittance, hybrid, and transmission) and analyze two-port network interconnections.
- CO 4:** Apply Fourier series to analyze periodic waveforms in electrical circuits, determining effective and average values, power factor, and harmonic effects.
- CO 5:** Understand and design various types of filters (low pass, high pass, band pass, band elimination, and constant-k) for specific applications.

UNIT I:**(9 Periods)**

Analysis of three phase balanced circuits: Phase sequence, star and delta connection of sources and loads, relation between line and phase quantities, analysis of balanced three phase circuits, and measurement of active and reactive power.

Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT II:**(10 Periods)**

Laplace transforms – Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications.

Transient Analysis: Transient response of R-L, R-C and R-L-C circuits (Series and parallel combinations) for D.C. and sinusoidal excitations – Initial conditions - Solution using differential equation approach and Laplace transform approach.

UNIT III:**(9 Periods)**

Network Parameters: Impedance parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, conversion of Parameters from one form to other, Conditions for Reciprocity and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations- problems.

UNIT IV:**(9 Periods)**

Analysis of Electric Circuits with Periodic Excitation: Fourier series and evaluation of Fourier coefficients, Trigonometric and complex Fourier series for periodic waveforms, Application to Electrical Systems – Effective value and average value of non-sinusoidal periodic waveforms, power factor, effect of harmonics

UNIT V:**(8 Periods)**

Filters: Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass, Design of Filters.

Total Periods: 45

TEXT BOOKS:

1. William Hayt and Jack E. Kemmerly, Engineering Circuit Analysis, McGraw-Hill, 8th Edition, 2013
2. Charles K. Alexander, Mathew N. O. Sadiku, Fundamentals of Electric Circuits, Tata McGraw-Hill, 3rd Edition, 2019

REFERENCES:

1. M. E. Van Valkenburg, Network Analysis, PHI, 3rd Edition, 2019.
2. N. C. Jagan and C. Lakshmi Narayana, Network Theory, B.S. Publications, 1st Edition, 2012.
3. A. Sudhakar, Shyam Mohan S. Palli, Circuits and Networks Analysis and Synthesis, Tata Mc Graw-Hill ,5th Edition,2017.
4. Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha, Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks), Umesh Publications 2012.
5. A. Chakrabarti, Circuit Theory: Analysis and Synthesis, Dhanpat Rai and Co.,7th Revised Edition. 2018.

ONLINE RESOURCES:

1. <https://archive.nptel.ac.in/courses/117/106/117106108/>
2. <https://archive.nptel.ac.in/courses/108/105/108105159/>

II Year B.Tech. – I Semester

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(EE23APC303) DC MACHINES AND TRANSFORMERS LAB**Course Objectives:**

The objectives of this course are to:

- Conduct various experiments on the speed control techniques of DC motors
- Conduct various experiments on DC motors and DC Generators
- Conduct various experiments for testing on 1-phase transformers

Course Outcomes:

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

- CO 1:** Understand and analyze speed control techniques and efficiency of DC machines.
- CO 2:** Apply theoretical concepts to determine the performance characteristics of DC Machines
- CO 3:** Obtain the load characteristics of D.C. Generators
- CO 4:** Determine the performance parameters of single-phase transformer.
- CO 5:** Analyze the performance analysis of transformers using various tests

List of Experiments:

1. Speed control of DC shunt motor by Field Current and Armature Voltage Control.
2. Brake test on DC shunt motor- Determination of performance curves.
3. Swinburne's test - Predetermination of efficiencies as DC Generator and Motor.
4. Hopkinson's test on DC shunts Machines.
5. Load test on DC compound generator-Determination of characteristics.
6. Load test on DC shunt generator-Determination of characteristics.
7. Fields test on DC series machines-Determination of efficiency.
8. Brake test on DC compound motor-Determination of performance curves.
9. OC and SC tests on single phase transformer.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers.
12. Parallel operation of Single-phase Transformers.
13. Separation of core losses of a single-phase transformer.

Note: **Minimum of 10 experiments should be performed**

ONLINE RESOURCES:

1. <https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html>

II Year B.Tech. – I Semester

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**(EE23APC304) ELECTRICAL CIRCUIT ANALYSIS-II AND
SIMULATION LAB****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the various electric circuit concepts through circuit simulation using PSPICE software
- Know performance of RLC series and parallel circuits through simulation studies
- Know the analysis of 3-phase balanced and unbalanced circuits by simulation
- Know the different parameter calculation and study the transient of given network
- Evaluate the performance of theorems through circuit simulation using PSPICE software

COURSE OUTCOMES:

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

CO 1: Understand the power calculations in three phase circuits.

CO 2: Analyze the time response of given network.

CO 3: Determination of two port network parameters

CO 4: Simulate and analyze electrical circuits using software tools.

CO 5: Apply various theorems to solve different electrical networks using simulation tools

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Measurement of Active Power and Reactive Power for balanced loads.
2. Measurement of Active Power and Reactive Power for unbalanced loads.
3. Determination of Z and Y parameters.
4. Determination of ABCD and hybrid parameters
5. Verification of Kirchhoff's current law and voltage law using simulation tools.
6. Verification of mesh and nodal analysis using simulation tools.
7. Verification of super position and maximum power transfer theorems using simulation tools.
8. Verification of Reciprocity and Compensation theorems using simulation tools.
9. Verification of Thevenin's and Norton's theorems using simulation tools.
10. Verification of series and parallel resonance using simulation tools.
11. Simulation and analysis of transient response of RL, RC and RLC circuits.
12. Verification of self-inductance and mutual inductance by using simulation tools.

ONLINE RESOURCES:

1. <https://www.vlab.co.in/broad-area-electrical-engineering>

II Year B.Tech. – I Semester

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(CS23ASC301) DATA STRUCTURES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand fundamental data structures, arrays, and basic search/sort algorithms.
- Explore linked lists and their operations, comparing them with arrays.
- Learn about stacks, their implementation, and applications.
- Study queues, including circular queues and dequeues, and their applications.
- Introduce trees, focusing on binary trees and binary search trees.

COURSE OUTCOMES:

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

- CO 1:** Understand the role of data structures in organizing and accessing data.
- CO 2:** Design, implement and apply linked lists for dynamic data storage.
- CO 3:** Develop applications using stacks and queues.
- CO 4:** Design and implement algorithms for operations on binary trees and binary search trees.
- CO 5:** Design novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees.

UNIT I:

Introduction to Data Structures: Definition and importance of Data structures, Abstract data types (ADTs) and its specifications. Arrays: Introduction, 1-D, 2-D Arrays, accessing elements of array, Row Major and Column Major storage of Arrays. Searching Techniques: Linear & Binary Search. Sorting Techniques: Bubble sort, Selection sort, Quick sort.

Sample experiments:

1. Program to find min & max element in an array.
2. Program to implement matrix multiplication.
3. Find an element in given list of sorted elements in an array using Binary search.
4. Implement Selection and Quick sort techniques.

UNIT II:

Linked Lists: Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

Sample experiments:

1. Write a program to implement the following operations.
 - a. Insert b. Deletion c. Traversal
2. Write a program to store name, roll no, and marks of students in a class using circular double linked list.
3. Write a program to perform addition of given two polynomial expressions using linked list.

UNIT III:

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

Sample experiments:

1. Implement stack operations using
 - a. Arrays b. Linked list
2. Convert given infix expression into post fix expression using stacks.
3. Evaluate given post fix expression using stack.
4. Write a program to reverse given linked list using stack.

UNIT IV:

Queues: Introduction to queues: properties and operations, Circular queues, implementing queues using arrays and linked lists, Applications of queues scheduling, etc.

Deque: Introduction to deque (double-ended queues), Operations on deque and their applications.

Sample experiments:

1. Implement Queue operations using
 - a. Arrays b. Linked list
2. Implement Circular Queue using
 - a. Arrays b. Linked list
3. Implement Dequeue using linked list.

UNIT V:

Trees: Introduction to Trees, Binary trees and traversals, Binary Search Tree – Insertion, Deletion & Traversal.

Sample experiments:

1. Implement binary tree traversals using linked list.
2. Write program to create binary search tree for given list of integers. Perform in-order traversal of the tree. Implement insertion and deletion operations.

TEXT BOOKS:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C Pearson, 2nd Edition.
2. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures in C, Susan Anderson Freed, Silicon Press, 2008.

REFERENCES:

1. Kurt Mehlhorn and Peter Sanders, Algorithms and Data Structures: The Basic Toolbox, Springer, 2008.
2. Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft, Data Structures and Algorithms in C, Pearson, 1987.
3. Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures, Franklin, Beedle & Associates, 2005.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 4th Edition, 2022.
5. Robert Sedgewick, Algorithms in C, Parts 1–5: Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms, Addison-Wesley, 3rd Edition, 2001.

II Year B.Tech. – I Semester

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

The objectives of this course is:

- 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:

- a) Forest Ecosystem.
- b) Grassland Ecosystem
- c) Desert Ecosystem.
- d) 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. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, Universities Press, 3rd Edition, 2021.
2. K. Raghavan Nambiar, Textbook of Environmental Studies for Undergraduate Courses as per UGC Model Syllabus, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.

REFERENCES:

1. Palaniswamy, Environmental Studies, Pearson Education, 2nd Edition, 2014.
2. S. Azeem Unnisa, Environmental Studies, Academic Publishing Company.
3. A. Koushik and C. P. Koushik, Perspectives in Environmental Studies, New Age International, 4th Edition, 2006.
4. M. Anji Reddy, Textbook of Environmental Sciences and Technology, BS Publications, 2nd Edition, 2023.
5. J. P. Sharma, Comprehensive Environmental Studies, Laxmi Publications, 3rd Edition, 2009.
6. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Pvt. Ltd., 2nd Edition, 2004.
7. G. R. Chatwal, A Textbook of Environmental Studies, Himalaya Publishing House, 4th Edition, 2014.
8. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2007.

II Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(EC23AES401) ANALOG CIRCUITS**COURSE OBJECTIVES:**

The objectives of this course are to:

- List various types of feedback amplifiers, oscillators and large signal Amplifiers.
- Explain the operation of various electronic circuits and linear ICs.
- Apply various types of electronic circuits to solve engineering problems.
- Analyze various electronic circuits and regulated power supplies for proper understanding
- Design electronic circuits for a given specification

COURSE OUTCOMES:

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

- CO 1:** Analyze the working principles of clippers & clappers and understand the DC analysis of BJT for various parameters.
- CO 2:** Design and Analysis of amplifiers using h-parameter model and feedback amplifier circuits.
- CO 3:** Apply basic principle to solve the problems on oscillators based on specifications and understand the basic building blocks of operational amplifiers.
- CO 4:** Analyze and Design of various linear and non-linear applications of OP-AMP.
- CO 5:** Analyze special integrated circuits and understand the working principle of data converters.

UNIT I:**(9 Periods)**

Diode clipping and clamping circuits: Diode clippers, clipping at two independent levels, Transfer characteristics of clippers, clamping circuit operation.

DC biasing of BJTs: Load lines, Operating Point, Bias Stability, Collector-to-Base Bias, Self-Bias, Stabilization against Variations in V and β for the Self-Bias Circuit, Bias Compensation, Thermal Runaway, Thermal Stability.

UNIT II:**(10 Periods)**

Small Signals Modeling of BJT: Analysis of a Transistor Amplifier Circuit using h parameters, Simplified CE Hybrid Model, Analysis of CE, CC, CB Configuration using Approximate Model, Frequency Response of CE and CC amplifiers.

Feedback Amplifiers: Classification of Amplifiers, the Feedback Concept, General Characteristics of Negative-Feedback Amplifiers, Effect of Negative Feedback upon Output and Input Resistances, Voltage-Series Feedback, Current-Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback.

UNIT III:**(8 Periods)**

Oscillator Circuits: Barkhausen Criterion of oscillation, Oscillator operation, R-C phase shift oscillator, Wien bridge Oscillator, Crystal Oscillator.

Operational Amplifiers: Introduction, Basic information of Op-Amp, Ideal Operational Amplifier, Block Diagram Representation of Typical Op-Amp, OP-Amps Characteristics: Introduction, DC and AC characteristics, 741 op-amp & its features.

UNIT IV:**(8 Periods)**

OP-AMPS Applications: Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, Integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

UNIT V:**(10 Periods)**

Timers and Phase Locked Loop: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger, PLL block schematic, principles and

description of individual blocks, 565 PLL, Applications of VCO (566).

Digital to Analog and Analog To Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Total Periods: 45

TEXT BOOKS:

1. J. Millman, C.Halkias ,Electronic Devices and Circuits-, Tata Mc-Graw Hill, 2nd Edition, 2010.
2. D. Roy Choudhury, Linear Integrated Circuits, New Age International (p) Ltd, 2nd Edition, 2003.

REFERENCES:

1. Robert L.Boylestad and Lowis Nashelsky ,Electronic Devices and Circuit Theory, Pearson Edition, 2021.
2. G.K. Mithal, Electronic Devices and Circuits, Khanna Publisher, 23rd Edition, 2017.
3. David Bell, Electronic Devices and Circuits, Oxford, 5th Edition, 2008.
4. Malvino, Albert Paul, and David J. Bates, Electronic Principles, McGraw-Hill/Higher Education, 2007.
5. Gayakwad R.A, Operational Amplifiers and Linear Integrated Circuits, Prentice Hall India, 2002.
6. Sanjay Sharma Operational Amplifiers and Linear Integrated Circuits, Kataria & Sons, 2nd Edition, 2010.
7. Behzad Razavi, Design of Analog CMOS Integrated Circuits

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/122106025>.
2. <https://nptel.ac.in/courses/108102112>.

II Year B.Tech. – II Semester

L	T	P	C
2	-	-	2

(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, MGH, 4th Edition.

REFERENCES:

1. Ahuja Hl, Managerial Economics, Schand.
2. S.A.Siddiqui and A.S.Siddiqui, Managerial Economics and Financial Analysis, New Age International.
3. Joseph G. Nellis and David Parker, Principles of Business Economics, Pearson, 2nd 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. – II Semester

L	T	P	C
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(EE23APC401) 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 using differential equations and 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 data 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. Principle of operation of DC and AC Servo motor, Transfer function of DC servo motor - AC servo motor, Synchros.

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, P, PI, PID Controllers.

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 – Lag, Lead, Lag-Lead Compensator (Basics only).

UNIT V:**(9 periods)**

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, state models - 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., 5th Edition, 2010.
2. I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International (P) Limited Publishers, 5th edition, 2007.

REFERENCES:

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

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108102043>
2. <https://nptel.ac.in/courses/108106098>.

II Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(EE23APC402) INDUCTION AND SYNCHRONOUS MACHINES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of induction machines, know equivalent circuit performance characteristics.
- Understand the torque developed and methods of starting of Induction motors.
- Understand the methods of starting of single-phase motors.
- Understand the working operation of alternator and their EMF's, parallel operation of Alternators.
- Understand the principal operations and methods of starting of synchronous motors

COURSE OUTCOMES:

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

- CO 1:** Understand the construction, operation, and performance parameters of squirrel cage and slip ring induction motors.
- CO 2:** Analyze the performance characteristics and testing methods for 3-phase induction motors.
- CO 3:** Evaluate the operation and starting methods of single-phase induction motors.
- CO 4:** Apply knowledge of synchronous generators to analyze their performance and Voltage regulations and synchronization methods.
- CO 5:** Understand the principles, operation, and performance issues of synchronous motors.

UNIT I:**(10 Periods)**

3- Phase Induction Motors: Construction of Squirrel cage and Slipring induction motors– production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions– rotor power input, rotor copper loss and mechanical power developed and their inter-relationship – equivalent circuit – phasor diagram, Applications.

UNIT II:**(9 Periods)**

Performance of 3-Phase Induction Motors: Torque equation – expressions for maximum torque and starting torque – torque-slip characteristics – double cage and deep bar rotors – No load, Brake test and Blocked rotor tests – circle diagram for predetermination of performance- methods of starting –starting current and torque calculations -speed control of induction motor with V/f control method, rotor resistance control and rotor emf injection technique –crawling and cogging – induction generator operation.

UNIT III:**(8 Periods)**

Single Phase Motors: Single phase induction motors – constructional features – double revolving field theory, Cross field theory – equivalent circuit- starting methods: capacitor start capacitor run, capacitor start induction run, split phase and shaded pole, AC series motor, Applications.

UNIT IV:**(10 Periods)**

Synchronous Generator: Constructional features of non-salient and salient pole type alternators- armature windings – distributed and concentrated windings – distribution and pitch factors – E.M.F equation – armature reaction – voltage regulation by synchronous impedance method – MMF method and Potier triangle method –two reaction analysis of salient pole machines -methods of synchronization- Slip test – Parallel operation of alternators.

UNIT V:**(8 Periods)**

Synchronous Motor: Synchronous motor principle and theory of operation – Effect of excitation on current and power factor– synchronous condenser –expression for power

developed – hunting and its suppression – methods of starting, Applications.

Total Periods: 45

TEXT BOOKS:

1. Dr. P.S. Bhimbra, Electrical Machinery, Khanna Publishing, 1st Edition, 2021.
2. M.G. Say, Performance and analysis of AC machines, CBS, 2002.

REFERENCES:

1. D.P. Kothari and I.J. Nagrath, Electrical machines, McGraw Hill Education, 5th Edition, 2017.
2. J.B.Gupta, Theory and Performance of Electrical Machines, S.K.Kataria and Sons, 2007.
3. A.E.Fitzgerald, Charles kingsley, Stephen D.Umans, Electric Machinery, McGraw- Hill, 7th Edition, 2020.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108/105/108105131>
2. <https://nptel.ac.in/courses/108106072>

II Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(EE23APC403) POWER SYSTEMS-I**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the Concepts of Hydro and Thermal power generating stations.
- Understand the concepts of nuclear power stations.
- Understand the concepts about Different Substations
- Understand and compare Distribution Systems and Underground cables.
- Illustrate the economic aspects of power generation and tariff methods

COURSE OUTCOMES:

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

CO 1: Understand the Concepts of Hydro and Thermal Power plants.

CO 2: Apply knowledge of nuclear power plant components and types of reactors to the operation of nuclear power stations.

CO 3: Analyze the layouts and bus bar arrangements of air-insulated and gas-insulated substations, comparing their advantages and constructional aspects.

CO 4: Understand the concepts of distribution systems, underground cables

CO 5: Analyze various economic aspects related to power generation and distribution

UNIT I:**(9 Periods)**

Hydroelectric Power Stations: Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation

Thermal Power Stations: Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

UNIT II:**(9 Periods)**

Nuclear Power Stations: Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

UNIT III:**(9 Periods)**

Substations: Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the substations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams. Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, comparison of air insulated substations and gas insulated substations.

UNIT IV:**(10 Periods)**

Distribution Systems: Classification of Distribution systems, A.C Distribution, Overhead versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, Design considerations in Distribution system.

Underground Cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading

UNIT V: Economic Aspects & Tariff:**(8 Periods)**

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block rate, two-part, three-part, and power factor tariff methods, Time of Day (ToD) tariff and Time of Use (ToU) tariff.

Total Periods: 45

TEXT BOOKS:

1. S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010.
2. J. B. Gupta, Transmission and Distribution of Electrical Power, S. K. Kataria and sons, 10th Edition, 2012.

REFERENCES:

1. I.J.Nagarath & D.P. Kothari, Power System Engineering, McGraw-Hill Education, 3rd Edition, 2019.
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 6th Edition, 2018.
3. V. K. Mehta and Rohit Mehta, Principles of Power System, S. Chand, 4th Edition, 2005.
4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1985.
5. Handbook of switchgear, BHEL, McGraw-Hill Education, 2007.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108102047>

II Year B.Tech. – II Semester

L	T	P	C
1	-	2	2

(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, John Wiley & Sons, 2013.

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

II Year B.Tech. – II Semester

L	T	P	C
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(EE23APC404) CONTROL SYSTEMS LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Analyze the dynamic response and stability of control systems
- Understand the operational characteristics of Synchros, servo motors, and magnetic amplifiers.
- Apply feedback control strategies, including PID and compensator design, to enhance system performance.
- Implement and troubleshoot control logic and automation systems using PLCs.
- Utilize MATLAB for stability analysis and state-space modeling of control systems.

COURSE OUTCOMES:

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

- CO 1:** Analyze the time response and stability of second-order and linear time-invariant systems using MATLAB and theoretical methods
- CO 2:** Evaluate the characteristics and control mechanisms of Synchros, servo motors, and magnetic amplifiers
- CO 3:** Apply the effects of P, PD, PI, and PID controllers on second order system
- CO 4:** Apply PLCs to implement logic gates, Boolean expressions, and motor speed control in practical scenarios
- CO 5:** Model state-space representations, and perform comprehensive stability analysis using MATLAB tools.

List of Experiments:

Any 10 of the Following Experiments are to be conducted.

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order system
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Linear system analysis (Time domain analysis, Error analysis) using MATLAB.
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
13. State space model for classical transfer function using MATLAB – Verification.

ONLINE RESOURCES:

1. <https://www.vlab.co.in/broad-area-electrical-engineering>

II Year B.Tech. – II Semester

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(EE23APC405) INDUCTION AND SYNCHRONOUS MACHINES LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Evaluate the operation of three phase and single phase induction motor.
- Analyze the voltage regulation methods of alternator.
- Obtain the V and Inverted V curves of a three-phase synchronous motor.
- Evaluate the parallel operation of alternator.

COURSE OUTCOMES:

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

- CO 1:** Analyze various performance characteristics of 3-phase and 1-phase induction motors
- CO 2:** Evaluate the performance of 3-phase Induction Motor by obtaining the circle diagram and equivalent circuit of 3-phase Induction Motor and single phase induction motor
- CO 3:** Adapt the power factor improvement methods for single phase Induction Motor
- CO 4:** Pre-determine the regulation of 3-phase alternator
- CO 5:** Determine the synchronous machine reactance of 3-phase alternator

List of Experiments:

Any 10 experiments of the following are required to be conducted

1. Brake test on three phase Induction Motor.
2. Circle diagram of three phase induction motor.
3. Speed control of three phase induction motor by V/f method.
4. Equivalent circuit of single-phase induction motor.
5. Power factor improvement of single-phase induction motor by using capacitors.
6. Load test on single phase induction motor.
7. Regulation of a three -phase alternator by synchronous impedance and MMF methods.
8. Regulation of three-phase alternator by Potier triangle method.
9. V and Inverted V curves of a three-phase synchronous motor.
10. Determination of X_d , X_q and Regulation of a salient pole synchronous generator.
11. Determination of efficiency of three phase alternator by loading with three phase induction motor.
12. Parallel operation of three-phase alternator under no-load and load conditions.
13. Determination of efficiency of a single-phase AC series Motor by conducting Brake test.

ONLINE RESOURCES:

1. <https://em-coep.vlabs.ac.in/List%20of%20experiments.html>

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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

TEXT BOOKS:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press, 1st Edition, 2018
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, Pearson, 2nd Edition, 2024

REFERENCES:

1. Introduction to Programming Using Python, Y. Daniel Liang, Pearson 1st 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>

III Year B.Tech. – I Semester

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(CS23AES501) INTRODUCTION TO QUANTUM TECHNOLOGY AND APPLICATIONS**COURSE OBJECTIVES:**

The objectives of this 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:

- CO 1:** Explain core quantum principles in a non-mathematical manner.
- CO 2:** Compare classical and quantum information systems.
- CO 3:** Identify theoretical issues in building quantum computers.
- CO 4:** Discuss quantum communication and computing concepts.
- CO 5:** 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, PsiQuantum, 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, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.

REFERENCES:

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

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

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(EC23APC503) DIGITAL CIRCUITS**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:

At the end of this course, the 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 de-multiplexer (74x155), comparator (74x85).

Total Periods:45**TEXT BOOKS:**

1. M.Morris Mano & Michel D. Ciletti, Digital Design, Pearson Education, 5th Edition, 1999.
2. Zvi Kohavi and Nirah K.Jha, Switching theory and Finite Automata Theory, Tata McGraw Hill, 2nd Edition, 2005.

REFERENCES:

1. Charles H Roth,Jr., Fundamentals of Logic Design, Brooks/cole Cengage Learning, 5th Edition, 2004.

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(EE23APC501) POWER ELECTRONICS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the differences between signal level and power level devices.
- Analyze controlled Rectifier Circuits.
- Analyze the operation of DC-DC choppers.
- Analyze the operation of Voltage Source Inverters.
- Analyze the operation of AC Voltage Controllers and Cycloconverters.

COURSE OUTCOMES:

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

- CO 1:** Understand the I-V Characteristics and Gate Drive Requirements of Power Devices Including Diodes, Thyristors, MOSFETs, and IGBTs
- CO 2:** Design Single-Phase and Three-Phase Rectifiers with Different Load Conditions and Evaluate Power Factor and Source Inductance Effects
- CO 3:** Apply Duty Ratio Control and Analyze Steady-State Waveforms of Buck, Boost, and Buck- Boost Converters.
- CO 4:** Analyze the Operation of Inverters with Various Load Conditions and Commutation Techniques.
- CO 5:** Evaluate the Operation of AC Voltage Controllers, Cycloconverters.

UNIT I:**(8 Periods)**

Power Switching Devices: Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO. Introduction to Gallium Nitride and Silicon Carbide Devices.

UNIT II:**(10 Periods)**

Rectifiers: Introduction to Single-phase half-wave and full-wave rectifiers, Single-phase half-wave and full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape, power factor and effect of source inductance; Analysis of rectifiers with filter capacitance, Dual Converter –Applications –Numerical problems.

UNIT III:**(8 Periods)**

DC-DC Converters: Elementary chopper with an active switch and diode, concepts of duty ratio, control strategies and average output voltage: Power circuit, analysis and waveforms at steady state, duty ratio control and average output voltage of Buck, Boost and Buck- Boost Converters, applications.

UNIT IV:**(9 Periods)**

Inverters: Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters – Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180-degree mode – 120-degree mode of operation –Applications –Numerical problems.

UNIT V:**(10 Periods)**

AC Voltage Controllers: Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With R and RL loads – modes of operation of TRIAC – TRIAC with R and RL loads – RMS load voltage, current and power factor - wave forms –Applications – Numerical problems.

Cycloconverters: Midpoint and Bridge connections - Single phase to single phase step-up and step-down Cycloconverters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation–Applications.

Total Periods: 45

TEXT BOOKS:

1. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, Prentice Hall of India, 2nd Edition, 1998.
2. P.S. Bimbhra, Power Electronics, Khanna Publishers, 4th Edition, 2010.

REFERENCES:

1. Ned Mohan, Power Electronics, Wiley, 2011.
2. M. D. Singh & K. B. Kanchandhani, Power Electronics, Tata Mc Graw Hill Publishing Company, 1998.
3. Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Kluwer Academic Publishers, 2nd Edition, 2004.
4. Vedam Subramanyam, Power Electronics, New Age International (P) Limited, 1996.
5. V. R. Murthy, Power Electronics, Oxford University Press, 1st Edition, 2005.
6. P. C. Sen, Power Electronics, Tata Mc Graw-Hill Education, 1987.
7. J. M. D. Murphy Power Electronic Control of Alternating Current Motors.

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(EE23APC502) POWER SYSTEMS - II**COURSE OBJECTIVES:**

The objectives of this course are to:

- Study about line parameters and constants
- Study the performance of transmission lines
- Know about overhead line insulators, corona, sag and tension in transmission lines
- Analyze power system transients and travelling waves using reflection, refraction.
- Understand the concept of voltage control, compensation methods

COURSE OUTCOMES:

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

- CO 1:** Determine transmission line parameters such as resistance, inductance, and capacitance for various conductor configurations, considering GMR, GMD, transposition, skin and proximity effects.
- CO 2:** Evaluate the performance of short, medium, and long transmission lines using appropriate models and calculate voltage regulation and efficiency.
- CO 3:** Analyze the performance of overhead line insulators, sag and tension in conductors, and corona losses with respect to operational and environmental conditions.
- CO 4:** Analyze the behaviour of travelling waves in power systems under various line terminations using reflection, refraction, and attenuation concepts.
- CO 5:** Explain voltage control methods and power factor improvement techniques, and examine compensation methods in transmission lines.

UNIT I:**(10 Periods)**

Transmission Line Parameters: Types of Conductors - Calculation of Resistance for Solid Conductors, Bundle Conductors, Skin effect, Proximity effect, Concept of GMR & GMD- Transposition of Power lines- Calculation of inductance for single phase and three phase, Single and Double circuit lines, Symmetrical and asymmetrical conductor configurations with and without transposition. Capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, effect of ground on Capacitance, Numerical Problems

UNIT II:**(8 Periods)**

Performance of Transmission Lines: Classification of Transmission Lines-Short, medium and long line and their models representation - Nominal-T, Nominal- π and A, B, C, D Constants for symmetrical networks, Numerical Problems for estimating regulation and efficiency of all types of lines, Ferranti effect and Charging Current.

UNIT III:**10 Periods)**

Overhead Line Insulators: Types of Insulators, String efficiency and Methods for improvement – Voltage Distribution, Calculation of String efficiency, Capacitance Grading and Static Shielding, Numerical Problems.

Sag and Tension: Sag and Tension Calculations with equal and unequal heights of towers, Effect of wind and ice on weight of conductor, Stringing chart, Sag template and its applications, Numerical Problems.

Corona: Corona- factors affecting corona, critical voltages and Power loss due to Corona. Radio Interference.

UNIT IV:**(9 Periods)**

Power System Transients and Travelling Waves: Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of Lines with Different Types of Conditions - Open Circuited Line, Short Circuited Line, T-Junction, Numerical Problems.

UNIT V: (8 Periods)

Voltage Control and Power Factor Improvement: Methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers, power factor improvement methods.

Compensation in Power Systems: Concepts of Load Compensation Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load – Compensation of lines.

Total Periods: 45**TEXT BOOKS:**

1. C.L. Wadhwa, Electrical Power Systems , New Age International Pub. Co, 3rd Edition, 2001.
2. D.P. Kothari and I.J. Nagrath, Modern Power System Analysis , Tata Mc Graw Hill Pub. Co.,New Delhi, 4th Edition, 2011.

REFERENCES:

1. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, A Text book on Power System Engineering , Dhanpat Rai Publishing Company (P) Ltd, 2008.
2. B.R.Gupta,—Power System Analysis and Design , S.ChandPublishing.1998.
3. John J. Grainger & W.D. Stevenson, Power System Analysis , Mc Graw Hill International,1994.
4. Hadi Sadat, Power System Analysis, Tata Mc Graw Hill Pub. Co. 2002.
5. W.D. Stevenson, Elements of Power System Analysis, McGraw Hill International Student Edition.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee17/preview

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(EE23APE501) ELECTRICAL SAFETY AND RISK MANAGEMENT**(Professional Elective - I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand electrical hazards, shocks, and preventive safety measures.
- Learn safety practices during installation of electrical equipment and plants.
- Apply safety standards in residential, commercial, and agricultural installations.
- Explore electrical safety measures in hazardous areas and earthing systems.
- Explain about electrical systems safety management and IE rules.

COURSE OUTCOMES:

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

- CO 1:** Explain the principles of electrical safety, types of shocks, and preventive measures in residential and commercial spaces.
- CO 2:** Apply safety procedures and use personal protective equipment during installation of electrical plants and rotating machines.
- CO 3:** Demonstrate safe electrical practices in residential, commercial, and agricultural installations.
- CO 4:** Analyze safety standards and protection methods for electrical equipment in hazardous areas, including equipment and system earthing.
- CO 5:** Demonstrate the electrical systems safety management and IE rules.

UNIT I:**(10 Periods)**

Introduction to Electrical Safety, Shocks and Their Prevention: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT II:**(10 Periods)**

Safety During Installation of Plant and Equipment: Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT III:**(8 Periods)**

Electrical Safety in Residential, Commercial and Agricultural Installations: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT IV:**(9 Periods)**

Electrical Safety in Hazardous Areas: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

Equipment Earthing and System Neutral Earthing: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement

of earthing system, description of an earthing system, neutral grounding (System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

UNIT V:

(8 Periods)

Safety Management of Electrical Systems: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

Review of IE Rules and Acts and Their Significance: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility.

The Electricity Act, 2003, (Part1, 2, 3,4 & 5)

Total Periods: 45

TEXT BOOKS:

1. S. Rao, Prof. H.L. Saluja, Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers. New Delhi, 1988.
2. Pradeep Chaturvedi, Energy Management Policy, Planning and Utilization, Concept Publishing Company, New Delhi, 1997.

REFERENCES:

1. www.apeasternpower.com/downloads/elecact2003.

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(EC23APE505) SIGNALS AND SYSTEMS**(Professional Elective - I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic properties of signal & systems and LTI systems.
- Learn Fourier series representation of periodic signals.
- Study representation of signals in continuous and discrete time Fourier transform
- Analyze the sampling theorem and characterize signals & systems in time & frequency domain.
- Apply Laplace transform and Z transform to study about the stability of systems.

COURSE OUTCOMES:

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

CO 1: Explain the basic properties of signal & systems and LTI systems.

CO 2: Apply Fourier series to represent periodic signals.

CO 3: Represent signals in continuous and discrete time Fourier transform.

CO 4: Analyze the sampling theorem and characterize signals & systems in time & frequency domain.

CO 5: Analyze the stability of systems by applying Laplace transform and Z transform.

UNIT I:**(9 Periods)**

Signals and Systems: Continuous and Discrete Time Signals, Transformations of the Independent Variable, Elementary Signals-Unit Impulse, Unit Step Functions, Ramp Signal, Rectangular function, Signum Function, Sinc & Sa Function, Exponential and Sinusoidal Signals, Classification of Signals & Systems, Continuous and Discrete Time Systems, Basic System Properties, Linear Time Invariant (LTI) Systems, Discrete-Time LTI Systems, Convolution Sum, Continuous Time LTI Systems, Convolution Integral, Properties of LTI Systems, Causal LTI Systems described by Differential and Difference Equations, Singularity Functions.

UNIT II:**(9 Periods)**

Fourier series representation of periodic signals: Response of LTI Systems to Complex Exponentials. Fourier Series Representation of Continuous Time Periodic Signals, Trigonometric, Polar, Exponential Fourier Series & related problems, Convergence of the Fourier Series, Properties of Continuous Time Fourier Series, Fourier Series Representation of Discrete Time Periodic Signals, Properties of Discrete Time Fourier Series, Fourier Series and LTI Systems, B.Tech.

UNIT III:**(9 Periods)**

The Continuous-Time Fourier Transform: Representation of aperiodic Signals, Continuous Time Fourier Transform, Fourier Transform for Periodic Signals, Properties of the Continuous Time Fourier Transform, Systems characterized by Linear constant coefficient differential equations, Discrete Time Fourier Transform - Representation of Aperiodic Signals, Discrete Time Fourier Transform, Frequency Response, Systems Characterized by Linear Constant-Coefficient Difference Equations.

UNIT IV:**(9 Periods)**

Time & Frequency Characterization of Signals and Systems: The Magnitude Phase Representation of the Fourier Transform, Magnitude Phase Representation of the Frequency Response of LTI Systems, Time-Domain Properties of Ideal Frequency Selective Filters, Time Domain and Frequency Domain Aspects of Non-ideal Filters, Examples of Continuous time filters and Discrete time filters described by differential equations, First-Order and Second-Order Continuous and Discrete-Time Systems, Examples of Time and Frequency Domain Analysis of Systems, Sampling: Representation of a Continuous Time Signal by Its Samples,

Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation, Effect of under sampling: Aliasing, Discrete Time Processing of Continuous-Time Signals.

UNIT V:**(9 Periods)**

Laplace and Z-Transforms: The Laplace Transform, Region of Convergence for Laplace Transforms, Inverse Laplace Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform, System Function Algebra and Block Diagram Representations, Unilateral Laplace Transform, Z-Transform - Region of Convergence for the z-Transform, Inverse z-Transform, Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot, Properties of the z-Transform, Some Common z-Transform Pairs, Analysis and Characterization of LTI Systems Using z-Transforms, System Function Algebra and Block Diagram Representations, Unilateral z-Transforms.

Total Periods: 45**TEXT BOOKS:**

1. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid, Signals and Systems, Pearson Higher Education, 2nd Edition, 1997.
2. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2011.

REFERENCES:

1. Simon Haykin and B. Van Veen, Signals & Systems, John Wiley, 2nd Edition, 2003.
2. Narayana Iyer and K Satya Prasad, Signals and systems, CENGAGE Learning, 1st Edition, 2011.
3. C. L. Philips, J. M. Parr and Eve A. Riskin, Signals, Systems and Transforms, Pearson education, 4th Edition, 2008.

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(EE23APE502) UTILIZATION OF ELECTRICAL ENERGY**(Professional Elective - I)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Explain the types, characteristics, and applications of electric drives and industrial loads.
- Introduce electric heating and welding techniques along with their advantages and applications.
- Impart knowledge on lighting systems, sources of light, illumination laws, and design of efficient lighting.
- Describe electric traction systems, speed-time characteristics, braking methods, and new traction technologies.
- Explore the principles and applications of electrolysis, metal deposition, and modern electrochemical technologies like fuel cells.

COURSE OUTCOMES:

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

- CO 1:** Apply illumination laws and design efficient lighting systems using appropriate light sources and controls.
- CO 2:** Compare various electric heating and welding methods and identify suitable applications in industries.
- CO 3:** Describe electrolytic processes, deposition methods, and illustrate applications in refining and energy systems like fuel cells.
- CO 4:** Explain the selection and characteristics of electric drives for continuous, intermittent, and variable load applications.
- CO 5:** Analyze electric traction systems, braking techniques, and summarize developments like magnetic levitation.

UNIT I:**(10 Periods)**

Illumination: Introduction - terms used in illumination - laws of illumination - sources of light. Discharge lamps- mercury vapour and sodium vapour lamps-comparison between tungsten filament lamps and fluorescent tubes-compact fluorescent lamp-LED-Basic principles of light Control-Types and design of good lighting system and practice - flood lighting.

UNIT II:**(10 Periods)**

Electric Heating: Introduction, Advantages and methods of electric heating - resistance heating - induction heating and dielectric heating.

Electric welding: Classification- resistance and arc welding - electric welding equipment - comparison between AC and DC Welding.

UNIT III:**(8 Periods)**

Electrolytic Process: Introduction - Basic principles - Faradays laws of electrolysis - Energy efficiency - Electro deposition -Factors governing deposition Processes - Deposition of Alloys - Extraction and refining of metals. Fuel Cells.

UNIT IV:**(9 Periods)**

Electric Drives: Type of electric drives - rating and choice of motor - starting and running characteristics - particular applications of electric drives - types of industrial loads - Continuous - intermittent and variable loads.

UNIT V:**(8 Periods)**

Electric Traction: Traction systems: System of electric traction and track electrification - Review of existing electric traction systems in India - Special features of traction motor - Speed-time curves for different services - methods of electric braking - plugging - rheostatic braking - regenerative braking. Introduction to Magnetic Levitation vehicles.

Total Periods: 45**TEXT BOOKS:**

1. C.L Wadhwa, Generation Distribution and Utilization of Electrical Energy, New age International Publishers, 2007.
2. J. B. Gupta, Utilization of Electrical Power and Electric Traction, S. K. Kataria and sons, 2002

REFERENCES:

1. Partab (2007), Art & Science of Utilization of electrical Energy, 2nd Edition, Dhanpat Rai & Sons, New Delhi.
2. G. C. Garg (2005), Utilization of Electrical Power & Electric traction, Khanna publishers, New Delhi, 8th Edition.
3. N. V. Suryanarayana, Utilization of Electrical Power including Electric drives and Electric traction, New Age International (P) Limited, Publishers, 1996.
4. E.Openshaw Taylor, Utilization of Electric Energy, Orient Longman,1971.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108105060>
2. <https://nptel.ac.in/courses/112105221>
3. https://vssut.ac.in/lecture_notes/lecture1426861925.pdf
4. <https://vpmpee.wordpress.com/uee-3340903/>

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(EE23APC503) POWER ELECTRONICS AND SIMULATION LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the characteristics of SCR, MOSFET, and IGBT.
- Design and analyze SCR triggering and commutation circuits.
- Evaluate single-phase and three-phase converters with R and RL loads.
- Analyze AC-AC converters, inverters, choppers, and Cycloconverters.
- Develop skills to implement and troubleshoot power electronic circuits.

COURSE OUTCOMES:

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

- CO 1:** Identify and interpret the characteristics of power semiconductor devices (SCR, MOSFET, IGBT) and their significance in power electronic circuits.
- CO 2:** Demonstrate the working of triggering and commutation techniques in SCR-based circuits.
- CO 3:** Analyze the performance of AC-DC converters and AC voltage controllers with R and RL loads under various conditions.
- CO 4:** Implement and analyze the operation of DC choppers and inverters with different types of loads.
- CO 5:** Design and simulate advanced converter configurations like Cycloconverters and dual converters and evaluate their performance under RL load.

List of Experiments:

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. Gate firing circuits for SCR's: (a) R triggering (b) R-C triggering.
3. Single Phase AC Voltage Controller with R and RL Loads
4. Single Phase fully controlled bridge converter with R and RL loads
5. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E).
6. DC Jones chopper with R and RL Loads
7. Single Phase Parallel inverter with R and RL loads.
8. Single Phase Cycloconverter with R and RL loads.
9. Single Phase Half controlled converter with R and RL load.
10. Single Phase Fully controlled converter with R and RL load.
11. Three Phase half-controlled bridge converter with R, RL-load.
12. Three Phase fully controlled bridge converter with R, RL-load.
13. Single Phase series inverter with R and RL loads.
14. Single Phase Bridge converter with R and RL loads.
15. Single Phase Dual converter with RL loads

Note: Minimum of 10 experiments should be performed

TEXT BOOKS:

1. O.P. Arora, Power Electronics Laboratory: Theory, Practice and Organization (Narosa series in Power and Energy Systems), Alpha Science International Ltd., 2007.
2. M. H. Rashid, Simulation of Electric and Electronic circuits using PSPICE, M/s PHI Publications.

REFERENCES:

1. PSPICE A/D User Manual – Microsim, USA.
2. PSPICE Reference Guide – Microsim, USA.
3. MATLAB and its Tool Books User Manual and – Math works, USA.

ONLINE RESOURCES:

1. http://vlabs.iitb.ac.in/vlabs-v/labs/mit_bootcamp/power_electronics/labs/index.php

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(EC23APC505) ANALOG AND DIGITAL CIRCUITS LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Study the characteristics and applications of semiconductor diodes and transistors.
- Design and analyze rectifiers, amplifiers, and oscillator circuits.
- Implement basic Op-Amp applications. and implement combinational and sequential logic circuits.
- Utilize universal gates for logic circuit realization and clock generation.
- Design and implement essential digital components like adders, multiplexers, flip-flops, encoders, and decoders.

COURSE OUTCOMES:

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

- CO 1:** Interpret the characteristics of diodes and transistors for circuit design.
- CO 2:** Construct and evaluate rectifiers, amplifiers, and oscillator circuits.
- CO 3:** Implement basic Op-Amp applications, combinational and sequential circuits using logic gates.
- CO 4:** Design digital systems using universal gates, multiplexers, and comparators.
- CO 5:** Develop and realize fundamental digital components such as adders, converters, flip-flops, encoders, and decoders.

ANALOG CIRCUITS

List of Experiments: (Any 06 Experiments are to be conducted)

1. CB Characteristics
2. CE Characteristics
3. CE Amplifier
4. CC Amplifier
5. Clippers
6. Clampers
7. Hartley & Colpitt's Oscillators.
8. RC Phase shift oscillator
9. Astable multivibrator
10. Monostable multivibrator
11. A to D Convertor
12. D to A Convertor
13. Op-Amp Applications-Adder, subtractor, comparator.

DIGITAL CIRCUITS

List of Experiments: (Any 6 Experiments are to be conducted)

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Generation of clock using NAND / NOR gates
4. Design a 4 – bit Adder / Subtractor
5. Design and realization of a 4 – bit Gray to Binary and Binary to Gray Converter
6. Design and realization of 8x1 MUX using 2x1 MUX
7. Design and realization of 4 bit comparator
8. Design and realization of Flip-Flops.
9. Design and realization of Encoders.
10. Design and realization of Decoders.
11. Design and realization of Comparator.

ONLINE RESOURCES:

1. <https://www.vlab.co.in/broad-area-electronics-and-communications>

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

The objectives 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.

TEXTBOOKS:

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

REFERENCES:

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

ONLINE RESOURCES:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCyvXh0E_y-bOO1_q
2. 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.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/>
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

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(EE23ACS501) COMMUNITY SERVICE PROJECT**Experiential learning through community engagement****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.

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.

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 programmes 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.

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(EE23APC601) ELECTRICAL MEASUREMENTS AND INSTRUMENTATION**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand measurement fundamentals, types of indicating instruments, and error analysis.
- Learn the principles of power, energy, frequency and power factor measurement using electromechanical instruments.
- Apply various bridge circuits for measuring resistance, inductance, and capacitance.
- Study digital voltmeters and various types of transducers for electrical measurements.
- Explore modern transducers and micro-sensors.

COURSE OUTCOMES:

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

- CO 1:** Explain the characteristics of measuring instruments and analyze errors in electrical measurements.
- CO 2:** Measure power, energy, power factor, and frequency using conventional instruments
- CO 3:** Apply DC and AC bridges to determine unknown electrical quantities.
- CO 4:** Differentiate between types of digital voltmeters and the working of CRO.
- CO 5:** Illustrate the working of sensor and transducers used in industrial automation.

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

Fundamentals: True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold); Error Analysis- Simple problems; Statistical treatment of data-Simple problems.

Indicating Instruments: Three forces in Electromechanical indicating instrument (Deflecting, controlling & damping forces); Moving iron type (attraction and repulsion), PMMC: Torque equation (Expression only, no derivation), shape of scale – simple problems on torque equations; Measurement of voltage and current - Extension of Range of ammeter and voltmeter – problems on extension of range of ammeter and voltmeter.

UNIT II: Measurement of Power, Power Factor, Frequency and Energy (9 Periods)

Measurement of power: Principle and Operation of Single-phase dynamometer wattmeter, expression (Expression only no derivation) for deflecting and control torques, errors and compensations.

Measurement of power factor: Principle and operation of Single-phase Electro-dynamometer Power factor meter.

Measurement of Frequency: Principle and Operation of single phase frequency meter-vibrating reed type, - Ferro dynamic type meter.

Measurement of Energy: Principle and Operation of Single phase induction type energy meter, driving and braking torques (expression only no derivation), errors and compensations, testing by phantom loading.

UNIT III: D.C and A.C Bridges**(9 Periods)**

Measurement of Resistance: Methods of measuring low, medium and high resistances – Sensitivity of Wheatstone's bridge– Kelvin's double bridge for Measuring low resistance, Megger for measurement of high resistance.

Measurement of Inductance: - Maxwell's bridge, Anderson's bridge.

Measurement of Capacitance: De Sauty bridge. Wien's bridge–Schering bridge–Numerical problems.

UNIT IV: Digital Volt Meters and CRO**(8 Periods)**

Digital Voltmeters: Ramp type, Dual Slope integrating type, successive approximation, Potentiometric type DVMs.

Cathode Ray Oscilloscope: Cathode Ray Tube-Time Base Generator-Horizontal and Vertical Amplifiers – Applications of CRO – Measurement of Phase, Frequency, Current and Voltage-Lissajous Patterns.

UNIT V:**(9 Periods)**

Transducers and Sensors: Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle Operation of Resistor, Inductor and Capacitive Transducers; LVDT and its Applications, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, Piezo Electric Transducers, Photo electric Transducers, Hall effect, Photo Diodes. Optocoupler

Silicon based micro sensors: Pressure sensor, Gyro sensor, Accelerometer, Flow sensor, Proximity sensor, Temperature sensor, Humidity sensor. (Elementary treatment only)

Total Periods: 45**TEXT BOOKS:**

1. A.K. Sawhney, Electrical & Electronic Measurement & Instruments, Dhanpat Rai & Co. Publications, 2007.
2. E.W.Golding and F.C. Widdis, Electrical Measurements and measuring Instruments, Reem Publications, 5th Edition, 2011.

REFERENCES:

1. H.S.Kalsi, Electronic Instrumentation Tata Mcgrawhill, 3rd Edition, 2011.
2. Reissl and, M.U, Electrical Measurements: Fundamentals, Concepts, Applications, New Age International (P) Limited, 2010.
3. R.K.Rajput, Electrical & Electronic Measurement & Instrumentation, S. Chand & Co., 2nd Edition, 2013.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee112/preview

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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, 3rd Edition, 1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, McGraw Hill Education, 3rd Edition, 2017.

REFERENCES:

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, Penram International Publishing, 6th Edition, 2013.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson, 2nd Edition, 2012.
3. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, 3rd Edition, 2004.

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(EE23APC602) POWER SYSTEM ANALYSIS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand per-unit system and form Y_{Bus} using graph theory.
- Form and modify Z_{Bus} for network changes.
- Analyze power flow using GS, NR, and FDLF methods.
- Perform symmetrical and unsymmetrical fault analysis.
- Assess system stability using swing equation and equal area criterion.

COURSE OUTCOMES:

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

- CO 1:** Analyze the concepts of per unit system, determine the Y_{Bus} of a given power system network.
- CO 2:** Evaluate the Z_{Bus} of a given power system network.
- CO 3:** Illustrate the load flow studies on a given power system network using GS, NR, and FDLF methods.
- CO 4:** Demonstrate the concepts of fault analysis, symmetrical component theory, and the application of series reactor.
- CO 5:** Analyze the concept of steady-state stability and transient stability of power system networks.

UNIT I:**(9 Periods)**

Per-Unit System and Y_{Bus} Formation: Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, Y_{Bus} formation by Direct and Singular Transformation Methods, Applications, Numerical Problems.

UNIT II:**(8 Periods)**

Formation of Z_{Bus} : Partial network, Algorithm for the Modification of Z_{Bus} Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old buses - Modification of Z_{Bus} for the changes in network, Applications.

UNIT III:**(9 Periods)**

Power Flow Analysis: Static load flow equations – Load flow solutions using Gauss Seidel Method: Algorithm and Flowchart. Acceleration Factor, Load flow Solution for Simple Power Systems (Max. 3-Buses): Newton Raphson Method in Polar Co-Ordinates Form: Load Flow Solution- Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods- Comparison of Different Methods, Applications.

UNIT IV:**(10 Periods)**

Short Circuit Studies: Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory: Positive, Negative and Zero sequence components, Positive, Negative and Zero Sequence Networks. Symmetrical Fault Analysis: LLLG faults with and without fault impedance, Unsymmetrical Fault Analysis: LG, LL and LLG faults with and without fault impedance, Applications, Numerical Problems.

UNIT V:**(9 Periods)**

Stability Analysis: Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers, Applications.

Total Periods: 45

TEXT BOOKS:

1. G.W.Stagg and A.H.El-Abiad, Computer Methods in Power System Analysis, McGraw-Hill, 2006.
2. I.J.Nagrath, D.P.Kothari, Modern Power system Analysis, Tata McGraw-Hill Publishing Company, 4th Edition, 2011.

REFERENCES:

1. Grainger and Stevenson, Power System Analysis, McGraw Hill, 1994.
2. Hadi Saadat, Power System Analysis, McGraw Hill, 1998.
3. B.R.Gupta, Power System Analysis and Design, S. Chand & Company, 2005.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee120/preview

III Year B.Tech. – II Semester

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(EE23APE601) AI AND ML FOR ELECTRICAL ENGINEERING**(Professional Elective - II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce symbolic reasoning, rule-based systems, and expert systems in AI.
- Explore machine learning techniques and address underfitting and overfitting.
- Understand neural network models and their learning mechanisms.
- Examine fuzzy logic systems and controller design using fuzzy inference.
- Apply AI/ML techniques to electrical engineering problems like load forecasting and motor control.

COURSE OUTCOMES:

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

- CO 1:** Explain the foundational concepts, architectures, and reasoning approaches in Artificial Intelligence.
- CO 2:** Differentiate between supervised, unsupervised, and reinforcement learning techniques and apply pre-processing methods for machine learning models.
- CO 3:** Construct neural network models such as perceptron, ADALINE, and back propagation networks for classification tasks.
- CO 4:** Design a fuzzy logic controller using fuzzification, rule base, and defuzzification for control applications.
- CO 5:** Apply AI techniques for load flow analysis, economic dispatch, and speed control of electrical machines.

UNIT I:**(8 Periods)**

Introduction to Artificial Intelligence: Introduction and motivation - Approaches to AI - Architectures of AI - Symbolic Reasoning System - Rule based Systems - Knowledge Representation - Expert Systems.

UNIT II:**(10 Periods)**

Overview of Machine Learning: The Motivation & Applications of Machine Learning: Learning Associations, Classification, Regression; Supervised Learning; Unsupervised Learning; Reinforcement Learning; Gradient Descent: Batch Gradient Descent, Stochastic Gradient Descent; Data pre-processing; Under fitting and Overfitting issues

UNIT III:**(10 Periods)**

Artificial Neural Networks: Basics of ANN - Comparison between Artificial and Biological Neural Networks - Basic Building Blocks of ANN - Artificial Neural Network Terminologies - McCulloch Pitts Neuron Model - Learning Rules - ADALINE and MADALINE Models - Perceptron Networks (Continuous and Discrete) – Perceptron Convergence Theorem - Back Propagation Neural Networks - Associative Memories – BAM and Hopfield networks.

UNIT IV:**(9 Periods)**

Fuzzy Logic: Classical Sets - Fuzzy Sets - Fuzzy Properties, Operations and relations - Membership Functions - Fuzzy Logic Controller Design - Fuzzification methods - Fuzzy Rule base – Defuzzification methods.

UNIT V:**(8 Periods)**

Applications of AI Techniques: Load forecasting, Load flow studies, Economic load dispatch, Speed control of DC Motor, Speed Control of Induction Motors.

Total Periods: 45

TEXT BOOKS:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, Introduction to Neural Networks using MATLAB, McGraw Hill, 2006.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, WILEY India Edition, 3rd Edition, 2012.

REFERENCES:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, Introduction to Fuzzy Logic using MATLAB, Springer International Edition, 2013.
2. Yung C. Shin and Chengying Xu, Intelligent System, Modelling, Optimization & Control, CRC Press, 2009.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 3rd Edition, 2014
4. Russell. S and Norvig. P, Artificial Intelligence - A Modern Approach, Pearson, 4th Edition, 2022
5. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

III Year B.Tech. – II Semester

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(EE23APE602) PROGRAMMABLE LOGIC CONTROLLERS**(Professional Elective - II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamentals of PLCs, their types, components, and differences from traditional relay systems.
- Familiarize students with Easy Veep software, PLC documentation, binary logic, and industrial communication interfaces.
- Enable the design and development of PLC programs using instructions, counters, timers, and advanced functions.
- Impart knowledge on PLC programming logic, hardware configurations, and integration with control systems.
- Explore real-time industrial applications of PLCs in various domains such as manufacturing, packaging, and process industries.

COURSE OUTCOMES:

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

- CO 1:** Describe the architecture, types, and functions of various PLCs including Allen-Bradley and Mitsubishi series.
- CO 2:** Interpret PLC documentation, binary operations, and software tools to establish PC-PLC-HMI communication.
- CO 3:** Develop PLC-based programs using logic instructions, counters, timers, and advanced control functions.
- CO 4:** Implement PLC programming for specific applications including VFDs, robotic arms, and subroutine-based logic.
- CO 5:** Analyze real-time industrial processes and apply troubleshooting techniques using PLCs for control and automation.

UNIT I:**(8 Periods)**

Introduction to PLCs: Basic functions of PLCs, Mechanical relays versus PLC, Different types of PLC's – Allen-Bradley – Micrologix: ML1000, ML1100, SLC500, Compact Logix, Mitsubishi FX series, HMI's, Processor and I/O cards

UNIT II:**(10 Periods)**

PLC Computational Tool: Introduction to Easy Veep software, Link between mechanical, electrical and programming documentation, Logic diagrams, Flip-Flop Logic, M8000, M8001 internal bits interpretation, Binary code, data table, manipulation and search engine in Mitsubishi environment Communication between PC and PLC, Communication between PC and HMI, PLC and HMI Serial Local network, Introduction to SLC500.

UNIT III:**(11 Periods)**

PLC Development: PLC software and applications, Boolean algebra – understanding binary code, ADD and SUB functions, UP and Down Counters, Introduction to k1Y0, MOV function, CPR and ZCP functions, SHWT and SHRD instructions, Introduction to Absolutely Drum Instruction. Allen Bradley PLC: Introduction to Rockwell Software, Hardware focus, Hardware considerations (Field wiring, Master Control Relay, VFD), Basic programming and applications, Cascade control – subroutine, Different program.

UNIT IV:**(8 Periods)**

PLC Programming: Programming instructions: Instructions and binary interpretation, Bit Instruction, Timers and counters, Comparison instructions, Programming Instructions - Math instructions, Move and Logical Instructions, Discussions of programming, communications for PLC-Robotic arm, Exercise of setup and monitoring.

UNIT V:

(8 Periods)

Applications: Analog and Digital parameters by using SLC5/03-VFD-Panel Mate series 1700, Practical Troubleshooting, troubleshooting technique, Control system stability and tuning basics. Applications: Process to rewind, test, and integrate with extrusion process for wiring and fibre optic industries, Food industry – yeast, flour distribution and control. Process Medical equipment Industry – Gas analyzer, Leak tester (using CO₂), plastic wrapping machines etc.

Total Periods: 45

TEXT BOOKS:

1. Hugh Jack, Automating Manufacturing Systems with PLCs, Lulu Publishers, 1st Edition, 2010.
2. R. Bliesener and F. Ebel, Programmable Logic Controllers, Festo Didactic Publishers, 1st Edition, 2002.

REFERENCES:

1. W. Bolton, Programmable Logic Controllers, Newnes, 4th Edition, 2006.
2. Jay F. Hooper, Introduction to PLCs, Carolina Academic Press, 2nd Edition, 2006.
3. Siemens, PLC Handbook, Automation Direct, 1st Edition,

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108105088>

III Year B.Tech. – II Semester

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(EE23APE603) SWITCHGEAR AND PROTECTION**(Professional Elective - II)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the principles, construction, and operation of various circuit breakers.
- Learn the working and characteristics of electromagnetic, static, and microprocessor-based relays.
- Study the protection schemes for generators and transformers.
- Analyze the protection of feeders, transmission lines, and busbars.
- Explore protection against overvoltages and grounding methods in power systems.

COURSE OUTCOMES:

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

- CO 1:** Explain the arc interruption process and characteristics of various circuit breakers.
- CO 2:** Analyze the construction and operation of electromagnetic, static, and numerical relays.
- CO 3:** Apply suitable protection methods for generators and transformers under different fault conditions.
- CO 4:** Design protection schemes for feeders, transmission lines, and busbars using appropriate relays.
- CO 5:** Evaluate overvoltage protection strategies and grounding techniques for system safety and performance.

UNIT I:**(8 Periods)**

Circuit Breakers: Elementary principles of arc interruption, Restriking Voltage and Recovery voltages - Restriking Phenomenon, Average, Max. RRRV, Current Chopping and Resistance Switching - CB ratings and Specifications, Selection of CB: Types and Numerical Problems. Description and Operation of- Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers - Auto reclosures.

UNIT II:**(10 Periods)**

Electromagnetic, Static and Numerical Relays: Basic Requirements of Relays – Primary and Backup protection - Construction details of – Attracted armature, balanced beam, inductor type and differential relays – Universal Torque equation – Characteristics of over current, Direction and distance relays. Static Relays – Advantages and Disadvantages – Definite time, Inverse and IDMT static relays – Comparators – Amplitude and Phase comparators. Microprocessor based relays – Advantages and Disadvantages – Block diagram for over current (Definite, Inverse and IDMT), Distance Relays, Impedance Relays and Reactance Relays with their Flow Charts.

UNIT III: Protection of Generators and Transformers**(10 Periods)**

Protection of Generators: Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on percentage winding unprotected.

Protection of Transformers: Percentage Differential Protection, Numerical Problem on Design of CTs Ratio, Buchholtz relay Protection.

UNIT IV:**(9 Periods)**

Protection of Feeders, Transmission Lines and Busbars: Protection of Feeders (Radial & Ring main) using over current Relays. Protection of Transmission lines – 3 Zone protection using Distance Relays. Carrier current protection. Protection of Bus bars - Differential protection.

UNIT V:

(8 Periods)

Protection Against Over Voltages: Generation of Over Voltages in Power Systems. - Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lightning Arresters - Insulation Coordination –BIL. Neutral Grounding, Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance – Arcing Grounds and Grounding Practices.

Total Periods: 45

TEXT BOOKS:

1. Sunil S. Rao, Switchgear and Protection, Khanna Publishers, 1st Edition.
2. Badari Ram, D. N. Viswakarma, Power System Protection and Switchgear, TMH Publications, 1st Edition.

REFERENCES:

1. J. Lewis Blackburn, Protective Relaying: Principles and Applications, CRC Press, 3rd Edition, 2006.
2. EPRI, Numerical Protective Relays, Final Report 2004 – 1009704, EPRI, USA, 2004.
3. Walter A. Elmore, Protective Relaying: Theory and Applications, Marcel Dekker, 2nd Edition, 2003.
4. Y. G. Paithankar, Transmission Network Protection, Taylor and Francis, 2009.
5. P. M. Anderson, Power System Protection, Wiley Publishers, 1st Edition, 1999.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee101/preview

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(EC23APE605) COMMUNICATION SYSTEMS**(Professional Elective - III)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of communication systems and amplitude modulation techniques.
- Learn about the angle modulation techniques and bandwidth considerations in communication systems.
- Gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
- Examine pulse modulation and digital modulation techniques used in modern communication systems.
- Study wireless communication systems, cellular networks, and GSM technology.

COURSE OUTCOMES:

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

- CO 1:** Understand the fundamentals of communication systems and amplitude modulation techniques.
- CO 2:** Learn about the angle modulation techniques and bandwidth considerations in communication systems.
- CO 3:** Gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
- CO 4:** Get familiar with pulse modulation and digital modulation techniques used in modern communication systems.
- CO 5:** Know about wireless communication systems, cellular networks, and GSM technology.

UNIT I:**(9 Periods)**

Analog communication - I: Elements of communication systems, need for Modulation, Modulation Methods, Baseband and carrier communication Amplitude Modulation (AM), Generation of AM signals, Rectifier detector, Envelope detector, sideband and carrier power of AM, Double side band suppressed carrier (DSB SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Single sideband (SSB) transmission, VSB Modulation.

UNIT II:**(9 Periods)**

Analog communication-II: Angle Modulation & Demodulation: Concept of instantaneous frequency Generalized concept of angle modulation, Bandwidth of angle modulated waves- Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Pre-emphasis & De-emphasis, Illustrative Problems.

UNIT III:**(9 Periods)**

Digital communications - I (Qualitative Approach only): Pulse analog modulation techniques, Generation and detection of Pulse amplitude modulation, Pulse width modulation, Pulse position modulation Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA, CDMA, SDMA: Advantages and applications

UNIT IV:**(9 Periods)**

Digital communications-II (Qualitative Approach only): Pulse Code Modulation, DPCM, Delta modulation, Adaptive delta modulation, Overview of ASK, PSK, QPSK, BPSK and M-PSK techniques.

UNIT V: (9 Periods)

Wireless Communications (Qualitative Approach only): Introduction to wireless communication systems, Examples of wireless communication systems, comparison of 2G and 3G cellular networks, Introduction to wireless networks, Differences between wireless and fixed telephone networks, Introduction to Global system for mobile (GSM), GSM services and features.

Total Periods: 45

TEXT BOOKS:

1. H. Taub, D. Schilling, and Gautam Sahe, Principles of Communication Systems, McGraw Hill, 3rd Edition, 2007.
2. George Kennedy and Bernard Davis, Electronics & Communication Systems, McGraw Hill, 4th Edition, 2009.

REFERENCES:

1. Wayne Tomasi, Electronic Communication Systems: Fundamentals Through Applications, Pearson Education.
2. Simon Haykin, Principles of Communication Systems, John Wiley, 2nd Edition.
3. Sham Shanmugam, Digital and Analog Communication Systems, Wiley-India, 2006.
4. Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson Education, 2nd Edition, 2002.

III Year B.Tech. – II Semester

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(EE23APE604) ELECTRIC DRIVES**(Professional Elective - III)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic structure, dynamics, and control methods of electric drives.
- Study converter-fed control methods for DC motors and their performance characteristics.
- Learn chopper-fed DC motor drive control and closed-loop operation.
- Analyze control methods for induction motor drives including voltage, frequency, and rotor-side control.
- Explore the operation and control of synchronous, stepper, and BLDC motor drives.

COURSE OUTCOMES:

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

- CO 1:** Explain the dynamics, control modes, and braking techniques of electric drives.
- CO 2:** Analyze converter-fed DC motor drives and evaluate their speed-torque characteristics.
- CO 3:** Evaluate chopper-fed DC motor control methods including regenerative and braking operations.
- CO 4:** Analyze control strategies for three-phase induction motor drives using voltage, frequency, and slip control.
- CO 5:** Describe the operation and control of synchronous, stepper, and BLDC motor drives with appropriate drive circuits.

UNIT I:**(8 Periods)**

Introduction to Electric Drives: Electrical drives — block diagram, advantages of electric drive, parts of electric drives, choice of electrical drives, the status of DC and AC drives. Dynamics of electrical drives-fundamental torque equations, speed- torque conventions, and multi-quadrant operation; Equivalent values of drive parameters - loads with rotational and translational motion; Load torques — components, nature and classification. Concept of steady-state stability. Electric braking methods — regenerative, dynamic and plugging. Modes of operation of electrical drives — steady state, acceleration including starting and deceleration including stopping. Speed control and drive classifications, closed-loop control of drives — current limit control, torque control, speed control and position control (Block diagram only).

UNIT II:**(10 Periods)**

Single-Phase and Three Phase Converter Fed DC Drives: Control of DC separately excited motor by single-phase and three-phase half and full bridged converters — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Single phase half-controlled rectifier fed DC series motor — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Multi-quadrant operation of DC separately excited DC motor fed from fully controlled rectifier - mechanical reversible switch in armature, dual converter and field current reversal.

UNIT III:**(9 Periods)**

DC Chopper Fed Drives: Control of DC separately excited motor by one, two and four quadrant choppers - voltage and current waveforms for continuous conduction (motoring, regenerative and dynamic braking), speed-torque expressions and characteristics. Chopper control of DC series motor—operation, speed-torque expressions and characteristics. Closed loop chopper control of separately excited DC motor (Block diagram only).

UNIT IV:**(9 Periods)**

Induction Motor Drives: Three phase induction motors — Introduction, Stator variable voltage control — speed-torque characteristics, AC voltage controllers and efficiency of induction motor under voltage control. Stator variable voltage and variable frequency control — slip speed control, torque-power limitations and modes of operation. Voltage Source Inverters (VSIs) and Current Source Inverters (CSIs) fed induction motor and closed loop operation of induction motor drives (Block diagram only). Comparison of VSI and CSI fed drives. Static rotor resistance control, slip power recovery schemes – static scherbius and Kramer drive, speed-torque characteristics.

UNIT V: Synchronous and Stepper Motor Drives**(9 Periods)**

Synchronous Motor Drives: Separate control and self-control of synchronous motors — operations of self- controlled synchronous motors by VSI and CSI. Load commutated CSI fed Synchronous motor—operation and speed torque characteristics. Closed loop control operation of synchronous motor drives (Block diagram only).

Stepper Motor Drives: Variable reluctance and permanent magnet operation — features of stepper motor — torques Vs stepping rate characteristics and drive circuits. BLDC motor operation and control

Total Periods: 45**TEXT BOOKS:**

1. Gopal K. Dubey, Fundamentals of Electric Drives, Narosa Publications/Alpha Science International Ltd., 1st Edition, 2002.
2. M. H. Rashid, Power Electronic Circuits, Devices and Applications, Prentice Hall of India, New Delhi, 3rd Edition, 2003.

REFERENCES:

1. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw Hill Publications, New Delhi, 2nd Edition, 2008.
2. Ramu Krishnan, Electric Motor Drives: Modelling, Analysis, and Control, Pearson, 1st Edition, 2015.
3. Vedam Subramanyam, Thyristor Control of Electric Drives, Tata McGraw Hill Publications, New Delhi, 1st Edition, 2008.
4. S. K. Pillai, A First Course on Electrical Drives, New Age International (P) Ltd., New Delhi, 2nd Edition, 2007.
5. P. C. Sen, Principles of Electrical Machines and Power Electronics, Wiley, 3rd Edition, 2013.

ONLINE RESOURCES:

1. https://web.iitd.ac.in/~amitjain/Drives_VTR.pdf
2. https://sde.uoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
3. <https://nptel.ac.in/courses/108/104/108104140/>
4. <https://nptel.ac.in/courses/108/102/108102046/>
5. https://swayam.gov.in/nd1_noc19_ee65/preview

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(EE23APE605) RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES**(Professional Elective - III)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamentals of renewable energy sources and their role in addressing global energy challenges.
- Impart knowledge on solar, wind, biomass, and tidal energy systems and their working principles.
- Explain students with energy storage technologies and green energy systems like fuel cells and hydrogen energy.
- Explain the need, planning, and grid integration of distributed generation (DG) systems.
- Analyze the technical, economic, and control aspects of DG systems and their impact on existing power networks.

COURSE OUTCOMES:

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

- CO 1:** Explain the fundamentals of renewable energy sources and analyze the working of solar energy systems.
- CO 2:** Classify different types of wind, biomass, and tidal energy systems and assess their feasibility.
- CO 3:** Compare energy storage technologies and explain the operational principles of fuel cells and hydrogen energy.
- CO 4:** Illustrate the planning and integration of distributed generation systems into the grid.
- CO 5:** Evaluate the technical, economic, and control impacts of distributed generation on existing power systems.

UNIT I: Energy Scenario and Solar Energy**(9 Periods)**

Introduction: Fundamentals of renewable energy sources, Types of energy, Renewable and Non-renewable energy, SWOT analysis, Global warming and climate change, World energy transformation by 2050, Prospects of renewable energy in the world, Renewable energy availability in India.

Solar Energy Fundamentals: Solar Spectrum, propagation of solar radiation from the sun to earth, solar radiation geometry: sun-earth geometry, extra-terrestrial and terrestrial radiation.

Solar Thermal: Solar Collectors, Solar parabolic trough, Solar tower, Solar cooker, Solar water heater, Solar dryer, Solar Pond.

Solar Electric Power Generation: A Generic PV Cell, PV Materials, Equivalent Circuits for PV Cells, Modules and Arrays; I-V Curve under Standard Testing Conditions; Impact of Temperature and Insolation on I-V curves; Shading Impacts on I-V curves; Maximum Power Point Trackers (MPPT).

UNIT II: Wind and Other Energy Systems**(9 Periods)**

Wind Energy: Air, Wind, Global and Local Wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Classification of wind energy conversion system (WECS)- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).

Tidal Power: fundamental characteristics of tidal power, harnessing tidal energy, advantages, and limitations.

UNIT III: Energy Storage and Green Energy (10 Periods)

Energy Storage: Stationary Battery Storage – Basics of Lead-Acid batteries, Battery Storage Capacity, Coulomb efficiency instead of energy efficiency, Battery Sizing. Different Battery storage technologies and comparison of their performance. Introduction to Super capacitors.

Green Energy: Historical Development, Basic Operation of a Fuel Cell, Fuel Cell Thermodynamics, Entropy and the theoretical efficiency of Fuel Cells, Gibbs Free Energy and Fuel Cell efficiency, Electrical output of an Ideal Cell, Electrical Characteristics of Real Fuel Cells, Types of Fuel Cells, H₂: Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

UNIT IV: Introduction to DG and its Grid Integration (9 Periods)

Introduction: Need for Distributed generation, current scenario in Distributed Generation, and Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

Grid integration of DGs: Different types of interfaces - Inverter based DGs and rotating machine-based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultra-capacitors, flywheels.

UNIT V: Technical Impact, Economic and Control aspects of DG (8 Periods)

Technical impacts of DGs: Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems

Economic and control aspects of DGs: Market facts, issues, and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.

Total Periods: 45

TEXT BOOKS:

1. Muhammad Kamran, Muhammad Rayyan Fazal, Renewable Energy Conversion Systems, Elsevier Academic Press, 1st Edition, 2021.
2. G. D. Rai, Non-Conventional Sources of Energy, Khanna Publisher, 2004

REFERENCES:

1. G N Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002.
2. Mukund R Patel, Wind and Solar Power Systems: Design, Analysis, and Operation, Taylor & Francis, 2nd Edition, 2006.
3. H. Lee Willis, Walter G. Scott, —Distributed Power Generation – Planning and Evaluation, Marcel Decker Press, 2000.
4. Gilbert M. Masters, —Renewable and Efficient Electric Power System, IEEE Press, Wiley, 2nd Edition, 2013.
5. N. Jenkins, J.B. Ekanayake and G. Strbac, —Distributed Generation, The Institution of Engineering and Technology, London, 1st Edition, 2010.

III Year B.Tech. – II Semester

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(EC23AES501) TINKERING LAB**COURSE OBJECTIVES:**

The objectives of this 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.

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(EE23APC603) ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Calibration of various electrical measuring instruments
- Accurate determination of inductance and capacitance using AC Bridges
- Measurement of resistance for different range of resistors using bridges
- Performance of transducers and sensors

COURSE OUTCOMES:

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

- CO 1:** Determine resistance, inductance, and capacitance using standard bridge methods.
- CO 2:** Calibrate single-phase energy meters using direct and phantom loading techniques to ensure measurement accuracy.
- CO 3:** Compute active and reactive power in single-phase and three-phase circuits.
- CO 4:** Extend the measurement range of basic meters and analyze displacement using LVDT.
- CO 5:** Operate CRO, temperature sensors (RTD, thermocouple), and strain gauges to measure electrical and physical parameters.

List of Experiments:

1. Measurement of resistance using Wheatstone bridge and Kelvin's Double Bridge.
2. Measurement of inductance using Maxwell's bridge, Anderson bridge.
3. Measurement of capacitance using De-Sauty's bridge, Schering bridge
4. Calibration of single phase energy meter using direct loading method.
5. Calibration of energy meter using Phantom load kit.
6. Measurement of Power using 3-Voltmeter and 3-Ammeter methods in a single phase Circuit.
7. Measurement to Real and Reactive Power in a three phase circuit.
8. Extension of range of given Ammeter and Voltmeter
9. Measurement of displacement using LVDT.
10. Study of CRO: Measurement of voltage, current, frequency using lissajous patterns.
11. Measurement of different ranges of temperatures using i) RTD ii) Thermocouple
12. Measurement of strain with the help of strain gauge transducers

Note: Minimum of 10 experiments should be performed

ONLINE RESOURCES:

1. <http://vlabs.iitkgp.ernet.in/asnm/#>

III Year B.Tech. – II Semester

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(EC23APC507) MICROPROCESSORS AND MICROCONTROLLERS LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Become skilled in 8086 Assembly Language programming.
- Understand the detailed software and hardware structure of the microprocessor.
- Train their practical knowledge through laboratory experiments.
- Understand and learn 8051 Microcontroller.
- 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: (Any TEN of the experiments are to be conducted)

- 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/Step signal.

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.

TEXT BOOKS:

1. Kenneth.J.Ayala, The 8051 microcontroller, Cengage learning, 3rd Edition, 2010.
2. A.K ray and K.M.Bhurchandani, Advanced microprocessors and peripherals, TMH, 2nd Edition, 2006.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, 2nd Edition, 2008.

III Year B.Tech. – II Semester

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**(EE23ASC601) APPLICATIONS OF SOFT COMPUTING TOOLS
IN ELECTRICAL ENGINEERING****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand MATLAB programming, Simulink modelling, and toolbox functionalities for electrical simulations.
- Apply concepts for modelling and analysis of networks, transformers, converters, and control systems.
- Analyze system behaviour using PI controllers, PWM techniques, and stability analysis tools.
- Design real-time simulation models for various electrical engineering applications.
- Develop smart grid models using virtual PMUs and wide-area control systems in MATLAB/Simulink.

COURSE OUTCOMES:

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

- CO 1:** Demonstrate the use of MATLAB environment, Simulink, and essential toolboxes for electrical system simulations.
- CO 2:** Apply modelling techniques to simulate electrical systems like networks, transformers, and power converters using MATLAB/Simulink.
- CO 3:** Analyze control strategies such as PI controllers and PWM techniques for power electronic systems.
- CO 4:** Evaluate system performance under transient stability, reactive power control, and fault conditions using soft computing tools.
- CO 5:** Analyze the concepts of virtual PMUs and wide-area control systems using MATLAB/Simulink.

Theory:

MATLAB-Introduction, different tool boxes, creation of program files, creation of Simulink files, GUI, commonly used blocks, Simpower system toolbox, control system toolbox, Sim Drive lines, Creation of functions, Project implementation through MATLAB

List of Experiments:

1. Transient analysis of given electrical network
2. Simulation of 1-phase and 3-phase transformers
3. Study of the dynamics of second order system
4. Implementation of buck and boost dc-dc converters
5. Study on the design of PI controllers and stability analysis for a DC-DC buck Converter
6. Sine-PWM techniques for single-phase half-bridge, full-bridge and three-phase inverters
7. Economic Load Dispatch of (i) Thermal Units and (ii) Thermal Plants using Conventional method
8. Transient Stability Analysis of Power Systems using Equal Area Criterion (EAC)
9. Reactive Power Control in a transmission system (Ferranti effect, Effect of shunt Inductor)
10. Fault studies using Zbus matrix
11. Design of virtual PMU
12. Wide area control of Two area Kundur system

Note: Minimum of 10 experiments should be performed

TEXT BOOKS:

1. Agam Kumar Tyagi, MATLAB and Simulink for Engineers, Oxford University Press, 1st Edition, 2012.

2. Hadi Saadat, Power System Analysis, McGraw Hill Education, 3rd Edition, 2010.

REFERENCES:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design, Wiley, 3rd Edition, 2003.
2. Arun G. Phadke, James S. Thorp, Synchronized Phasor Measurements and Their Applications, Springer, 1st Edition, 2008.

ONLINE RESOURCES:

1. <http://vem-iitg.vlabs.ac.in/>
2. <https://vp-dei.vlabs.ac.in/Dreamweaver/>

III Year B.Tech. – II Semester

L	T	P	C
2	-	-	-

(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, 9th Edition, 2019.
2. Prabuddha Ganguli, Intellectual Property Rights, Tata McGraw Hill, 2001.
3. P. Narayan, Intellectual Property Law, Eastern Law House, 3rd Edition, 2007.
4. Adrian Wallwork, English for Writing Research Papers, Springer Cham Heidelberg New York, 2nd 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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2	-	-	2

(BA23AHS701) BUSINESS ETHICS AND CORPORATE GOVERNANCE
(Management Course)

COURSE OBJECTIVES:

The objectives of this course is 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, Cyber security 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 ,Safe guarding 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 – Benefits and Limitations. Emerging Global Trends in Corporate Governance (OECD Guidelines)

Total Periods: 30

TEXT BOOKS:

1. Murthy, C.S.V., Business Ethics and Corporate Governance, Himalaya Publishing House (HPH), July 2017.
2. Dutta, Bholananth, Podder, S.K., Corporate Governance, VBH, June 2010.

REFERENCES:

1. K. Nirmala and K. Readdy, Business Ethics and Corporate Governance, Hyderabad, India: Himalaya Publishing House.
2. H. R. Machiraju, Corporate Governance, Hyderabad, India: Himalaya Publishing House, 2013.
3. K. Venkataramana, Corporate Governance, Hyderabad, India: Shree Hari Book Publications.
4. N. M. Khandelwal, Indian Ethos and Values for Managers, New Delhi, India.

ONLINE RESOURCES:

1. 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/
4. 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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2	-	-	2

(BA23AHS702) E - BUSINESS**(Management Course)****COURSE OBJECTIVES:**

The objectives of this course is 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.
- The students 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, Razorpay).

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

TEXT BOOKS:

1. Arati Oturkar & Sunil Khilari, E-Business, Everest Publishing House, 2022
2. P.T.S Joseph, E-Commerce, Prentice Hall of India, 4th Edition, 2011

REFERENCES:

1. Debjani, Kamallesh K Bajaj, E-Commerce, Tata Mc Graw-Hill's, 2nd Edition, 2005
2. Dave Chaffey, E-Commerce E-Management, Pearson, 2nd Edition, 2012.
3. Henry Chan, E-Commerce Fundamentals and Application, Raymond Leatham Wiley India 2007
4. S.Jaiswal, E-Commerce, Galgotia Publication Pvt Ltd., 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

L	T	P	C
2	-	-	2

(BA23AHS703) MANAGEMENT SCIENCE
(Management Course)

COURSE OBJECTIVES:

The objectives of this course is to:

- Provide fundamental knowledge on Management, Administration, Organization & 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**TEXT BOOKS:**

1. Frederick S. Hillier, Mark S. Hillier, Introduction to Management Science, McGraw Hill, 1st Edition, 2023.
2. A. R. Aryasri, Management Science, TMH, 2019.

REFERENCES:

1. Stoner, Freeman, Gilbert, Management, Pearson Education, 1st Edition, 2019.
2. Koontz & Weihrich, Essentials of Management, TMH, 6th Edition, 2005.
3. Thomas N. Duening, John M. Ivancevich, Management: Principles and Guidelines, Biztantra, 1st Edition, 2004.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 1st Edition, 2004.
5. Samuel C. Certo, Modern Management, PHI, 9th Edition, 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

L	T	P	C
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(EE23APC701) POWER SYSTEM OPERATION AND CONTROL**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the economic dispatch problem and loss considerations in thermal and mixed generating systems.
- Analyze hydro-thermal coordination strategies and optimal power flow scheduling methods.
- Study the modelling of thermal plants and the concept of Automatic Load Frequency Control.
- Explore the methods of reactive power compensation and voltage control in transmission systems.
- Learn the fundamentals of electricity markets, deregulation, pricing strategies, and demand-side management.

COURSE OUTCOMES:

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

- CO 1:** Solve economic load dispatch problems for thermal units with and without considering transmission losses.
- CO 2:** Analyze short-term hydro-thermal scheduling and evaluate optimal power flow strategies.
- CO 3:** Model thermal units and evaluate the performance of single-area Automatic Load Frequency Control (ALFC).
- CO 4:** Demonstrate methods of reactive power compensation and analyze the impact on voltage stability.
- CO 5:** Interpret deregulated electricity markets, pricing strategies, and demand-side management mechanisms.

UNIT I:**(9 Periods)**

Economic Operation of Power Systems: Brief description about electrical power systems, introduction to power system operation and control, Characteristics of various steam units, combined cycle plants, cogeneration plants, Steam units economic dispatch problem with & without considering losses and its solutions, B Matrix loss formula – Numerical problems.

UNIT II:**(9 Periods)**

Hydro-Thermal Coordination and Optimal Power Flow: Hydro-thermal Coordination: Characteristics of various types of hydro-electric plants and their models, Introduction to hydro-thermal Coordination, Scheduling energy with hydro-thermal coordination, Short-term hydro-thermal scheduling – Numerical problems

UNIT III:**(9 Periods)**

Automatic Generation Control: Speed governing mechanism, modelling of speed governing mechanism, models of various types of thermal plants (first order), definitions of control area, Block diagram representation of an isolated power system, Automatic Load Frequency control of single area system with and without control, Steady state and dynamic responses of single area ALFC loop – Numerical examples

UNIT IV:**(9 Periods)**

Reactive Power Control: Requirements in ac power transmission, factors affecting stability & voltage control, fundamental transmission line equation, surge impedance, Natural loading, uncompensated line on open circuit, uncompensated line under load, types of compensations on compensated transmission lines, passive and active compensators, uniformly distributed fixed and regulated shunt compensation, series compensation, compensation by sectioning – Numerical problems

UNIT V:

(9 Periods)

Power Systems Deregulation: Principle of economics, utility functions, power exchanges, electricity market models, market power indices, ancillary services, transmission and distribution charges, principles of transmission charges, transmission pricing methods, demand-side management, regulatory framework – Numerical problems

Total Periods: 45

TEXT BOOKS:

1. Allen J. Wood, Bruce F. Wollenberg, Power Generation, Operation and Control, John Wiley & Sons, 2nd Edition, 1996.
2. D. P. Kothari, I. J. Nagrath, Power System Engineering, McGraw Hill Education India Pvt. Ltd., 3rd Edition, 2019.

REFERENCES:

1. Olle I. Elgerd, Electric Energy Systems Theory: An Introduction, TMH Publishing Company Ltd., 2nd Edition, 1983.
2. T. J. E. Miller, Reactive Power Control in Electric Systems, John Wiley & Sons, 1st Edition, 1982.

IV Year B.Tech. – I Semester

L	T	P	C
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(EC23APC601) DIGITAL SIGNAL PROCESSING**(Professional Elective - IV)****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, Hanging, 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

TEXT BOOKS:

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 , Pearson Education, New Delhi, 2nd Edition, 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.

IV Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(EE23APE701) ELECTRIC VEHICLE TECHNOLOGY**(Professional Elective - IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the evolution, environmental impact, and comparative performance of electric vehicles.
- Explore electric traction concepts and drive-train configurations in electric vehicles.
- Learn control strategies for various electric drives used in EVs.
- Study energy storage technologies including batteries, super capacitors, and fuel cells.
- Analyze energy management strategies and charging infrastructure for EVs.

COURSE OUTCOMES:

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

- CO 1:** Compare conventional, hybrid, and electric vehicles based on efficiency and environmental impact.
- CO 2:** Explain electric traction and various drive-train topologies used in electric vehicles.
- CO 3:** Apply control techniques for motors like BLDC, induction, PM, and SRM in electric vehicles.
- CO 4:** Analyze different energy storage devices and evaluate their performance in EV applications.
- CO 5:** Evaluate energy management strategies and assess EV charging standards and infrastructure.

UNIT I: (10 Periods)

Introduction to Electric Vehicles: History of electric vehicles, social and environmental importance of electric vehicles, impact of modern drive-trains on energy supplies.

Case Studies: Comparison by efficiency of Conventional, Hybrid, Electric and Fuel Cell Vehicles.

UNIT II: (8 Periods)

Electric Drive-Trains: Basic concept of electric traction, Introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies.

UNIT III: (9 Periods)

Electric Drives and Control: Introduction to electric components used in electric vehicles, Control of BLDC Motor, Control of Induction Motor Drive, Permanent Magnet (PM) motor Drive & Switched Reluctance Motor (SRM) Drive.

UNIT IV: (9 Periods)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its modelling, SOC, Different Types of Batteries, Super Capacitor based energy storage and its analysis, Fuel Cells, Hybridization of different energy storage devices.

UNIT V: (9 Periods)

Energy Management Strategies and Charging Infrastructure: Introduction to energy management strategies used in electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies, Types of EV charging Infrastructure & Standardized Communication protocols for EV charging.

Case Studies: Current issues in electric Vehicles, Thermal Protection of Battery.

Total Periods: 45

TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2nd Edition, 2017.
2. Ali Emadi, Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines), CRC Press, 2015.

REFERENCES:

1. James Larminie, John Lowry, —Electric Vehicle Technology ExplainedII, Wiley, 2nd Edition 2012.
2. John G. Hayes and A. Goodarzi, Electric Powertrain - Energy Systems, Power Electronics and drives for Hybrid, electric and fuel cell vehicles, Wiley, 2018.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108106170>
2. https://onlinecourses.nptel.ac.in/noc22_ee53
3. https://onlinecourses.nptel.ac.in/noc21_ee112

IV Year B.Tech. – I Semester

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(EE23APE702) HVDC and FACTS**(Professional Elective - IV)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand conventional and advanced transmission systems.
- Analyze HVDC system types and converter operations.
- Study HVDC control strategies and power flow control.
- Understand FACTS controllers and compensator operation.
- Explore UPFC, IPFC operation and control structures.

COURSE OUTCOMES:

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

- CO 1:** Explain conventional transmission control methods and the need for HVDC and FACTS in modern power systems.
- CO 2:** Analyze the performance of HVDC systems and converter circuits with and without overlap.
- CO 3:** Apply various control strategies in HVDC links and evaluate their impact on power flow and stability.
- CO 4:** Explain the working principles of FACTS controllers and converter-based compensators.
- CO 5:** Evaluate the operational capabilities and control structures of UPFC and IPFC.

UNIT I:**(9 Periods)**

Introduction: Electrical Transmission Networks, Conventional Control Mechanisms- Automatic Generation Control, Excitation Control, Transformer Tap-Changer Control, Phase-Shifting Transformers; Advances in Power- Electronic Switching Devices, Principles and Applications of Semiconductor Switches; Limitations of Conventional Transmission Systems, Emerging Transmission Networks, HVDC and FACTS. Concepts of virtual inertia

UNIT II:**(9 Periods)**

High Voltage Dc Transmission – I: Types of HVDC links - Monopolar, Homopolar, Bipolar and Back-to-Back, Advantages and disadvantages of HVDC Transmission, Analysis of Graetz circuit, Analysis of bridge circuit without overlap, Analysis of bridge with overlap less than 60° , Rectifier and inverter characteristics, complete characteristics of rectifier and inverter, Equivalent circuit of HVDC Link.

UNIT III:**(9 Periods)**

High Voltage DC Transmission – II: Desired features and means of control, control of the direct current transmission link, Constant current control, Constant ignition angle control, Constant extinction angle control, Converter firing- angle control- IPC and EPC, frequency control and Tap changer control, Starting, Stopping and Reversal of power flow in HVDC links.

UNIT IV:**(9 Periods)**

Flexible AC Transmission Systems-I: Types of FACTS Controllers, brief description about various types of FACTS controllers, Operation of 6- pulse converter, Transformer Connections for 12-pulse, 24-pulse and 48-pulse operation, principle of operation of various types of Controllable shunt VAR Generation, Principle of switching converter type shunt compensator, principles of operation of various types of Controllable Series VAR Generation, Principle of Switching Converter type series compensator.

UNIT V:**(9 Periods)**

Flexible AC Transmission Systems-II: Unified Power Flow Controller (UPFC) – Principle of operation, Transmission Control Capabilities, Independent Real and Reactive Power Flow Control; Interline Power Flow Controller (IPFC) – Principle of operation and Characteristics, UPFC and IPFC control structures (only block diagram description), objectives and approaches of voltage and phase angle regulators

Total Periods: 45

TEXT BOOKS:

1. Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, Wiley-Interscience, New Jersey, 2000.
2. E.W. Kimbark, Direct current transmission, Vol. I, Wiley Interscience, New York, 1971.

REFERENCES:

1. K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, New Delhi, 2007.
2. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez and César Angeles-Camacho, FACTS: Modelling and Simulation in Power Networks, John Wiley & Sons, West Sussex, 2004.
3. R Mohan Mathur and Rajiv K Varma, Thyristor-Based FACTS Controllers for Electrical Transmission Systems, IEEE Press, Wiley-Interscience, New Jersey, 2002.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108104013>,
2. <https://nptel.ac.in/courses/108107114>

IV Year B.Tech. – I Semester

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3	-	-	3

(EE23APE703) ELECTRICAL DISTRIBUTION SYSTEM**(Professional Elective - V)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the fundamentals of power distribution systems including sub-transmission structures, substations, and primary feeders.
- Analyze the optimal location, rating, and loading of substations and various types of distribution system loads.
- Study and apply different modelling techniques and load flow algorithms suitable for radial distribution systems.
- Evaluate voltage drops, power losses, and capacitor placement strategies for improving distribution efficiency.
- Explore modern distribution automation technologies such as SCADA, GIS, AMR, and their role in system reliability and control.

COURSE OUTCOMES:

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

- CO 1:** Describe the structure and components of distribution systems, and identify the factors influencing substation and feeder design.
- CO 2:** Analyze substation configurations and load characteristics to enhance distribution system planning and performance.
- CO 3:** Apply radial feeder models to perform distribution load flow analysis for voltage and power flow estimation.
- CO 4:** Evaluate power loss and voltage drop in distribution feeders, and recommend capacitor placement for system efficiency.
- CO 5:** Explain the functions and components of distribution automation systems, including SCADA, GIS, and AMR technologies.

UNIT I:**(9 Periods)**

Distribution System Fundamentals: Brief description about electrical power transmission and distribution systems, Different types of distribution sub-transmission systems, Substation bus schemes, Factors effecting the substation location, Factors effecting the primary feeder rating, types of primary feeders, Factors affecting the primary feeder voltage level, Factors effecting the primary feeder loading.

UNIT II:**(9 Periods)**

Distribution System Substations and Loads: Substations: Rating of a distribution substation for square and hexagonal shaped distribution substation, Service area with —nll primary feeders, K constant, Radial feeder with uniformly and non-uniformly distributed loading. Benefits derived through optimal location of substations.

Loads: Various types of loads, Definitions of various terms related to system loading, Distribution transformer loading, feeder loading, Relationship between the Load Factor and Loss Factor, Modelling of star and delta connected loads.

UNIT III:**(9 Periods)**

Distribution System Load Flow: Exact line segment model, Modified line model, approximate line segment model, Step-Voltage Regulators, Line drop compensator, Forward/Backward sweep distribution load flow algorithm – Numerical problems

UNIT IV:**(10 Periods)**

Voltage Drop and Power Loss Calculation: Analysis of non-three phase primary lines, concepts of four-wire multi-grounded common-neutral distribution system, Percent power loss calculation, Distribution feeder cost calculation methods, Capacitor installation types, Series and Shunt Capacitors, Types of three-phase capacitor-bank connections, Procedure

for best capacitor location, Economic justification for capacitors – Numerical problems.

UNIT V:

(8 Periods)

Distribution Automation: Distribution automation, distribution management systems, distribution automation system functions, Basic SCADA system, Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR), Outage management, decision support applications, substation automation, control feeder automation.

Total Periods: 45

TEXT BOOKS:

1. William H. Kersting, Distribution System Modelling and Analysis, CRC Press, New York, 2002.
2. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill Inc., New Delhi, 1986.

REFERENCES:

1. James Northcote-Green and Robert Wilson, Control and automation of electrical power distribution systems, CRC Press (Taylor & Francis), New York, 2007.
2. Biswarup Das, Power distribution Automation, IET publication, 2016.
3. Dr. M. K. Khedkar, Dr. G.M. Dhole, Electric Power Distribution Automation, Laxmi Publications, 1st Edition, 2017.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_ee126/preview

IV Year B.Tech. – I Semester

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(EE23APE704) MODERN CONTROL THEORY**(Professional Elective - V)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand state-space modelling and solution of continuous-time linear systems.
- Analyze controllability and observability in both time-varying and time-invariant systems.
- Design state feedback controllers and observers using modal control concepts.
- Evaluate system stability using Lyapunov's direct method for linear and nonlinear systems.
- Formulate and solve various optimal control problems with performance criteria.

COURSE OUTCOMES:

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

- CO 1:** Construct state-space models for linear time-invariant systems and solve state equations using matrix methods.
- CO 2:** Evaluate controllability and observability of state-space systems using appropriate mathematical tests.
- CO 3:** Design state feedback controllers and observers to achieve desired closed-loop dynamics.
- CO 4:** Analyze system stability using Lyapunov's direct method for linear and nonlinear systems.
- CO 5:** Formulate and optimize control strategies using optimal control theory for various performance criteria.

UNIT I:**(9 Periods)**

State Variable Description: Concept of State – State Equations for Linear Continuous Time Models – Non uniqueness of state model – State diagrams for continuous time state models – Solution of state equations – State transmission matrix.

UNIT II:**(10 Periods)**

Controllability and Observability: Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability of state models in Jordan canonical form and other canonical forms.

UNIT III:**(9 Periods)**

Modal Control: The Effect of State Feedback on Controllability and Observability. Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

UNIT IV:**(9 Periods)**

Stability Analysis: Stability in the sense of Lyapunov. Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov for the Linear and Nonlinear continuous time autonomous systems

UNIT V:**(8 Periods)**

Optimal Control: Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Infinite time Regulator, Output regulator problem. Tracking problem, Parameter Optimization

Total Periods: 45

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory, New Age International Publishers, 2nd Edition, 1996.
2. K. Ogata, Modern Control Engineering, Prentice Hall of India, 3rd Edition, 1998.

REFERENCES:

1. I.J. Nagarath and M.Gopal, Control Systems Engineering New Age International (P) Ltd.
2. Stainslaw H. Zak, Systems and Control Oxford Press, 2003.
3. M. Gopal, Digital Control and State Variable Methods, Tata Mc Graw-Hill Companies, 1997.

IV Year B.Tech. – I Semester

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(EE23APE705) SWITCHED MODE POWER CONVERSION**(Professional Elective - V)****COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand basic concepts of DC-DC converters
- Understand the concepts of resonant converters and their classification, various types of multilevel inverters, power conditioners, UPS and filters.
- Apply various modulation and harmonic elimination techniques over the converters.
- Analyze the state space modelling of various types of converters.
- Design inductor and transformer for various power electronic applications.

COURSE OUTCOMES:

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

- CO 1:** Develop state-space models and analyze the operation of basic DC-DC converters such as Buck, Boost, Buck-Boost, and Cuk converters.
- CO 2:** Analyze the operation and control of isolated switching mode power converters including flyback, forward, Luo, half-bridge, and full-bridge converters.
- CO 3:** Evaluate resonant converter topologies and their operation under soft-switching conditions such as ZVS and clamped-voltage operation.
- CO 4:** Design modulation and control techniques for single-phase and three-phase inverters, including multilevel inverter configurations.
- CO 5:** Select and design power conditioning components such as UPS systems, filters, inductors, and capacitors for switched-mode power applications.

UNIT I:**(8 Periods)**

DC-DC Converters: Principles of step-down and step-up converters – Analysis and state space modelling of Buck, Boost, Buck- Boost and Cuk converters – Numerical Examples.

UNIT II:**(9 Periods)**

Switching Mode Power Converters: Analysis and state space modelling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Numerical Examples.

UNIT III:**(9 Periods)**

Resonant Converters: Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control – Numerical Examples.

UNIT IV:**(9 Periods)**

DC-AC Converters: Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V:**(10 Periods)**

Power Conditioners, UPS and Filters: Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

Total Periods: 45**TEXT BOOKS:**

1. L. Umanand, Power Electronics: Essentials and Applications, Wiley, 2009

2. M.H. Rashid, Power Electronics handbook, Elsevier Publication, 2001.

REFERENCES:

1. Philip T. Krein, Elements of Power Electronics, Oxford University Press, 2012
2. V Ramanarayanan, Course material on Switched Mode Power Conversion Dept. of Electrical Engg. IISc. Bangalore.
3. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design, John Wiley and Sons, 3rd Edition, 2006
4. M.H. Rashid, Power Electronics Circuits, Devices And Applications, Prentice Hall of India New Delhi, 3rd Edition, 2007.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108108036>
2. <https://nptel.ac.in/courses/108105180>

IV Year B.Tech. – I Semester

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(EE23ASC701) POWER SYSTEMS AND SIMULATION LAB**COURSE OBJECTIVES:**

The objectives of this course are to:

- Experimentally determine sequence impedances, sub-transient reactances of synchronous machines, and analyze various fault conditions.
- Develop MATLAB programs for YBus and ZBus matrix formation and load flow studies using Gauss-Seidel and Fast Decoupled methods.
- Simulate the swing equation and power system dynamics for stability assessment.
- Develop SIMULINK models for single and two-area load frequency control problems under different control strategies.
- Analyze the characteristics of various protective relays used in power systems.

COURSE OUTCOMES:

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

- CO 1:** Apply symmetrical components theory to determine sequence impedances of cylindrical and salient pole synchronous machines.
- CO 2:** Interpret the impact of various faults (LG, LL, LLG, LLLG) on synchronous machines and system stability.
- CO 3:** Evaluate load flow using Gauss-Seidel, Newton-Raphson, and Fast Decoupled methods and construct YBus/ZBus matrices.
- CO 4:** Analyze single and two-area load frequency control models under uncontrolled and PI-controlled conditions using simulation tools.
- CO 5:** Ability to compare the operating characteristics of electromagnetic, static, and microprocessor-based relays.

List of Experiments:

1. Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine
2. Determination of Sequence Impedances of salient pole Synchronous Machine
3. Unsymmetrical Fault Analysis (LG, LL, LLG) on an un loaded alternator
4. Symmetrical Fault Analysis (LLL) on an un loaded alternator
5. Determination of Sub transient reactance of salient pole synchronous machine
6. Equivalent circuit of three winding transformer.
7. YBus formation using Soft Tools
8. ZBus formation using Soft Tools
9. Gauss-Seidel load flow analysis using Soft Tools
10. Newton-Raphson load flow analysis using Soft Tools
11. Fast decoupled load flow analysis using Soft Tools
12. Solve the Swing equation and Plot the swing curve
13. Develop and simulate a model for a single-area load frequency control problem under both uncontrolled and PI-controlled conditions using suitable soft tools.
14. Develop and simulate a model for a Two-area load frequency control problem under both uncontrolled and PI-controlled conditions using suitable soft tools.
15. Characteristics of IDMT Over Current Relay (Electro Magnetic Type)
16. Characteristics of Static Negative Sequence Relay
17. Characteristics of Over Voltage Relay
 - i) Electromagnetic Type
 - ii) Microprocessor Type
18. Characteristics of Percentage Biased Differential Relay
 - i) Electromagnetic Type
 - ii) Static Type

Note: Minimum of 10 experiments should be performed

TEXT BOOKS:

1. Hadi Saadat, Power System Analysis, McGraw-Hill Education, 1st Edition, 2010.
2. D.P. Kothari and I.J. Nagrath, Modern Power System Analysis, McGraw-Hill Education, 4th Edition, 2011.

REFERENCES:

1. G.W. Stagg and A.H. El-Abiad, Computer Methods in Power System Analysis, McGraw-Hill, 1st Edition, 1968.
2. M.L. Soni, P.V. Gupta, U.S. Bhatnagar, A. Chakrabarti, Power System Engineering, Dhanpat Rai & Co., 2nd Edition, 2013.
3. Agam Kumar Tyagi, MATLAB and Simulink for Engineers, Oxford University Press, 1st Edition, 2012.

ONLINE RESOURCES:

1. <https://www.ee.iitb.ac.in/~vlabsync/template/vlab/index.html#>

IV Year B.Tech. – I Semester

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(BA23AAC701) GENDER SENSITIZATION**COURSE OBJECTIVES:**

The objectives of this course is 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 Bhargubanda, 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 Edn., March 1990

REFERENCES:

1. Wtatt, Robin and Massood, Nazia, Broken Mirrors: The dowry Problems in India, London: Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), 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, AnupamaSihag, 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
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
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
7. 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
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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(EE23AIP701) 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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(EE23AIP801) 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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(EE23APW801) 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:

1. SK. Sears, GA. Sears, RH. Clough, Construction Project Management, John Wiley and Sons, 6th Edition, 2016.
2. Saleh Mubarak, Construction Project Scheduling and Control, 4th 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, 8th 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, 12th Edition, 2021.

III Year B.Tech. – I Semester

L	T	P	C
3	-	-	3

(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

L	T	P	C
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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, 10th Edition, 2018
2. Tanenbaum A S, Modern Operating Systems, Pearson, 4th Edition, 2016

REFERENCES:

1. Stallings W Operating Systems -Internals and Design Principles, Pearson, 9th Edition, 2018
2. D.M. Dhamdhere, Operating Systems: A Concept Based Approach, McGraw- Hill, 3rd 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

L	T	P	C
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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, 3rd 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, 3rd Edition.
2. Patrick Henny Winston, Artificial Intelligence, Pearson Education, 3rd 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, 3rd Edition.
2. E. Rich and K. Knight, Artificial Intelligence, TMH, 3rd Edition.

REFERENCES:

1. Patrick Henny Winston, Artificial Intelligence, Pearson Education, 3rd 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

1. Andrew Tanenbaum, Feamster, Wetherall, Computer Networks (Global Edition), Pearson, 6th Edition, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, 5th Edition, 2017.

REFERENCES:

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson, 6th Edition, 2019.
2. Youlu Zheng, Shakil Akthar, Networks for Computer Scientists and Engineers, Oxford Publishers, 1st 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, 1st 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, 2nd 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, 3rd Edition, 2006.
2. David A. Bell, Electronics Devices and Circuits Theory, Oxford University press, 5th Edition, 2008.

REFERENCES:

- 1 . Electronics Devices and Circuits Theory, R.L.Boylestad, Louis Nashelsky and K.Lal Kishore, 12th Edition, 2006, Pearson, 2006.
2. Electronic Devices and Circuits, N. Salivahanan, and N.Suresh Kumar, TMH, 3rd Edition, 2012.
3. S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 5th 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, 2nd 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, 4th Edition, 2012.

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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, 3rd 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 I:**(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, 11th Edition, 2016
2. Peter F. Drucker, Innovation and Entrepreneurship, Harper Business, 1st Edition, 1985

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.
3. Namita Thapar, The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited, 2022.
4. 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; 1st Edition Pease, Allan & Barbara. The Definitive Book Ff Body Language RHUS Publishers, 2016.

REFERENCES:

1. Alice Savage, Masoud Shafiei, Effective Academic Writing, 2nd Edition. 2014.
2. Shalini Verma, Body Language, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata, Communication Skills 2nd 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
7. <https://archive.nptel.ac.in/courses/109/107/109107172/#>
8. <https://archive.nptel.ac.in/courses/109/104/109104107/>

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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 1:** Apply linear algebra concepts to ML techniques like PCA and regression.
- CO 2:** Analyze probabilistic models and statistical methods for AI applications.
- CO 3:** Implement optimization techniques for machine learning algorithms.
- CO 4:** Utilize vector calculus and transformations in AI-based models.
- CO 5:** 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:**

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.

REFERENCES:

1. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.
2. 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, 4th 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
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, 6th Edition, 2008.
2. Bahl and Bahl and Tuli, Essentials of Physical Chemistry, 28th Edition, 2024.

REFERENCES:

1. Fuel Cell Hand Book, by US Department of Energy, 7th 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, 6th Edition, 2025.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/104106137>
2. https://onlinecourses.nptel.ac.in/noc24_ee109/preview
3. 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, 1st Edition, 2017.
2. Edward A. Keller and Duane E. DeVecchio, Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, Routledge, 5th Edition, 2019.

REFERENCES:

1. Ben Wisner, J.C. Gaillard, and Ilan Kelman (Editors), Handbook of Hazards and Disaster Risk Reduction and Management, Routledge, 2nd Edition, 2012.
2. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann, 4th Edition, 2020.
3. Bimal Kanti Paul, Environmental Hazards and Disasters: Contexts, Perspectives and Management, Wiley-Blackwell, 2nd Edition, 2020

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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. - CO₂ 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, 4th 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, 3rd 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, 2nd 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, 4th Edition.

REFERENCES:

1. Herbert Schildt, *Java: The Complete Reference*, Tata McGraw-Hill, 11th Edition, 2019.
2. Kathy Sierra and Bert Bates, *Head First Java*, O'Reilly Media, 2nd Edition, 2005.
3. Cay S. Horstmann, *Core Java Volume I – Fundamentals*, Pearson, 12th Edition, 2022.
4. Cay S. Horstmann, *Core Java Volume II – Advanced Features*, Pearson, 12th Edition, 2022

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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, 2nd 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, 8th Edition, 2020.
2. Bernard Menezes, Cryptography, Network Security and Cyber Laws, Engage Learning, 1st Edition, 2010.

REFERENCES:

1. Beerhouse Frozen, Debden Mukhopadhyaya, Cryptography and Network Security, McGraw Hill, 3rd Edition, 2015.
2. Jason Albanese, Wes Sonnenreich, Network Security Illustrated, McGraw-Hill Professional, 1st Edition, 2003.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105031/lecture>
2. [https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhyaya IITKharagpur](https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhyayaIITKharagpur)
3. <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, 3rd 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, 5th Edition.
2. Roger S. Pressman, Software Engineering A practitioner's Approach, Mc- Graw Hill International Edition, 9th Edition.

REFERENCES:

1. Software Engineering, Ian Sommerville, Pearson, 10th 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
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview

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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, 5th Edition, 1999.
2. ZviKohavi and NirahK.Jha, Switching theory and Finite Automata Theory, Tata McGraw Hill, 2nd Edition,2005.

REFERENCES:

1. Charles H Roth Jr., Fundamentals of Logic Design, Brooks/Cole Cengage Learning, 5th Edition, 2004.

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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, 4th Edition, 2000.
2. Chetan Singh Solanki, Solar Photovoltaics Fundamentals, Technologies and Applications, PHI Learning Private Limited, 2nd Edition 2012.

REFERENCES:

1. Stephen Peake, Renewable Energy Power for a Sustainable Future, Oxford International, 4th Edition, 2018.
2. S. P. Sukhatme, Solar Energy, Tata Mc Graw Hill Education Pvt. Ltd, 3rd Edition, 2008.
3. B H Khan, Non-Conventional Energy Resources, Tata Mc Graw Hill Education Pvt Ltd, 2nd Edition, 2011.
4. S. Hasan Saeed and D.K.Sharma, Non-Conventional Energy Resources, S.K.Kataria & Sons, 3rd 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

L	T	P	C
3	-	-	3

(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>

III Year B.Tech. – II Semester

L	T	P	C
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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

L	T	P	C
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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, 2nd Edition, 2012
2. Lesikar R. V., Pettit J. D., Flatley M. E., Basic Business Communication, Mcgraw Hill Education, 11th 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>

III Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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>

III Year B.Tech. – II Semester

L	T	P	C
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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 ($\mathbb{R}^2$, $\mathbb{R}^3$, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigenvalues, eigenvectors), Finite-dimensional examples (2×2 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
2. 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/>

III Year B.Tech. – II Semester

L	T	P	C
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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
2. https://onlinecourses.nptel.ac.in/noc20_ma23/preview
3. https://onlinecourses.nptel.ac.in/noc19_ma29/preview

III Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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, 4th Edition, 2021.
2. Donald A. Neamen, Semiconductor Physics and Devices: Basic principles, 4th Edition, McGraw Hill, 2012.

REFERENCES:

1. B. G. Streetman, S. Banerjee, Solid State Electronic Devices, PHI Learning, 6th 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., 2nd Edition, 2011.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/113/106/113106062/>
2. https://onlinecourses.nptel.ac.in/noc20_ph24/preview

III Year B.Tech. – II Semester

L	T	P	C
3	-	-	3

(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. Billmeyer, A Text book of Polymer Science, 3rd Edition, 2025.
2. G.S. Mishra, Polymer Chemistry, 4th 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, 3rd 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

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, 2nd 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

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, 4th 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, 2nd 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 21st 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, 3rd Edition, 2003.
2. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, Tata McGraw-Hill, 5th Edition, 2006.

REFERENCES:

1. C. J. Date, *Introduction to Database Systems*, Pearson, 8th Edition, 2004.
2. Ramez Elmasri and Shamkant B. Navathe, *Fundamentals of Database Systems*, Pearson, 6th 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_01275806667282_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, 10th 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, 1st 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, 3rd Edition, 2015.
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, 1st Edition, 1998.

REFERENCES:

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGrawHill, 3rd Edition, 2017.
2. Patterson, Introduction to Artificial Intelligence & Expert System, Pearson, 1st 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.

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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 DevelopersII, Wiley, 1st edition, 2020.
2. Andreas M. Antonopoulos, Mastering Bit coin: Programming the Open Block Chain, O'Reilly, 1st edition, 2017.

REFERENCES:

1. Joseph Barbara, Paul R. Allen, Block chain: A Practical Guide to Developing Business, Law, and Technology Solutions, Mc Grow Hill, 1st Edition, 2018.
2. Melanie Swan, Block chain: Blueprint for a New Economy, O'Reilly, 1st Edition, 2017.

ONLINE RESOURCES:

1. <https://github.com/blockchainedindia/resources>
2. https://onlinecourses.nptel.ac.in/noc22_cs44/preview

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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, 1st Edition, 2019.
2. Mike Chappell, James Michael Stewart, Darrel Gibson, CISSP (ISC)² Certified Information Systems Security Professional Official Study Guide, 9th Edition, 2021.

REFERENCES:

1. Charles J. Brooks, Christopher Grow, Philip Craig and Donald Short, Cyber security Essentials, Say box, 1st Edition, 2018.
2. William Stallings, Network Security Essentials, Pearson Education, 6th Edition, 2018.
3. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India, 1st Edition, 2011.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_cs116/preview

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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, 3rd Edition, 2017.
2. Kimberly Graves, CEH: Official Certified Ethical Hacker Review Guide, Wiley, 1st Edition, 2007.

REFERENCES:

1. Michael Gregg, Certified Ethical Hacker (CEH) Cert Guide, Pearson, 3rd Edition, 2019.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_cs94/preview

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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, 2nd 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, 2nd 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
2. <https://www.coursera.org/specializations/data-science-python>

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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 Knaflitz, 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/>

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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 Transcoding 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)

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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, 1st 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, 1st 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>

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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, 3rd Edition, 2016.
2. William K. Pratt, Digital Image Processing, John Wiley, 3rd Edition, 2004

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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, 3rd Edition, 1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, McGraw Hill Education, 3rd Edition, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System

Design, Pearson, 2nd Edition, 2012.

REFERENCES:

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, Penram International Publishing, 6th Edition, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, 3rd Edition, 2004.

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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, Venturi 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. 3rd 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., 2nd 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, 1st Edition, 2001
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 1st Edition, 2017.

REFERENCES:

1. Iqbal Husain, Electric and Hybrid Vehicles Design Fundamentals, CRC Press, 3rd Edition, 2021.
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, Energy Storage in Power Systems, Wiley Publication, ISBN: 978-1-118-97130-7, 1st 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), 2nd 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, 1st Edition, 2004.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2nd Edition, 2003.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/108/102/108102121/>
2. <https://nptel.ac.in/syllabus/108103009>

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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, 2nd Edition, 2016.
2. Albert Thumann, William J. Younger, Handbook of Energy Audits, Taylor & Francis Ltd, 7th Edition, 2008.

REFERENCES:

1. Umesh Rathore, Energy management, S.K. Kataria & Sons, 2nd Edition, 2014.
2. W.C.Turner, Stevedoty, Energy Management Hand Book, CRC press, 6th 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), 1st 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
5. <https://www.youtube.com/watch?v=ENLzwTVjxms>
6. <https://www.youtube.com/watch?v=7hDyLuFJ0c8>
7. <https://www.youtube.com/watch?v=lkNIuFkzxBk>

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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, 1st Edition, 2013.
2. Fereidoon. P.Sioshansi, Smart Grid – Integrating Renewable, Distributed and Efficient Energy, Academic Press, USA, 1st Edition, 2011.
3. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press Publication, England, 1st Edition, 2013.
4. Phadke A G, Thorp J S, Synchronized Phasor Measurements and Their Applications, Springer, Newyork, 1st Edition, 2012.

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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>

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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, 4th 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, 1st 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>

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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, 4th Edition, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata McGraw-Hill Publishing Company Ltd., 2005.
3. Joel E. Ross, Total Quality Management, CRC Press, 3rd 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., 1st Edition, 1993.
3. Richard S. Leavenworth and Eugene Lodewick Grant, Statistical Quality Control, Tata McGraw-Hill, 7th 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>

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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, 1st Edition, 2014
2. Michael W. Johnson, Sales and Business Development, Routledge, 1st 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>

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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, 18th Edition, 2020
2. V. Rajesh, The Phenomenal Rise of E-Commerce in India: Techno Marketing Strategies, SAGE Publications, 1st 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. 4th Edition, 2008
3. Shikha Kapoor. Personality Development and Soft Skills - Preparing for Tomorrow,

Wiley, 1st 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_2iUCG87CQhELCYtvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHIsQFwJZel_j2PUy0pwjVUgj7KlJ
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
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

IV Year B.Tech. – I Semester

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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)**

21st 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, 1st Edition, 2016.
2. Larry James, The First Book of Life Skills, Embassy Books, 1st Edition, 2016.

REFERENCES:

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, Personality Development & Soft Skills, Oxford Publishers, 3rd 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, 1st Edition, 2015.
6. Shalini Verma, Development of Life Skills and Professional Practice, Sultan Chand (G/L) & Company, 1st Edition, 2014.
7. Daniel Goleman, Emotional Intelligence, Bantam, 2006.
8. Butterfield Jeff, Soft Skills for Everyone, Cengage Learning India Pvt Ltd, 1st Edition, 2011.
9. Stephen P. Robbins, Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6th Edition, 2015.
10. Gopala Swamy Ramesh, Mahadevan Ramesh, The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education, 1st Edition, 2013.

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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:**

1. Ulysses- Alfred Lord Tennyson
2. Ain't I woman?-Sojourner Truth
3. The Second Coming-W.B. Yeats
4. 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
5. Characters and characterization

UNIT III:**(10 Periods)****Essay and Short Story:**

1. The Luncheon - Somerset Maugham
2. The Happy Prince-Oscar Wilde
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 Livingstone
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, 1st 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/>

IV Year B.Tech. – I Semester

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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/>

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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>

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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 (ψ), 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, 4th 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>

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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, 2nd 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

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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 Aliofkhazraei, 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

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, 6th Revised Edition, 2020.
2. U. Satyanarayana, Biotechnology, Books & Allied Ltd., 5th 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, 2nd 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

IV Year B.Tech. – I Semester

L	T	P	C
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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, 1st Edition, 2007.
2. B S Murty, P Shankar, BaldevRai, BB Rath and James Murday, Textbook of Nanoscience and Nanotechnology, Univ. Press, 1st 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
3. 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, 2nd Edition, 2016.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, Oxford University Press, USA, 4th Edition, 1998.

REFERENCES:

1. Sanjay K. Sharma and AckmezMudhoo, Green Chemistry for Environmental Sustainability, CRC Press, 1st Edition, 2010.
2. Edited by AlvisePerosa 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

HONORS DEGREE

III Year B.Tech. – I Semester

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(EE23AHN501) ADAPTIVE CONTROL SYSTEMS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic concepts of Adaptive control and types
- Understand the concept of Self Tuning Regulator
- Design various STR based Adaptive control strategies
- Understand the concept of MRAS
- Understand the concept of Gain scheduling and applications of Adaptive control

COURSE OUTCOMES:

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

- CO 1:** Understand the basic concepts of Adaptive control system, types, formulation of adaptive control problem.
- CO 2:** Analyze the Adaptive models like STR and MRAS
- CO 3:** Design of STR based control algorithms
- CO 4:** Apply the MARS concepts for various applications
- CO 5:** Evaluate the given dynamical system performance using Adaptive control

UNIT I: (10 Periods)

Introduction, Block Diagram of an Adaptive System, Effects of Process Variations on System Performance, Types of Adaptive Schemes, Formulation of the Adaptive Control Problem, Abuses of Adaptive Control, Least Squares Method and Regression Models for Parameter Estimation – Theorems, Estimating Parameters in Models of Dynamic Systems, The Finite Impulse Response Model, The Transfer Function Model, and The Stochastic Model

UNIT II: (9 Periods)

Block Diagram of Deterministic Self Tuning Regulator (STR), Pole Placement Design – Process Model, Model Following, Causality Conditions. Indirect STRs – Estimation, Continuous - Time STRs, Direct STRs – Minimum Phase Systems, Adaptive Control Algorithm, Feed Forward Control, Non-Minimum Phase Systems – Adaptive Control Algorithm, Algorithm for Hybrid STR.

UNIT III: (9 Periods)

Energy resources and Sector wise energy Consumption Pattern Impact of energy on economy and development - National and State Level Energy policies and Issues - Status of Nuclear and Renewable Energy and Power Sector reforms. Energy policy 2030 Design of Minimum Variance and Moving - Average Controllers, Stochastic STR – Indirect STR, Algorithm for Basic STR, Theorems on Asymptotic Properties. Unification of Direct STRs, Generalized Direct Self Tuning Algorithm, Self-Tuning Feed Forward Control. Linear Quadratic STR – Theorems on LQG Control, Algorithms for Indirect LQG – STRs Based on Spectral Factorization and Riccati Equation.

UNIT IV: (9 Periods)

Model Reference Adaptive System (MRAS), The MIT Rule, Block Diagram of an MRAS for adjustment of Feed Forward Gain based on MIT Rule. Adaptation Gain – Methods for determination. Design of MRAS using Lyapunov Theory – Block Diagram of an MRAS based on Lyapunov Theory for a First Order System. Proof of The Kalman – Yakubovich Lemma, Adjustment Rules for Adaptive Systems, Relation between MRAS and STR.

UNIT V: (8 Periods)

Gain Scheduling – Principle, Block Diagram, Design of Gain Scheduling Controllers, Nonlinear

Transformations, Block Schematic of a Controller based on Nonlinear Transformations. Application of Gain Scheduling for Ship Steering, Flight Control. Self-Oscillating Adaptive System (SOAS) – Principle, Block Diagram, Properties of The Basic SOAS, Procedure for Design of SOAS. Industrial Adaptive Controllers and applications.

Total Periods: 45

TEXT BOOKS:

1. K.J.Astrom and Bjorn Wittenmark, Adaptive control, Pearson Edu., 2nd Edition.
2. Sankar Sastry, Adaptive Control, Dover Publications, 1st Edition, 2011.

REFERENCES:

1. V. V. Chalam, Adaptive Control Systems: Techniques and Applications, Marcel Dekker Inc., 1987.
2. M. G. Miskhin, D. I. Braun, Adaptive Control Systems, McGraw Hill, 1975.
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing, Springer, 1995.
4. G. C. Goodwin, K. S. Sin, Adaptive Control, Prentice Hall, 1984.

III Year B.Tech. – I Semester

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(EE23AHN502) BATTERY MANAGEMENT SYSTEMS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce battery basics including cell types, configurations, and charging/discharging characteristics.
- Explain the architecture and key functions of Battery Management Systems
- Understand SOC and SOH estimation techniques and cell balancing methods.
- Study battery modelling approaches and simulate EV performance using various models.
- Design BMS considering distance, load, and energy balancing in multi-battery systems.

COURSE OUTCOMES:

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

- CO 1:** Understand the role of battery management system
- CO 2:** Identify the requirements of Battery Management System
- CO 3:** Interpret the concept associated with battery charging / discharging process.
- CO 4:** Analyze various parameters of battery and battery pack.
- CO 5:** Design the model of battery pack.

UNIT I:**(10 Periods)**

Introduction: Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging.

UNIT II:**(9 Periods)**

Battery Management System: Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power.

UNIT III:**(9 Periods)**

Battery State of Charge and State of Health Estimation: Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing.

UNIT IV:**(9 Periods)**

Modelling and Simulation: Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs.

UNIT V:**(8 Periods)**

Design of Battery Management Systems: Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.

Total Periods: 45**TEXT BOOKS:**

1. Gregory L. Plett, Battery Management Systems, Volume I: Battery Modelling, Artech House, 2015.
2. Gregory L. Plett, Battery Management Systems, Volume II: Equivalent-Circuit

Methods, Artech House, 2015.

REFERENCES:

1. H. J. Bergveld, W. S. Kruijt, P. H. L. Notten, Battery Management Systems: Design by Modelling, Philips Research Book Series, 2002.
2. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House, 2010.
3. Valer Pop, et al., Battery Management Systems: Accurate State-of-Charge Indication for Battery Powered Applications, Vol. 9, Springer Science & Business Media, 2008.

III Year B.Tech. – I Semester

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(EE23AHN503) RESTRUCTURED POWER SYSTEMS**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the structure, models, and challenges of deregulated electric utilities.
- Explain OASIS functionality and analyze different types of market power.
- Describe ATC concepts, electricity pricing mechanisms, and forecasting challenges.
- Understand ISO and GENCO roles in power system operation under competition.
- Study transmission cost allocation methods and management of ancillary services.

COURSE OUTCOMES:

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

- CO 1:** Understand restructuring models and market mechanisms in electric utilities.
- CO 2:** Analyze the operation of OASIS and strategies to mitigate market power.
- CO 3:** Calculate ATC and interpret electricity price volatility and forecasting.
- CO 4:** Evaluate system operation planning in pool and bilateral market structures.
- CO 5:** Apply transmission pricing techniques and assess ancillary service provision.

UNIT I: (10 Periods)

Key Issues in Electric Utilities: Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion

UNIT II: (9 Periods)

Open Access Same-Time Information System (Oasis) and Market Power: Structure of OASIS – Posting of Information – Transfer capability on OASIS. Market Power: Introduction – Different types of market Power – Mitigation of Market Power – Examples.

UNIT III: (8 Periods)

Available Transfer Capability (ATC) and Electricity Pricing: Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow. Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT IV: (8 Periods)

Power System Operation in Competitive Environment: Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT V: (9 Periods)

Transmission Cost Allocation Methods and Ancillary Services Management: Introduction – Transmission Cost Allocation Methods: Postage Stamp Rate Method – Contract Path Method – MW-Mile Method – Unused Transmission Capacity Method – MVA-Mile method – Comparison of cost allocation methods. Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

Total Periods: 45

TEXT BOOKS:

1. Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers, 2001.
2. Mohammad Shahidehpour and Muwaffaq alomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 2001.

III Year B.Tech. – I Semester

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(EE23AHN601) AC DRIVES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand the basic concepts of phase Controlled Induction Motor Drive
- Understand the concept of Voltage Source Inverter Fed Induction Motor Drive
- Design various Rotor Side Control of Slip-Ring Induction Motor
- Understand the concept of Control of Synchronous Motor Drives
- Understand the concept of PMSM and BLDC Drives.

COURSE OUTCOMES:

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

- CO 1:** Understand the basic concepts of AC Motor Drives
- CO 2:** Modelling and analysis Stator Voltage and Frequency Control of Induction Motor, Torque-Speed Characteristic Static Frequency Changers, PWM Inverter Fed Induction Motor Drive.
- CO 3:** Design of speed control of induction motor from rotor end.
- CO 4:** Design and analysis of synchronous motor drives.
- CO 5:** Understand Design the concept of BLDC motor PMSM Motor

UNIT I: (10 Periods)

Phase Controlled Induction Motor Drive: Stator Voltage Control of Induction Motor, Phase-Controlled Converter Fed Induction Motor, Power Circuit and Gating, Reversible Phase-Controlled Induction Motor Drive, Torque-Speed Characteristics.

UNIT II: (9 Periods)

Voltage Source Inverter Fed Induction Motor Drive: Stator Voltage and Frequency Control of Induction Motor, Torque-Speed Characteristic Static Frequency Changers, PWM Inverter Fed Induction Motor Drive, Variable-Voltage Variable Frequency Operation of Induction Motor, Constant E/f and V/f Control Schemes, Slip Regulation.

UNIT III: (9 Periods)

Rotor Side Control of Slip-Ring Induction Motor: Slip-Power Recovery Schemes, Steady-State Analysis- Range of Slip, Equivalent Circuit, Performance Characteristics; Rating of Converters.

Vector Control of Induction Motor: Principles of Vector Control, Direct Vector Control, Indirect Vector Control, Implementation – Block Diagram, Estimation of Flux, Flux Weakening Operation.

UNIT IV: (9 Periods)

Control of Synchronous Motor Drives: Synchronous Motor - Control Strategies-Constant Torque Angle Control-Power Factor Control, Constant Flux Control, Flux Weakening Operation, Load Commutated Inverter Fed Synchronous Motor Drive, Motoring and Regeneration, Phasor Diagrams.

UNIT V: (8 Periods)

PMSM and BLDC Drives: Characteristics of Permanent Magnet, Synchronous Machines with Permanent Magnet, Vector Control of PMSM- Motor Model and Control Scheme, Constant Torque Angle Control, Constant Mutual Flux Linkages, Unity PF Control. Modelling of PM Brushless DC Motor, Drive Scheme, Commutation Torque Ripple, Phase Advancing.

Total Periods: 45

TEXT BOOKS:

1. R. Krishnan, Electric Motor Drives Modelling, Analysis & control, Pearson Education, 2001.
2. B. K. Bose Modern Power Electronics and AC Drives, Pearson Publications, 2001.

REFERENCES:

1. MD Murphy & FG Turn Bull, Power Electronics control of AC motors, Pergaman press, 1st Edition, 1998.
2. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1st Edition, 1995.
3. S. K. Pillai, A First Course on Electrical Drives, New Age International, 1st Edition, 1989.
4. Vedam Subrahmanyam, Electric Drives: Concepts and Applications, McGraw Hill Education, 2nd Edition, 2017.

III Year B.Tech. – II Semester

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(EE23AHN602) EV CHARGING TECHNOLOGIES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Understand key battery parameters and types.
- Learn battery modelling methods and SOC estimation.
- Know EV charging infrastructure and standards.
- Study lithium battery charging techniques.
- Explore power electronics in EV charging.

COURSE OUTCOMES:

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

- CO 1:** Understanding Battery Basics and Key Parameters
- CO 2:** Analyzing Battery Modelling Techniques and Capacity Estimation
- CO 3:** Exploring Charging Infrastructure and Regulatory Frameworks
- CO 4:** Evaluating Battery Charging Techniques and Performance
- CO 5:** Understanding Power Electronics in EV Charging Systems

UNIT I: (10 Periods)

Battery Basics: Battery parameters- Cell and Battery Voltages, Charge (or Amp hour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amp hour (or Charge) Efficiency, Energy Efficiency, Self-discharge Rates, Battery Geometry, Battery Temperature, Heating and Cooling Needs 35 3.2.12 Battery Life and Number of Deep Cycles Types of batteries- lead-acid, nickel based sodium based, lithium batteries, metal-air batteries. Refilled Batteries.

UNIT II: (9 Periods)

Battery Modelling: The Purpose of Battery Modeling, Electrochemical model, black box model, equivalent circuit model - Battery Equivalent Circuit, Modeling Battery Capacity, simulating a Battery at a Set Power, Calculating the Peukert Coefficient, Approximate Battery Sizing, Battery state of charge estimation.

UNIT III: (8 Periods)

Charging Infrastructure: EV supply equipment, charging standards, classification of charging infrastructure, connecting EVs to the electricity grid, regulatory framework for EV charging connections, communication protocols for smart charging, Battery Management System.

UNIT IV: (10 Periods)

Battery Charging Techniques: Basic Terms for Evaluating Charging Performances, Charging Algorithms for Li Ion Batteries, Optimal Charging Current Profiles for Lithium Ion battery, Lithium Titanate Oxide Battery with Extreme Fast Charging Capability. Super Capacitors for battery charging.

UNIT V: (8 Periods)

Power Electronics in EV Charging: Active front end rectifiers - Forward converters, half and full bridge DC-DC converters, power factor correction converters, decreasing impact on the grid and switches, bidirectional battery chargers, wireless charging.

Total Periods: 45

TEXT BOOKS:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2012.
2. RuiXiong, Weixiang Shen, Advanced Battery management Technologies for Electric Vehicle, Wiley, 2018.

REFERENCES:

1. NITI Aayog, Handbook of Electric Vehicle Charging Infrastructure Implementation, Government of India, 2018.
2. Chris Mi, M. Abul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 2017.
3. Bruno Scrosati, Jurgen Garche, Werner Tillmetz, Advances in Battery Technologies for Electric Vehicles, Woodhead Publishing Series in Energy, 2015.
4. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_ee134/preview

III Year B.Tech. – II Semester

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(EE23AHN603) POWER SYSTEM WIDE AREA MONITORING AND CONTROL**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce real-time computer control systems like SCADA and WAMS.
- Explain the concepts and methods of power system state estimation.
- Study advanced estimation techniques and observability analysis.
- Understand power system security and contingency analysis.
- Analyze voltage stability and voltage collapse phenomena.

COURSE OUTCOMES:

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

- CO 1:** Understand SCADA and WAMS in real-time power system monitoring.
- CO 2:** Apply estimation techniques to determine system operating states.
- CO 3:** Perform observability analysis and dynamic state estimation.
- CO 4:** Conduct security assessment and contingency analysis.
- CO 5:** Evaluate voltage stability and propose preventive measures.

UNIT I:**(10 Periods)**

Computer Control of Power Systems: Need for real - time and computer control of power systems, operating states of a power system - 3 state & 5 states operation of power system - Supervisory Control and Data Acquisition system (SCADA), implementation considerations, energy control centers. WAMS (Wide Area Measurement system): Architecture, Components of WAMS, GUI (Graphical User Interface), Applications: Voltage Stability Assessment, Frequency stability Assessment, Power Oscillation Assessment, Communication needs of WAMS, WAMPAC (Wide Area Monitoring Protection & Control), RAS (Remedial Action Scheme). Standards: IEEE 1344, IEEE C37.118 (2005), IEEE Standard C37.111-1999 (COMTRADE), IEC61850 GOOSE.

UNIT II:**(9 Periods)**

State Estimation in Power Systems: Introduction, Power system state estimation, Maximum likelihood, weighted least Square estimation, Weighted least square estimation. State Estimation of AC Networks: Types of measurements, Linear weighted least square (WLS) estimation theory, DC Load flow based WLS state estimation, Linearized model of WLS state estimation of Non - Linear AC power systems, sequential and non - Sequential methods to process measurements, Typical results of state estimation on an Ac network.

UNIT III:**(9 Periods)**

Types of State Estimation and Network Observability: State estimation by conventional WLS (normal equations), Orthogonal decomposition and its algorithm, hybrid method. Tracking of state estimation, Dynamic state estimation, Detection and identification of bad measurements, estimation of quantities not being measured. Network observability and pseudo-measurements, observability by graphical technique and triangularisation approach, Optimal meter placement, Application of power system state estimation.

UNIT IV:**(9 Periods)**

Power System Security Analysis: Concept of security, Security analysis and monitoring, factors affecting power system security, detection of network problems, an overview of security analysis. Contingency analysis for generator and line outages by Interactive Linear Power Flow (ILPF) method, Fast decoupled inverse Lemma based approach, network sensitivity factors, Contingency selection, concentric relaxation and bounding.

UNIT V:

(8 Periods)

Voltage Stability: Basic concepts, Voltage collapse – general characterization, classification, Voltage stability analysis – modelling, dynamic analysis, static analysis, shortest distance to instability, continuation power flow analysis, prevention of voltage collapse – design measures, operating measures.

Total Periods: 45

TEXT BOOKS:

1. Allen J. Wood, Bruce F. Wollenberg, Power System Generation, Operation and Control, John Wiley & Sons, 2nd Edition, 1996.
2. John J. Grainger, William D. Stevenson Jr., Power System Analysis, McGraw Hill ISE, 1994.

REFERENCES:

1. P. Kundur, Power System Stability and Control, McGraw Hill, 1994.
2. Fahd Hashiesh, M. M. Mansour, Hossam E. Mostafa, Wide Area Monitoring, Protection and Control: The Gateway to Smart Grids, Lambert Academic Publishing, 2013.
3. E. Handschin, Real-time Control of Electrical Power Systems, Elsevier Publications, 1988.
4. IEEE Proceedings, Special Issue on Computer Control of Power Systems, July 1974.

IV Year B.Tech. – I Semester

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(EE23AHN701) COMPUTER-AIDED DESIGN OF ELECTRICAL MACHINES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce the fundamental principles and methodologies involved in designing electrical machines.
- Enable students to design various types of electrical machines like transformers, DC and AC machines.
- Provide knowledge on thermal, magnetic, and mechanical design aspects of machines.
- Familiarize students with the design of special machines such as PM machines, SRM, and axial flux machines.
- Impart skills in using Computer-Aided Design (CAD) and Finite Element Analysis (FEA) tools in machine design.

COURSE OUTCOMES:

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

- CO 1:** Understand the basic design approach, constraints, and parameters of electrical machines.
- CO 2:** Design transformers, DC machines, and induction motors based on specifications and performance criteria.
- CO 3:** Analyze and develop designs for synchronous and special electrical machines.
- CO 4:** Evaluate the performance and thermal characteristics of machine components.
- CO 5:** Apply CAD and simulation tools for modelling and Analyzing electrical machines.

UNIT I: Introduction and Transformer Design**(9 Periods)**

Fundamentals of Machine Design: design process, design specifications, performance constraints. Equivalent circuit approach and basic parameters.

Design of Transformers: Core design, winding arrangements, insulation, cooling, losses, and efficiency. Winding types in electrical machines.

UNIT II:**(9 Periods)**

Machines and Induction Motor Design: Design of DC machines – armature, field system, commutator, brushes, thermal considerations.

Design of 3-Phase Induction Motors: stator, rotor, slots, magnetic loading, performance estimation.

Design of Single-Phase Induction Motors: construction, design equations, losses, efficiency.

UNIT III:**(8 Periods)**

Design of Synchronous Machines: rotor, stator, excitation system, ventilation.

Design of Synchronous Reluctance Machines: flux path, salient pole design, reluctance torque optimization.

UNIT IV:**(10 Periods)**

Brushless PM Machines: Design of Brushless Permanent Magnet Machines – rotor configurations, materials, magnet placement, cogging reduction. Thermal considerations, efficiency improvement techniques, mechanical design.

UNIT V: Special Machines and CAD Tools**(9 Periods)**

Design of Switched Reluctance Machines: excitation, rotor/stator pole design.

Design of Stepper Motors: permanent magnet and variable reluctance types.

Design of Axial Flux Machines: geometry, torque density. Computer-Aided Design (CAD) and Finite Element Analysis in electrical machines.

Total Periods: 45

TEXT BOOKS:

1. R. K. Agarwal, Principles of Electrical Machine Design, S. K. Kataria & Sons, 2020.
2. A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & Co., 2018.

REFERENCES:

1. S. K. Sen, Principles of Electrical Machine Design with Computer Programs, Oxford & IBH Publishing, 2006.
2. M. V. Deshpande, Design and Testing of Electrical Machines, PHI Learning, 2014.
3. Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, Design of Rotating Electrical Machines, Wiley, 2nd Edition, 2013.

IV Year B.Tech. – I Semester

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(EE23AHN702) GRID INTERFACE OF ELECTRIC VEHICLES**COURSE OBJECTIVES:**

The objectives of this course are to:

- Introduce smart grids, micro grids, and PEV integration.
- Study V2G/G2V impact on grids and renewables.
- Analyze EV power conversion and control systems.
- Understand planning and control of PEV charging.
- Explore PEVs as ancillary service providers.

COURSE OUTCOMES:

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

- CO 1:** Understanding the Fundamentals of Smart Grid and Electric Vehicle Integration
Analyze Impact of EV on smart grid
- CO 2:** Analyzing the Impact of EVs and V2G on the Smart Grid and Renewable Energy Systems
- CO 3:** Applying Power Conversion Technologies for Smart Grids and Electric Vehicles-
- CO 4:** Designing Control and Management Strategies for PEV Parking Lots
- CO 5:** Evaluating the Role of PEVs as Ancillary Services in Smart Grids

UNIT I:**(8 Periods)**

Introduction to Smart Grid and PEV: Introduction to smart grid and microgrid, Impact of PEVs on Distributed Energy Resources in the Smart Grid, V2G Technology and PEVs Charging Infrastructures.

UNIT II:**(8 Periods)**

Impact of V2G and G2V on the Smart Grid and Renewable Energy Systems: Types of Electric Vehicles, Motor Vehicle Ownership and EV Migration, Impact of Estimated EVs on Electrical Network, Impact on Drivers and the Smart Grid, Standardization and Plug-and-Play.

UNIT III:**(10 Periods)**

Power Conversion Technology in the Smart Grid and EV: Impacts of EV Penetration on Grid Power Profile, Requirements of Its Control and Monitoring, Hybrid EV Powertrain Architectures, Control, Monitoring and Management Strategies of EV, V2G Communication System, System model of EV, Case study of three phase fault and its impact.

UNIT IV:**(9 Periods)**

Planning, Control and Management Strategies for Parking Lots for PEVs: Introduction to PEV Charging Facility, Long-Term Planning for PEV Parking Lots, Control and Management of PEV Parking Lots - stages of implementation.

UNIT V:**(10 Periods)**

PEV as Ancillary Service in Smart Grid: Introduction to Ancillary Services, PEV Charger Optimization, PEV as ancillary source, Control Strategies for PEVs to Follow the Individual Operation Values, Systems and Control Algorithm for Smart PEV Chargers, Avoiding the Harmonic Propagation Within the Grid, Case study.

Total Periods: 45**TEXT BOOKS:**

1. Lu, J. and Hossain, Vehicle-To-Grid: Linking Electric Vehicles to The Smart Grid, Institution of Engineering and Technology, 2015.
2. Rajakaruna, S., Shahnia, F. and Ghosh, A. eds., Plug in Electric Vehicles in Smart Grids: Integration Techniques, Springer, 2014.

REFERENCES:

1. Salman, S.K., Introduction to the Smart Grid: Concepts, Technologies and Evolution IET., Volume-94, 2017.