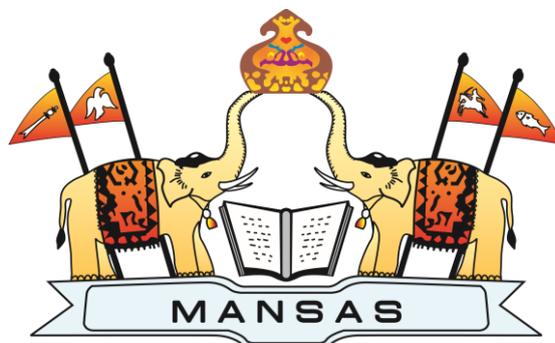# ACADEMIC REGULATIONS
&
CURRICULUM

Applicable to the students admitted from the Academic Year 2024-25 Onwards

ELECTRICAL AND ELECTRONICS ENGINEERING
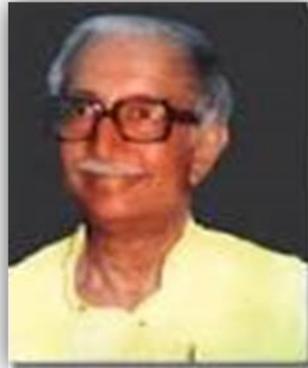## B. Tech. Program

MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING
(Autonomous)

(Approved by AICTE, New Delhi, and permanently affiliated to JNTUGV, Vizianagaram,

Listed u/s 2(f) & 12(B) of UGC Act 1956)

Vijayaram Nagar Campus, Chintalavalasa, Vizianagaram-535005, Andhra Pradesh.

The visionaries

Late Dr. P V G Raju
Raja Saheb of Vizianagaram
Founder Chairman-MANSAS
Ex-Minister for Education and Health, Govt. of AP
Ex Member of Parliament

Late Dr. P. Anand Gajapathi Raju
Ex-Chairman-MANSAS
Ex-Minister for Education and Health
Govt. of AP.
Ex-Member of Parliament.

P. Ashok Gajapathi Raju
Chairman-MANSAS
Ex-Union Minister for Civil Aviation,
Govt. of India.
Ex-Minister for Finance,
Govt. of AP

<h1 align="center">Academic Regulations (R24M) for B. Tech (Regular-Full time)</h1>

<p align="center">(Effective for the students admitted into I year from the Academic Year 2024-25 onwards)</p>

1. Award of the Degree

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 **160** credits and secures all **160** credits.

2. Award of B.Tech. degree with Honors

1. A student will be declared eligible for the award of the B.Tech degree with Honors if he/she fulfills the following:

   (i)   Student secures additional **18** credits fulfilling all the requisites of B.Tech program i.e., **178** credits.

   (ii) Registering for Honors is optional.

   (iii) Honors is to be completed simultaneously with B.Tech. program.

2. 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, forfeit their seat in B.Tech. course and their admission stands cancelled.
   This clause shall be read along with clause 1 (a) (i).

3. Admissions

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

4. Program related terms

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

Credit definition:

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

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

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

5. Semester/Credits:

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

ii. The summer break term is for Six /eight weeks during which a student has the opportunity to pursue Internship/ apprenticeship/work-based vocational education and training. This is intended to meet the mandatory requirement of a student to carry out 2-credit Community Project and Mini Project modules. This is especially helpful for students who wish to exit after two semesters or four semesters of study.

iii. Regular courses may also be offered during the summer on a fast-track mode to enable students to do additional courses or complete backlogs in coursework. The student will have the option to repeat the course inclusive of continuous assessment.

iv. The institution can decide on the courses to be offered in the summer term depending on the availability of faculty and the number of students.

6. 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 160)	Percentage of total credits
1.	Engineering Major	81	50.625
2.	Extended Open Elective Cluster (EOEC)	29	18.125
3.	Generic Engineering Stream	20	12.5
4.	Ability Enhancement Courses (AEC)	6	3.75
5.	Value Added Courses (VAC)	6	3.75
6.	Skill Enhancement Courses (SEC)	8	5
7.	Projects	10	6.25
	Total	**160**	**100**

7. Course Classification:

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

Course Category	Course Modules	Total Credits
Professional Core	• 16 Professional Core Theory Mandatory of 3 credits each **16 * 3 credits = 48 credits** • 5 Professional Core Elective Theory of 3 credits each **5 * 3 credits = 15 credits** • 6 Professional Core Lab of 2 credits each **6 * 2 credits = 12 credits** • Projects (Mini & Major) **(2 + 8) credits = 10 credits** • Department specific module (SEC) = **2 credits**	**87**
Basic Sciences	• M-I and M-II **2 * 3 credits = 6 credits** • Physics + Lab **(3 + 1) credits = 4 credits** • Chemistry + Lab **(3 + 1)credits = 4 credits** • Department Specific Math oriented courses **2 * 3 credits = 6 credits**	**20**
Humanities	• **AEC** (Language Proficiency = 2 credits; Env. Studies = 2 credits; Community Project = 2 credits) • **VAC** (E & HV = 2 credits; Constitutional values/ Rights = 2 credits; Health & Wellness =2 credits) • **SEC** (Quantitative Problem Solving = 2 credits)	**14**

Engineering Sciences/Professional Sciences	**EOEC–Extended Open Elective Cluster**
	• 6 Theory Mandatory modules. **6 * 3 credits = 18** credits
	• 1 Theory Elective module. **1 * 3 credits = 3** credits
	• 4 Lab/practice modules. **4 * 2 credits = 8** credits,
	which is an elective cluster where students can choose from multiple clusters which they can opt for as secondary skill with total of **29 credits**.
	
	  • Procedural Programming + Lab **(3 +1) credits = 4** credits
	  • Computer Aided Engineering Drawing = **2** credits
	  • Engineering Workshop = **2** credits
	  • Office tools & Social Media Etiquette = **2** credits
		39

		160
Honors	Optional For Honors (In Professional Core Area as a deep dive into Professional Elective Cluster) **4 Modules * 4 credits = 16 credits**	**16**
	4 Year Honors Degree	**176**

8. Programme Pattern

i. Total duration of the B. Tech (Regular) Program is four academic years of 8 semesters.

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

iii. There will be an Induction Program before the commencement of the First Semester for the newly admitted students in order to provide orientation and acclimatization to the college campus and professional learning environment. Several activities such as physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization to the departments, innovation activities etc., form part of the Induction Program.

v. Value Added Courses (VAC) like Health & Wellness, Constitutional Rights/Values, Ethics and Human Values are mandatory credit courses for all the undergraduate students.

vi. Ability Enhancement Courses (AEC) like Language Proficiency, Environmental Studies and Community Project are mandatory credit courses for all the undergraduate students.

vii. Skill Enhancement Courses (SEC) like Office Tools & Social Media Etiquette, Engineering Workshop, Quantitative Problem Solving Techniques and Departmental Specific Module are mandatory credit courses for all the undergraduate students.

viii. Undergraduate degree with Honors is offered as an option for the students having good academic record.

xvi. 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.

9. Evaluation Process

➢ The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for 3 credit theory subjects, 50 Marks for 2 credit theory courses and 100 marks for practical subjects. Community Project and Mini Project shall be evaluated for 50 marks while Main Project work shall be evaluated for 200 marks.

➢ 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 Continuous Assessment (CA) and Summative Assessment (SA) marks taken together for the theory, practical, design, drawing subject or project etc.

THEORY COUSES

Assessment Method	Marks
Continuous Assessment (CA)	40
Summative Assessment (SA)	60
Total	**100**

i. For theory subject, the distribution shall be 40 marks for Continuous Assessment and 60 marks for the Summative Assessment.

ii. For practical subject, the distribution shall be 40 marks for Continuous Assessment and 60 marks for the Summative Assessment.

a) Continuous Assessment (5- unit/3 Credit courses)
   i. Continuous Assessment, which is evaluated for 40 Marks is divided into 2 parts: Periodic Assessment (PA) examinations for 25 Marks and Teacher Assessment (TA) for 15 Marks. There shall be two Periodic Assessment (PA) examinations each of 25 marks during a semester. The weighted average in 80/20 ratio will be taken for 25 marks. The duration of exam is 90 minutes. The PA question paper contains 3 long answer questions with internal choice. Each Long answer question carries 7 marks. (3 * 7M = 21 marks). This will be scaled up to 25 marks)
   ii. The first PA examination shall be conducted on Units I & II with either/or type question from each unit and the second PA examination shall be conducted on Units III, IV and V with either/or type question from each unit.
   iii. The Teacher Assessment (TA) for 15 marks shall be based on assignments/projects/presentations /surprise tests/quizzes which the concerned course owner/subject teacher shall design. The TA methodology shall be approved upfront by the Board of Studies and the same shall be informed to the students at the beginning of the semester itself.

The weighted average in 80/20 ratio is calculated in the following manner. For example:

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

If the student is absent for any one PA examination, the final PA 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 PA: Absent
Marks obtained in second PA: 25
Final PA Marks: (25x0.8) + (0x0.2)   =20

Final Continuous Assessment marks shall be evaluated as follows:
CA = Final PA + TA

b) Summative Assessment - Evaluation Pattern for 5-Unit/3-Credit courses
Summative Assessment examination of 3-credit theory subjects shall have the following pattern:

➢ The SA will be conducted for 60 Marks (**180 minutes**)
➢ Question Paper contains two parts: Part – A is for 50 Marks and Part – B is for 10 Marks.
➢ **In Part – A**, there shall be one question from each of the 5 units (with either/or choice) which will be evaluated for 10 marks each
➢ **In Part – B**, there will be 1 question of 10 marks (with either/or choice) that may be a case study or comprehensive examination treating the course as one complete whole.

c) Continuous Assessment (5-unit/2 Credit courses)

For a 2-credit theory course, Continuous Assessment is evaluated for 20 Marks and shall only include the Periodic Assessment (PA) examination. There will be no Teacher Assessment component for these courses. There shall be two PA examinations each of 20 marks. The weighted average in 80/20 ratio will be taken for 20 marks. The duration of exam is **90 minutes**. The PA question paper contains 3 long answer questions with internal choice. Each Long answer question carries 6 marks. (3 * 6M = 18 marks. This will be scaled up to 20 marks)

d) Summative Assessment – Evaluation Pattern for 5-Unit/2-Credit courses

Summative Assessment examination of 2-credit theory courses shall have the following pattern:
➢ The Examination will be conducted for 30 Marks (5 * 6 Marks).
➢ Question Paper contains 5 questions (with either/or choice), one from each unit.
➢ The duration of exam is for **120 minutes**.

PRACTICAL COURSES

Assessment Method	Marks
Continuous Assessment (CA)	40
Summative Assessment (SA)	60
Total	**100**

a) For practical subjects, there shall be a Continuous Assessment during the semester for 40 marks and Summative Assessment for 60 marks.

b) The CA shall include 2 components: Day-to-day work evaluated for 25 marks and Pre-Summative Assessment examination evaluated for 15 marks. Day-to-day work in the laboratory shall be evaluated by the concerned laboratory teacher based on the regularity/record/viva and the Pre-Summative Assessment Examination shall be conducted before the end of the semester.

c) The SA shall be evaluated for 60 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same domain.

d) The Summative Assessment laboratory examination shall be conducted for **120 minutes** and assessment includes:

> ➢ Knowledge on Principles/concepts/Procedure: 20 Marks
> ➢ Experimental design /work, Results-Interpretation and analysis: 30 marks
> ➢ Viva voce: 10 marks.

e) Computer Aided Engineering Drawing – Evaluation Pattern

Assessment Method	Marks
Continuous Assessment (CA)	40
Summative Assessment (SA)	60
Total	**100**

a) The CA shall include 2 components: Day-to-day work evaluated for 25 marks and Pre-Summative Assessment examination evaluated for 15 marks. Day-to-day work shall be evaluated by the concerned subject teacher based on the reports/submissions prepared in the class. The Pre-Summative Assessment examination pattern shall consist of 3 questions (either/or type) of 5 marks each.

b) The Summative Assessment examination shall be evaluated for 60 marks, conducted by the concerned teacher and a senior expert in the subject from the same domain.

c) The question paper shall contain 3 questions (with either/or choice). Each question will be of 20 marks (5 marks for free hand drawing and list of commands and 15 marks for final drawing prepared in AutoCAD). A student shall answer all questions.

f) Computer Aided Geometric Design and Assembly Lab – Evaluation Pattern

Assessment Method	Marks
Continuous Assessment (CA)	40
Summative Assessment (SA)	60
Total	**100**

1. The CA shall include 2 components: Day-to-day work evaluated for 25 marks and Pre-Summative Assessment examination evaluated for 15 marks. Day-to-day work shall be evaluated by the concerned subject teacher based on class reports and submissions. The pre-summative examination question paper consists of two questions: one on modeling & drafting and one on assembly & drafting. Each question carries 5 marks. Student must answer both questions. And the remaining 5 marks are allocated for viva-voce.

2. The SA examination shall be evaluated for 60 marks, conducted by the concerned teacher and a senior expert in the subject from the same or related department.

3. The SA examination question paper consists of two questions: one on modeling & drafting and one on assembly & drafting. Each question

carries 25 marks (divided into 5 marks for free hand drawing & procedure and 20 marks for final drawings (modeling/ assembly/ drafting). Student must answer both questions and the remaining 10 marks are allocated for viva-voce.

10. **Community Project:** There will be a summer break of 4 to 6 weeks at the end of each academic year to provide opportunity to students to engage in internships with industry/government agencies/NGO etc. These internships are intended to give exposure to the students through Community Projects and Mini Projects.

   ➢ A student shall identify and provide a solution to the problem relevant to society.

   ➢ A student shall engage at least 30 hours on community project. Community project shall be evaluated internally for 50 marks by Project Review Committee (PRC). PRC comprising of HoD, Two senior faculty and guide shall review the progress.

11. **Mini Project:**

   ➢ A student shall undergo internship (Physical/Virtual) for a period of 4 weeks and provide solution to the problem relevant to Industry/ Modern tool during the vacation after VI semester and submit comprehensive report/certificate (For virtual internship) issued by external agencies.

   ➢ The recommended Virtual Internships offered by external agencies/regulating bodies like AICTE/APSCHE etc, conversions and appropriate grades/marks are to be approved by the BoS at the beginning of the semester.

   ➢ Mini project shall be evaluated internally for 50 marks by Project Review Committee (PRC). PRC shall prepare rubrics for assessment.

12. **Skill Enhancement Course:**

   Skill Enhancement Course is assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end examination.

Assessment Method	Marks
Continuous Internal	40
Semester End Examination	60
Total	100

   Continuous Internal Assessment   : (40 Marks)
   Continuous assessment   : 20 Marks
   Internal test   : 20 Marks

The end examination shall be evaluated for 60 marks, conducted by the concerned course teacher and a senior expert in the subject from the same department.

Procedure	: 20 Marks
Experimental work & Results	: 30 marks
Viva voce	: 10 marks.

The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course (Minimum 30 hours) 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.

The recommended courses offered by external agencies, conversions and appropriate grades/marks are to be approved by the BoS at the beginning of the semester.

If a student prefers to take a certificate course offered by external agency and approved by BoS, 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 BoS.

Evaluation pattern for Quantitative Problem Solving Techniques :

The Course is assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end examination.

Assessment Method	Marks
Continuous Internal	40
Semester End Examination	60
Total	100

Continuous Internal Assessment   : (40 Marks)
Continuous assessment	: 20 Marks
Internal test	: 20 Marks

The end examination shall be evaluated for 60 marks, conducted by the concerned course teacher and a senior expert in the subject from the same department.

Objective Test	: 50 Marks
(MCQs, 50 Questions, each one mark)	
Viva voce	: 10 marks.

13. **Main Project Work:**

The 4th Year of study comprises only self-study courses giving opportunity to students to spend one full year as an intern at various organizations (government/private) in pursuance of his/her career aspiration. The student is also expected to complete the Main Project during this period. At the end of the year, the candidate shall submit the main project report and may also include a certificate of internship.

The project report shall be evaluated with an external examiner. The total marks for project work is **200 marks** and the distribution shall be **80 marks** for continuous assessment and **120 marks** for summative assessment. The supervisor assesses the student for 40 marks (Report: 20 marks, Seminar: 20 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 40 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 120 marks.

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

14. **Massive Open Online Courses (MOOCs):**

➢ It is recommended to register and complete minimum two courses through MOOCs approved by the BoS. A student can pursue courses other than core through MOOCs. A student is not permitted to register and pursue core courses through MOOCs.

➢ The student shall register for the (Minimum of 12 weeks) courses offered by SWAYAM/NPTEL as Program elective/Open elective with the approval of the BoS. The Head of the Department shall appoint one mentor for each MOOC. The student has to submit the pass certificate issued by SWAYAM/NPTEL after completion of the course.

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

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

15. Academic Bank of Credits (ABC)

The Institution is part of the Academic Bank of Credits (ABC) initiative to promote increased opportunity of mobility for a student (as per NEP 2020). As such,

i.   A student, upon joining the institution, will become part of the ABC.

ii. All credits earned by the students in the institution as well as through MOOCs will be reflected in his/her account in the ABC

iii. The student will be able to avail transfer of credits earned from other institutions to his account as per the regulations of UGC/AICTE/JNTUGV declared from time to time.

16. Guidelines for offering Honors

The objective of introducing B.Tech.(Honors) 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.

iii. A student is permitted to register for Honors and is allowed to take maximum of two subjects per semester pertaining to the Honors.

iv. Separate class work and timetable of the courses offered under Honors program shall be arranged.

v.   Courses that are used to fulfill the student's primary major may not be double counted towards the Honors. Courses with content substantially equivalent to courses in the student's primary Major may not be counted towards the Honors.

vi. Students can complete the courses offered under Honors either in the college or in online platforms like SWAYAM with a minimum duration of 12 weeks for a 3-credit course satisfying the criteria for credit mobility. If the courses under Honors are offered in conventional mode, then the teaching and evaluation procedure shall be similar to regular B. Tech courses.

vii. A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree program.

viii. 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.

ix. 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 IV semester in case of regular and Lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.

iii. Transfer of credits from Honors to regular B. Tech degree and vice-versa shall not be permitted.

iv. An honor is to be completed simultaneously with a Major degree program.

Registration for Honors:

i. The eligible and interested students shall apply through the HOD of his/her parent department. The whole process should be completed within one week before the start of every semester. Selected students shall be permitted to register the courses under Honors.

ii. The selected students shall submit their willingness to the principal through his/her parent department offering Honors. The parent department shall maintain the record of student pursuing the Honors.

iii. The students enrolled in the Honors courses will be monitored continuously. An advisor/mentor from parent department shall be assigned to a group of students to monitor the progress.

iv. There is no fee for registration of subjects for Honors program offered in offline at the respective institutions.

17. Attendance Requirements:

i. A student shall be eligible to appear for the external examinations if he/she acquires a minimum 75% of attendance in aggregate of all the subjects.

ii. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted.

iii. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

iv. 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.

v. 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.

vi. Given the extensive scope for learning in blended mode, a student can seek consideration of time spent online or on course projects in lieu of attendance. The college academic committee will arbiter engagement of students on a case-to-case basis where a student falls short of the requisite attendance.

vii. For induction program attendance shall be maintained as per AICTE norms.

18. Promotion Rules:

A student shall be promoted from IV semester to V semester if he fulfills the minimum attendance requirement (75%) and academic requirement of 40% of credits (any decimal fraction should be rounded off to lower digit) up to either III semester or IV semester from the following examinations irrespective of whether the candidate takes the examination or not.

➢ Two regular and Two supplementary examinations of I semester

➢ Two regular and One supplementary examinations of II semester

➢ One regular examination and One supplementary examination of III semester

➢ One regular examination of IV semester.

A student shall be promoted from VI semester to VII semester if he fulfills the minimum attendance requirement (75%) and academic

requirement of 40% of credits (any decimal fraction should be rounded off to lower digit) up to either V Semester or VI semester from the following examinations irrespective of whether the candidate takes the examination or not.

- ➢ Three regular and Three supplementary examinations of I semester
- ➢ Three regular and Two supplementary examinations of II semester
- ➢ Two regular and Two supplementary examinations of III semester
- ➢ Two regular and One supplementary examinations of IV semester
- ➢ One regular and One supplementary examination of V semester
- ➢ One regular examination of VI semester.

19. **Grading:**

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

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

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade letter	Grade points
≥ 90	A+ (Outstanding)	10
≥ 80 and < 90	A (Excellent)	9
≥ 70 and < 80	B (Very Good)	8
≥ 60 and < 70	C (Good)	7
≥ 50 and < 60	D (Average)	6
≥ 40 and < 50	E (Pass)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

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

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

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

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

where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course.

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

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

where "S_i" is the SGPA of the ith semester and C_i is the total number of credits up to that semester.

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

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

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

Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters A^+, A, B, C, D and F.

Award of Class:

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

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.0 (Without any supplementary appearance)
First Class	≥ 6.0 and < 7.0
Second Class	≥ 5.0 and < 6.0
Pass Class	≥ 4.0 and < 5.0

Note: Students who have written supplementary examinations to fulfil the credit requirement will not be awarded First Class with Distinction. For such students the highest degree that is awarded will be First Class Only.

CGPA to Percentage conversion Formula = CGPA x 10

20. With–holding of Results

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

21. Multiple Entry / Exit Option

With NEP setting in, the theme is we will need to give different entry-exit options for students and a possibility to tailor a 4-year course or even a 3-year exit degree to suit their interests and requirements.

- Exit-Entry at each year of study through the entire 4-year duration.
- Possible multiple Degree Options with different Credit requirements that provide an option to a student to pick an option that best suits his/her interests and requirements.

Note: Four Year undergraduate program (FYUP) with or without Honors is the most recommended exit. But if for some unavoidable reasons, a student needs to exit at the end of Year I, Year II, Year III, the following would be the respective exit requirements with a tentative certificate/ diploma/ degree defined.

Year of Exit	Degree	Credits Required to be Earned During Course Work	Exit Extra Credits (Crash Course & Exam)	Total Credits
End of Year I	Office Tools Certificate (Or something equivalent as determined by Affiliating University)	40	6	46
End of Year II	Diploma in Discipline 1 (Or something equivalent as determined by Affiliating University)	88	8	96
End of Year III	Bachelor in Vocational Sciences in **Discipline1** (Or something equivalent as determined by Affiliating University)	136	0	136
End of Year IV (Without Honors)	Bachelor of Technology in **Discipline 1**) (Or something equivalent as determined by Affiliating University)	160	0	160

Year of Exit	Degree	Credits Required to be Earned During Course Work	Exit Extra Credits (Crash Course & Exam)	Total Credits
End of Year IV (With Honors)	Bachelor of Technology with Honors in **Discipline 1**) (Or something equivalent as determined by Affiliating University)	176	0	176

Note: The exit extra credits at Year II and Year III would essentially come from critical courses as determined by BoS from the following semester.

(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 6 credit bridge course. The 6 extra credits would be to make the certificate self-sufficient, with one 3-Credit Course on Taxation and one 3-Credit Course on Accounting 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, 88 credits followed by an additional exit of 8-credit bridge course with 2 Integrated 4 Credit courses in Major with 3+1 Theory and Lab distribution administrated as a Crash course in 1 month which 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 institution 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, State government and the affiliating univeristy.

22. 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 subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

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

23. 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.

24. Student Transfers:

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

25. General Instructions:

a. The academic regulations should be read as a whole for purpose of any interpretation.
b. Malpractices rules-nature and punishments are appended.
c. Where the words "he", "him", "his", occur in the regulations, they also include "she", "her", "hers", respectively.
d. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the institution is final.
e. The institution may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the institution.
f. 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.

* * *

Regulations for MALPRACTICES during the conduct of examinations

	Nature of Malpractices/Improper conduct	Punishment
1.a	If the candidate 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 subject of the examination (theory or practical) in which he 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 subject of the examination) - **FIRST TIME** (whether copied or not)	Expulsion from the examination hall and cancellation of the performance in that subject only. • To keep the CC footage of the act as an evidence. • To obtain a statement from student and get it authorized by observer and Chief superintendent.
1.b	If the candidate 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 subject of the examination (theory or practical) in which he 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 subject of the examination) - **SECOND TIME**(whether copied or not)	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations, project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. • To keep the CC footage of the act as an evidence. • To obtain a statement from student and get it authorized by observer and Chief superintendent.
1.c	If the candidate 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 subject of the examination (theory or practical) in which he 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 subject of the examination) - **REPITITION OF THE ABOVE ACT** (After second time and whether copied or not)	Nature of punishment to be given for the improper conduct shall be as per the recommendations of the committee. • The committee comprising of Principal, Vice principal, Chief superintendent, Controller of Examinations and HoD to discuss and initiate the action to be taken and recommend. • To keep the CC footage of the act as evidence. • To obtain a statement from student and invigilator and authorized by Chief superintendent.
2.a.	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. • To keep the CC footage of the act as an evidence.

2.b	If the candidate communicates through cell phones / through any other means with any candidate or persons in or outside the exam hall in respect of any matter. (i) If the communication is with the person(s) who belongs to our college.	Confiscation of the mobile or electronic gadgets involved and Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations, project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. • To obtain all relevant proofs of evidence from the Mobile/ gadgets and handing over of the same to the candidate. • To keep the CC footage of the act as evidence. • To obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
	(ii) If the communication is with the person(s) outside the campus or people who are not related to our college.	Confiscation of the mobile or electronic gadgets involved and Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations, project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. • To obtain all relevant proofs of evidence from the Mobile/ gadgets and handing over of the same to the candidate. • To keep the CC footage of the act as evidence. • To obtain a statement from student and invigilator and authorized by observer and Chief superintendent. • The person(s) involved should be handed over to the police and a case is registered against him.
3.	If the candidate 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 and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University 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/candidate not on rolls, he will be handed over to the police and a case is registered against him.

		• To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs. • To keep the CC footage of the act as an evidence. • To obtain a statement from student, invigilator, subject expert and authorized by observer and Chief Superintendent.
4	If the candidate mishandles 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. Also, if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. In addition to the above punishment, a committee shall be constituted and recommends appropriate punishment for the improper conduct. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
5.	Uses objectionable, abusive or offensive language in the Examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject only. • To Obtain a statement from student and invigilator and get it authorized by Observer and Chief superintendent.
6.	Refuses to obey the orders of the Chief Superintendent/ACE/ 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 subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.

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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To obtain a statement from student and invigilator and authorized by observer and Chief superintendent. • The candidate shall be handed over to Police and register a case.
9.	If a 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.	If the student belongs to our college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. 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. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. • To keep the CC footage of the act as an evidence(If any). • To obtain a statement from invigilator and any others as witness authorized by observer and Chief superintendent.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations. • To Obtain a statement from Valuer / Chief Valuer authorized by Spot Coordinator and Controller of Examinations.

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🚫 Ragging

Salient Features

⇨ **Ragging within or outside any educational institution is prohibited.**

⇨ **Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student**

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	**6** Months	+	**Rs. 1,000/**
Assaulting or Using Criminal force or Criminalintimidation	**1 Year**	+	**Rs. 2,000/**
Wrongfully restraining or confining or causing hurt	**2 Years**	+	**Rs. 5,000/**
Causing grievous hurt, kidnapping or Abducts or rape or committing unnaturaloffence	**5 Years**	+	**Rs. 10,000/**
Causing death or abetting suicide	**10 Months**	+	**Rs. 50,000/**

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 – 1288
LET US MAKE MVGR A RAGGING FREE CAMPUS
ABSOLUTELY SAY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

ACADEMIC REGULATIONS (R24) FOR B.TECH. (LATERAL ENTRY SCHEME)

(Effective for the students getting admitted into II year through Lateral Entry Scheme from the Academic Year **2024-2025** onwards)

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

   (b) **Award of B.Tech. degree with Honors**

   A student will be declared eligible for the award of the B.Tech. with Honors if he/she fulfils the following:
      (i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.
      (ii) Registering for Honors is optional.
      (iii) Honors is to be completed simultaneously with B.Tech. programme.

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

3. **Minimum Academic Requirements**

   The following academic requirements have to be satisfied in addition to the requirements mentioned in item no.2

   i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.

   ii. A student shall be promoted from VI semester to VII semester if he fulfills the minimum attendance requirement (75%) and academic requirement of 40% of credits (any decimal fraction should be rounded off to lower digit) up to either V Semester or VI semester from the following examinations irrespective of whether the candidate takes the examination or not.
      ➢ Three regular and Three supplementary examinations of I semester
      ➢ Three regular and Two supplementary examinations of II semester
      ➢ Two regular and Two supplementary examinations of III semester
      ➢ Two regular and One supplementary examinations of IV semester
      ➢ One regular and One supplementary examination of V semester
      ➢ One regular examination of VI semester.

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

4. Course Pattern

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

ii) A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered. iii) When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

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

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COURSE STRUCTURE
B. Tech. (Regular/Honors) – Electrical and Electronics Engineering
(Applicable from the academic year 2024-25 onwards)

I Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1	R24MCHYT001	Chemistry	3	0	0	3
2	R24MMATT001	Linear Algebra and Differential Equations	3	1	0	3
3	R24MMATT002	Multi Variables and Vector Calculus	3	1	0	3
4	R24MCHYL001	Chemistry Lab	0	0	2	1
5	R24MSCSL001	Office Tools and Social Media Etiquette	0	0	3	2
6	R24MCIVT001	Environmental Studies	2	0	0	2
7	R24MENGT001	Language Proficiency	2	0	0	2
8	R24MENGT002	Constitutional Values	2	0	0	2
9	R24MENGT004	Ethics and Human Values	1	0	2	2
		Total Credits				**20**

II Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1	R24MPHYT001	Physics	3	0	0	3
2	R24MMATT004	Integral Transforms and Complex Variables	3	1	0	3
3	R24MEEET001	Electrical Circuit Analysis-I	3	1	0	3
4	R24MSCST001	Procedural Programming	3	0	0	3
5	R24MMECD001	Computer Aided Engineering Drawing	1	0	2	2
6	R24MPHYL001	Physics Lab	0	0	2	1
7	R24MSCSL002	Procedural Programming Lab	0	0	2	1
8	R24MENGT003	Health and Wellness	2	0	0	2
9	R24MMECW001	Engineering Workshop	0	0	3	2
		Total Credits				**20**

III Semester

S. No.	Course Code	Course Title	L	T	P	Credits
1	R24MEEET002	Electrical Circuit Analysis-II	3	0	0	3
2	R24MEEET003	Analog Electronic Circuits	3	0	0	3
3	R24MEEET004	Control Systems	3	0	0	3
4	R24MEEET005	Electrical Machines-I	3	0	0	3
5	R24MCSCT001	Data Structures	3	0	0	3
6	R24MCSCT002	Operating Systems	3	0	0	3
7	R24MEEEL001	Control Systems Lab	0	0	3	2
8	R24MEEEL002	Electrical circuits Lab	0	0	3	2
9	R24MCSCL001	Data Structures Lab	0	0	3	2
Total Credits						**24**

IV Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MEEET006	Signals and Systems	3	0	0	3
2	R24MECET001	Digital Electronics	3	0	0	3
3	R24MEEET007	Electrical Machines-II	3	0	0	3
4	R24MEEET008	Linear Digital Integrated Circuits	3	0	0	3
5	R24MCSCT003	Python Programming	3	0	0	3
6	R24MCSCT004	Database Management Systems	3	0	0	3
7	R24MEEEL003	Electrical Machines Lab	0	0	3	2
8	R24MEEEL004	Analog Electronics and Integrated Circuits Lab	0	0	3	2
9	R24MCSCL002	Python Programming Lab	0	0	3	2
Total Credits						**24**

V Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MEEET009	Power Generation, Operation and Control	3	0	0	3
2	R24MEEET010	AI Tools, Techniques and Applications	2	0	2	3
3	R24MEEET011	Power Electronics	3	0	0	3
4	R24MEEET012	Power Transmission and Distribution	3	0	0	3
5	R24MEEETXXX	DSC-E1	3	0	0	3
6	R24MCSCT005	Software Engineering	3	0	0	3
7	R24MEEEL005	Power Electronics Lab	0	0	3	2
8	R24MCSCL003	Database Management Systems Lab	0	0	3	2
9	R24MEEEP001	Community Project	0	0	2	2

Total Credits						**24**

		VI Semester				
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MEEET013	Power Semiconductor Drives	3	0	0	3
2	R24MEEET014	Power System Analysis	3	0	0	3
3	R24MEEET015	Microprocessors and AVR Microcontrollers	3	0	0	3
4	R24MCSCT006	OOP with JAVA	3	0	0	3
5	R24MEEETXXX	DSC-E2	3	0	0	3
6	R24MEEETXXX	DSC-E3	3	0	0	3
7	R24MEEEL006	Microprocessors and AVR Microcontrollers Lab	0	0	3	2
8	R24MCSCL004	OOP with JAVA Lab	0	0	3	2
9	R24MMATT007	Quantitative Problem Solving Techniques	2	0	0	2
		Total Credits				**24**

		VII Semester				
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MEEET016	Switchgear and Protection (Self-study/MOOCs)	3	0	0	3
2	R24MEEETXXX	DSC-E4 (Self-study/MOOCs)	3	0	0	3
3	R24MEEETXXX	DSC-E5 (Self-study/MOOCs)	3	0	0	3
4	R24MEEEP002	Mini Project	0	0	2	2
5	R24MEEEL007	MATLAB and SIMULINK/EV Lab/Embedded Lab/VLSI Lab	0	0	3	2
		Total Credits				**13.**

		VIII Semester				
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCSCT007	Computer Networks	3	0	0	3
	R24MCSCT008	Artificial Intelligence: Principles and Techniques	3	0	0	
	R24MCSCT009	OOAD and Design Patterns	3	0	0	
2	R24MEEEP003	Major-Dissertation/Academic Project-Major	0	0	16	8
		Total Credits				**11**

Department Elective Courses

		Power & Energy		
S. No	**Type of course**	**Course Code**	**Course Title (Elective Thread)**	**Regular/ Honors**
1	DSC -E1	R24MEEET017	**Utilization of Electrical Energy**	R
2	DSC -E2	R24MEEET018	Distribution System and Automation	R
3	DSC -E3	R24MEEET019	**Distributed Generation and Micro Grid**	R
4	DSC -E4	R24MEEET020	Power Quality	R
5	DSC -E5	R24MEEET021	HVDC Transmission	R

		Power Electronics & Drives		
S. No	**Type of course**	**Course Code**	**Course Title (Elective Thread)**	**Regular/ Honors**
1	DSC -E1	R24MEEET026	Special Electrical Machines	R
2	DSC -E2	R24MEEET027	Advanced Power Electronic Converters	R
3	DSC -E3	R24MEEET028	Flexible AC Transmission Systems	R
4	DSC -E4	R24MEEET029	Switched Mode Power Converters	R
5	DSC -E5	R24MEEET030	Electric Vehicle Technology	R

Power & Energy Sector

S. No	Course Code	Course Title	L	T	P	Credits	Sem
1	R24MEEEHT01	Power System Optimization	3	0	0	3	VI
2	R24MEEEHT02	Programmable Logic Controllers and SCADA Systems	3	0	0	3	VI
3	R24MEEEHT03	Connected Things	3	0	0	3	VII
4	R24MEEEHT04	Advanced Control systems	3	0	0	3	VII
5	R24MEEEHT05	Smart Grid and Energy Management	3	0	0	3	VIII
6	R24MEEEHT06	Nonconventional Energy Sources	3	0	0	3	VIII
Total Credits						**18**	

Power Electronics & Drives Sector

S. No	Course Code	Course Title	L	T	P	Credits	Sem
1	R24MEEEHT07	Control and Instrumentation Systems	3	0	0	3	VI
2	R24MEEEHT08	Modelling and Simulation of Power Electronic Systems	3	0	0	3	VI
3	R24MEEEHT09	Connected Things	3	0	0	3	VII
4	R24MEEEHT10	Embedded systems for Power Electronics and drives	3	0	0	3	VII
5	R24MEEEHT11	Advanced control techniques for power electronic systems	3	0	0	3	VIII
6	R24MEEEHT12	Power Electronic Converters for Renewable Energy Sources	3	0	0	3	VIII
Total Credits						**18**	

EXTENDED OPEN ELECTIVE CLUSTER

Business Management Cluster(BMC) (for CSE/IT/CSIT/AIML/DS/ICB)							
Type of Course	Course Code	Course Title	Sem	Type of Course	Course Code	Course Title	Sem
EOEC-T1	R24MBMCT001	Financial Management	III	EOEC-L1	R24MMECL001	Computer Aided Geometric Design and Assembly Lab	III
EOEC-T2	R24MMECT013	Leadership and Team Management	III	EOEC-L2	R24MBMCL001	Financial Accounting Lab	IV
EOEC-T3	R24MMECT020	Product Lifecycle Management	IV	EOEC-L3	R24MBMCL002	Digital Engineering Lab	V
EOEC-T4	R24MBMCT002	Quality Management	IV	EOEC-L4	R24MBMCL003	Business Analytics Lab	VI
EOEC-T5	R24MMECT022	Business Analysis	VI				
EOEC-T6	R24MBMCT003	Strategic Management	VIII				

	Course Code	Course Title
EOEC - E1	R24MBMCT004	Digital Marketing
	R24MMECT017	Logistics and Supply Chain Management
	R24MBMCT005	Entrepreneurship

R24

<table>
<tr><th colspan="8">Computer Science Cluster(CSC)
(for MEC, ECE, EEE, CIV and CHE)
(Not for CSE/IT/CSIT/AIML/DS/ICB)</th></tr>
<tr><th>Type of Course</th><th>Course code</th><th>Course Title</th><th>Sem</th><th>Type of Course</th><th>Course Code</th><th>Course Title</th><th>Sem</th></tr>
<tr><td>EOEC-T1</td><td>R24MCSCT001</td><td>Data Structures</td><td>III</td><td>EOEC-L1</td><td>R24MCSCL001</td><td>Data Structures Lab</td><td>III</td></tr>
<tr><td>EOEC-T2</td><td>R24MCSCT002</td><td>Operating Systems</td><td>III</td><td>EOEC-L2</td><td>R24MCSCL002</td><td>Python Programming Lab</td><td>IV</td></tr>
<tr><td>EOEC-T3</td><td>R24MCSCT003</td><td>Python Programming</td><td>IV</td><td>EOEC-L3</td><td>R24MCSCL003</td><td>Database Management Systems Lab</td><td>V</td></tr>
<tr><td>EOEC-T4</td><td>R24MCSCT004</td><td>Database Management Systems</td><td>IV</td><td>EOEC-L4</td><td>R24MCSCL004</td><td>OOP with JAVA Lab</td><td>VI</td></tr>
<tr><td>EOEC-T5</td><td>R24MCSCT005</td><td>Software Engineering</td><td>V</td><td></td><td></td><td></td><td></td></tr>
<tr><td>EOEC-T6</td><td>R24MCSCT006</td><td>OOP with JAVA</td><td>VI</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">EOEC-E1 Selfstudy /Moocs</td><td>R24MCSCT007</td><td>Computer Networks</td><td rowspan="3">VIII</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R24MCSCT008</td><td>Artificial Intelligence: Principles and Techniques</td><td></td><td></td><td></td><td></td></tr>
<tr><td>R24MCSCT009</td><td>OOAD and Design Patterns</td><td></td><td></td><td></td><td></td></tr>
</table>

R24MCHYT001	CHEMISTRY (Common to All Branches)					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Basics of 10 + 2 Chemistry	3	0	0	3

Course Objective

This course aims to help students
- To gain the comprehensive understanding of polymers and green chemistry
- To gain knowledge in electrochemistry, spectroscopic techniques and molecular machines.
- To get insight on phenomena of material deterioration and develop understanding on control and protective techniques.

Course Outcomes

After completing this course, the students will be able to

1	Classify macromolecules as materials such as polymers, rubbers and make use of these materials as good engineering materials with improved properties. **(BL4)**
2	Apply fundamentals of electrochemistry and electro analytical techniques and judge a suitable storage device for desired engineering applications. **(BL5)**
3	Choose certain spectroscopic techniques for analysis of compounds and explain the behaviour of materials as molecular switches. **(BL5)**
4	Classify various types of material deterioration phenomena and identify suitable control and protective techniques. **(BL4)**
5	Explain the principles of green chemistry and develop understanding on nanomaterials and harnessing of solar energy. **(BL5)**
6	Choose suitable material, analytical technique for identification, analysis and develop an understanding on material use, protection and energy storage. **(BL6)**

SYLLABUS

Unit I	HIGH POLYMERS	8 hr

Introduction – Stereospecific Polymers**;** Types of Polymerizations – Co-ordination polymerization - Zieglar – Natta Catalysis – Mechanism**;** Plastics –Types - Thermoplastics – Thermosets –Differences**;** Preparation, Properties and Applications of –PVC - Teflon – Bakelite – Nylon**;** Rubbers – Natural - Synthetic – Vulcanization**;** Preparation, properties and applications of - BUNA – S, Thiokol rubber**;** Fiber Reinforced Plastics – Introduction - Types of FRP – Aramids – Kevlar and Nomex**;** Conducting polymers - Introduction – Classification – Intrinsic and extrinsic – Applications.

Unit II	ELECTROCHEMISTRY AND ITS APPLICATIONS	8 hr

Introduction - Electrode Potential – Measurement of electrode potential - Electrochemical series**;** Expression for electrode potential – Electrochemical cell – EMF of the cell**;** Storage devices – Classification – Primary – Leclanché cell**;** Secondary - Solid state battery / Lithium-ion battery**;** Flow Cells - Fuel cells – Hydrogen – Oxygen fuel cell, Methanol – Oxygen fuel cell - Solid Oxide Fuel Cells**;** pH Metry**;** Conductometry**;** Potentiometry - Principle – Applications.

Unit III	**SPECTROSCOPY AND MOLECULAR SWITCHES**	**8 hr**

Introduction to spectroscopy - Electromagnetic radiation; Classification – Absorption and Emission spectroscopy; Laws of Absorption – Derivation of Beer – Lambert's law – Significance; UV – Visible Spectroscopy - 1 – Introduction – Principle; UV – Visible Spectroscopy – 2 - Instrumentation (block diagram) – Applications; Infra – Red Spectroscopy - 1 – Introduction to Infra - Red Spectroscopy – Principle; Infra – Red Spectroscopy – 2 - Instrumentation (block diagram) – Applications; Molecular switches - NOR and NOT logic gate operators - Characteristics - Rotaxanes and Catenanes as artificial molecular machines.

Unit IV	**Corrosion**	**8 hr**

Chemical Corrosion – Mechanism - Pilling Bed worth rule; Electrochemical Corrosion - Mechanism - Difference between dry and wet corrosion - Galvanic series; Types of Corrosion - Differential aeration corrosion, galvanic corrosion, pitting corrosion, waterline corrosion and stress corrosion; Factors influencing rate of corrosion - Metal-based factors and Environment based factors; Corrosion control Methods – Proper design, Use of Pure metal, Use of Alloy; Cathodic protection – Sacrificial Anodic protection method – Impressed current cathodic protection method- Use of Inhibitors; Protective coatings - Types - Metal Coatings – Anodic - Galvanizing and Cathodic Coating – Tinning; Passivation and Pourbaix diagram - Pourbaix diagram.

Unit V	**Concepts of Green Chemistry, Nano Chemistry and Solar Energy**	**8 hr**

Green Chemistry - Introduction - Principles of Green Chemistry; Applications – Any green two reactions; Nanomaterials - Introduction – Classification; Synthesis of Nano material by Top down and bottom-up approach; CVD Method – Sol gel method – Synthesis of iron oxide nano particles; Carbon nano tubes – Introduction - Classification – Applications; Harnessing of Solar Energy – Construction and Working of PV Cell; Solar collectors – Concentrating

LEARNING RESOURCES

TEXTBOOKS:

1. Jain and Jain, *Engineering Chemistry*, 17th ed. New Delhi, India: Dhanpat Rai Publications, 2015.
2. S.S. Dara, *Text Book of Engineering Chemistry*, 12th ed. New Delhi, India: S. Chand, 2006.
3. Y. Bharathi Kumari, *Text Book of Engineering Chemistry*, For JNTU R24 Hyderabad, India: VGS Publications, 2023

REFERENCE BOOKS:

1. T. F. Yen, *Chemistry for Engineers*, London, U.K.: Imperial College Press, 2008.
2. S. K. Chawla, *Engineering Chemistry*, latest ed. New Delhi, India: Dhanpat Rai & Co., 2017.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms levels	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MMATT001	**LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS** **(Common to all branches)**					
	Total Contact Hours	40 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus and Matrices	**3**	**1**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

1	Solve system of equations by Direct method. **(BL3)**
2	Make use of Linear Algebra techniques to find higher powers and inverse of Matrices and quadratic forms. **(BL3)**
3	Solve first order differential equations and make use of them to deal with real word problems. **(BL3)**
4	Solve the higher order differential equations to make use of them to deal with real word problems. **(BL3)**
5	Make use of Laplace transforms to solve initial value problems. **(BL3)**
6	Formulate Mathematical models and estimate appropriate physical quantities. **(BL6)**

SYLLABUS

Unit 1	**LINEAR ALGEBRA-1**	8 hr

Rank; Consistency criteria; Non homogeneous systems; Homogeneous systems; Characteristic equation; Eigen values; Eigen vectors; Properties.

Unit 2	**LINEAR ALGEBRA-2**	8 hr

Cayley-Hamilton Theorem; Higher powers; Matrix polynomials; Inverse of Matrix; Diagonalization; Quadratic forms (QF); Canonical forms (CF); Reduction of QF to CF.

Unit 3	**FIRST ORDER DIFFERENTIAL EQUATIONS & APPLICATIONS**	8 hr

Linear Differential Equations (DE); Solving Linear DE; Bernoulli's DE; Solving Bernoulli's DE; Exact DE; Non-exact DE; Newton's law of cooling; laws of natural growth and decay.

Unit 4	**HIGHER ORDER DIFFERENTIAL EQUATIONS**	8 hr

Homogeneous linear differential equations (DE)-1; Homogeneous linear DE -2; Non homogeneous linear DE (e^{ax}); Non homogeneous linear DE ($sin\ ax\ /\ cos\ ax$); Non homogeneous linear DE (x^k); Non homogeneous linear DE ($e^{ax}\ v(x)$) ; Particular integrals;
Method of variation of parameters.

Unit 5	**LAPLACE TRANSFORMS**	8 hr

Laplace transform (LT) of elementary functions-1; LT of elementary functions-2; LT using elementary properties-1; LT using elementary properties-2; Inverse LT (Partial Fractions); Convolution theorem; Initial value problems (IVP); Solving IVP.

	LEARNING RESOURCES
TEXT BOOKS:	
1	B.S.Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2	T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition
REFERENCE BOOKS:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011
2	B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
3	T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL 3	x				
CO2	BL 3		x			
CO3	BL 3			x		
CO4	BL 3				x	
CO5	BL 3					x
CO6	BL 6	x	x	x	x	x

		MULTI VARIABLES AND VECTOR CALCULUS				
R24MMATT002	Total Contact Hours	40 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus	**3**	**1**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

1	Test and find for maxima and minima for functions of several variables. (**BL6**)
2	Evaluate double and triple integrals of functions of several variables. (**BL5**)
3	Apply the concepts of gradient, curl and divergence to compute and analyse scalar and vector fields. (**BL3**)
4	Estimate the work done against a field, circulation and flux using vector calculus. (**BL6**)
5	Solve the partial differential equations by various methods. (**BL3**)
6	Formulate Mathematical models and estimate appropriate physical quantities. (**BL6**)

Unit 1	**MULTIVARIABLE CALCULUS**	**8 hr**

Partial derivative; Total derivative; Chain rule; Taylor's Series for functions of two variables;
Maclaurin's series; Jacobian and its properties; Maxima and minima; Lagrange's method of undetermined multipliers.

Unit 2	**MULTIPLE INTEGRALS**	**8 hr**

Double integrals; Double integrals over a region; Double integrals in polar co-ordinates; Change of order; Change of variables in double integrals; Triple integrals; Change of variables;
Applications of double and triple integrals.

Unit 3	**VECTOR DIFFERENTIATION**	**8 hr**

Gradient; Normal vector to the surface; Angle between surfaces; Directional derivative;
Divergence; Solenoidal vector; Curl of a vector; Irrotational vector.

Unit 4	**VECTOR INTEGRATION**	**8 hr**

Line integral; Circulation; Work done; Surface integral; Volume integral; Green's theorem;
Gauss divergence theorem; Stokes theorem (without proofs).

Unit 5	**PARTIAL DIFFERENTIAL EQUATIONS (PDE)**	**8 hr**

Formation of PDE (Eliminating arbitrary constants); Formation of PDE (Eliminating arbitrary functions); Lagrange's Linear PDE-1; Lagrange's Linear PDE-2; Homogeneous Linear PDE; Homogeneous Linear PDE (e^{ax+by}); Homogeneous Linear PDE (sin or cos $(ax + by)$);
Homogeneous Linear PDE ($x^m\ y^n$).

	LEARNING RESOURCES
TEXT BOOKS:	
1	B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2	T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition
REFERENCE BOOKS:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011
2	B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
3	T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL 6	x				
CO2	BL 5		x			
CO3	BL 3			x		
CO4	BL 6				x	
CO5	BL 3					x
CO6	BL 6	x	x	x	x	x

R24MCHYL001	CHEMISTRY LAB					
	Total Contact Hours	**28 (P)**	**L**	**T**	**P**	**C**
	Pre-requisite	**Basics of 10 + 2 Chemistry**	**0**	**0**	**2**	**1**
Course Objective: This course aims to help students						
• To verify the fundamental concepts with experiments						
Course Outcomes: After completing this course, the students will be able to						
1	Determine total hardness, dissolved oxygen, strength of acid in a lead acid battery, using volumetric analysis					
2	Explain conductometric, potentiometric, pH metric titrations and colorimetric determinations.					
3	Explain the synthesis of a polymer, nanomaterials.					

List of Experiments

1. Determination of HCl using sodium carbonate.
2. Determination of Strength of an acid in Pb-Acid battery.
3. Determination of Iron (II) using potassium dichromate.
4. Determination of Hardness of a groundwater sample.
5. Determination of Dissolved oxygen in ground water sample.
6. Potentiometric titration of Fe (II) with potassium dichromate.
7. Condcutometric titration of Strong acid VS Strong base.
8. Condcutometric titration of Weak acid VS strong base.
9. pH metric titration of strong acid and strong base.
10. Determination of percentage of Iron in Cement sample by colorimetry.

Additional Experiments

1. Preparation of nanomaterials by precipitation method.
2. Preparation of Bakelite.
3. Determination of Cell constant of a conductivity cell.

Advanced Design Experiments

1. Determination of viscosity of polymer solution using survismeter.
2. Measurement of 10Dq by spectrophotometric method.

TEXTBOOKS

1. A.I. Vogel, "Quantitative Chemical Analysis," 6th ed. Boston, MA, USA: Cengage Learning, 2000.
2. D. A. Day and A. L. Underwood, Quantitative Chemical Analysis. Upper Saddle River, NJ, USA: Prentice Hall, 1991.
3. K. Mukkanti, Practical Engineering Chemistry. Hyderabad, India: B.S. Publications, 2009.

REFERENCE BOOKS:

1. J. Cherukui, Laboratory Manual of Engineering Chemistry-II, VGS Techno Series, 2012.
2. Department of Chemistry, MVGR College of Engineering, Laboratory Manual.

R24MSCSL001	**OFFICE TOOLS & SOCIAL MEDIA ETIQUETTE**					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**0**	**0**	**3**	**2**

Course Objective

- To get hands-on exposure to office automation software.
- To perform basic data analysis tasks using spreadsheets.
- To practice methods of social media etiquette and digital wellbeing.

Course Outcomes

After completing this course, the students will be able to

1	Create documents and letters for professional communication.
2	Analyze and interpret data and provide effective visualization.
3	Create presentations and slideshows.
4	Practice various mechanisms of social media etiquette.

LIST OF EXPERIMENTS

1	Create a simple document containing tables, images, smart art and flowchart symbols. Apply various font styles, sizes, designs, bullet points and page layouts.
2	Create a document containing hyperlinks, equations, symbols and charts. Apply various header and footer formats, bookmarks and macros.
3	Create a document with citations, bibliography, table of figures, cross-reference and index.
4	Create a simple presentation with various layouts, background design, fonts and geometric shapes with different effects
5	Create a presentation with transitions, animations with timings and audio files.
6	Create a presentation with hyperlinks to internal slides, external files and language translator.
7	Create a spreadsheet using numerical data and perform various mathematical, statistical and engineering operations using built-in formulae.
8	Create a spreadsheet using text data and perform Text operations like search, replace, concatenate, trim etc.; use Date format to perform various Date & Time operations.
9	Create a spreadsheet using numerical data which is imported from real time datasets and perform visualization using graphs, pivot charts etc.
10	Create a spreadsheet using all available data formats and perform data migration, validation and consolidation.
11	Create digital profile on LinkedIn and observe patterns of a professional profile. Follow influential people from technology and software domain.
12	Create a social media profile on any latest platform following social media etiquette and mark a professional digital footprint.

	LEARNING RESOURCES	
	ONLINE COURSES	
1	https://books.libreoffice.org/en/	
2	https://www.w3schools.com/googlesheets/	
3	https://support.microsoft.com/en-us/training	
4	https://www.office.com/	
5	https://www.google.com/docs/about/	
6	https://workspace.google.com/products/sheets/	
7	https://in.linkedin.com/	
8	https://www.rd.com/list/social-media-etiquette/	

R24MCIVT001	ENVIRONMENTAL STUDIES					
	Total Contact Hours	28 (L)	L	T	P	C
	Pre-requisite	NIL	2	0	0	2

Course Objective

This course aims to impart a deep understanding of environmental processes, climate change, biodiversity, ecosystem functionality, and lifestyle impacts. Equipped with this knowledge, students will advocate for climate mitigation and combat climate change effectively.

Course Outcomes: After completing this course, the students will be able to apply and articulate

1. The roles of knowledge of biodiversity, ecosystem functionality, and resources in tackling pollution and environmental laws. (BL3)
2. The concepts of carbon cycle, climate systems, and microclimate and their connection to weather patterns and climate policies. (BL3)
3. The concepts of greenhouse gases, paleoclimate, energy balance, water cycle, and atmospheric motion and their role in climate systems. (BL3)
4. The knowledge of ocean, cryosphere, biosphere interactions and their influence on climate regulation. (BL3)
5. Sustainable practices such as energy and water conservation to promote environmental protection and resource efficiency. (BL3)

SYLLABUS

Unit I	**INTRODUCTION TO ENVIRONMENTAL STUDIES**	**5 hr**

Biodiversity and ecosystem functionality – Natural resources – Environmental pollution – Environmental episodes – Environmental legislation

Unit II	**INTRODUCTION TO CLIMATE CHANGE**	**5 hr**

Carbon cycle – Earth's Climate System – Weather and Climate – Understanding Microclimate - Policy initiatives to Combat Climate Change

Unit III	**SCIENCE BEHIND THE CLIMATE CHANGE – 1**	**5 hr**

Greenhouse gas effect - Paleoclimate - Energy Balance - Water Cycle – Atmospheric motion

Unit IV	**SCIENCE BEHIND THE CLIMATE CHANGE – 2**	**5 hr**

Ocean changes - Cryosphere dynamics – Volcanoes - Biosphere and climate regulation - Mitigation strategies

Unit V	**LIFESTYLE FOR ENVIRONMENT**	**5 hr**

Sustainability Challenges - Save Energy - Save Water - Reduce waste - Healthy Lifestyles

LEARNING RESOURCES

TEXTBOOKS:

1. E. Bharucha, *Textbook of Environmental Studies for Undergraduate Courses*, 2nd ed. Hyderabad, India: Universities Press, 2012.
2. A. Schmittner, *Introduction to Climate Science*. Corvallis, OR: Oregon State University, 2018. [Online]. Available: https://open.oregonstate.education/ climatechange/

REFERENCE BOOKS:
1. R. T. Wright and D. F. Boorse, *Environmental Science: Toward a Sustainable Future*, 13th ed. Boston, MA: Pearson, 2017.
2. United Nations Development Programme, *Climate Box. An interactive learning toolkit on climate change*. New York, NY, 2018.
3. J.K. Arora, B.K. Tyagi, K.S. Bath, R. Bal, and S.S. Ladhar, *Activity Book on Climate Change*. Punjab State Council for Science & Technology, 2022.
ADDITIONAL REFERENCE MATERIAL
1. Mission Life for Environment (https://missionlife-moefcc.nic.in/Download-Creatives-Save-Energy.php?id=MTE=)
ONLINE COURSES
1. Climate Change Science, IISc Bangalore, https://nptel.ac.in/courses/120108558
2. The Literature of Climate Crisis, Uni. of Hyderabad, https://nptel.ac.in/courses/109106733
3. Climate change: Extreme Events: IISER Bhopal https://nptel.ac.in/courses/105106707

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X

	LANGUAGE PROFICIENCY					
R24MENGT001	Total Contact Hours	28 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	---	**2**	**0**	**0**	**2**

Course Objective

The student will be able to apply the concepts of comprehension, Interpretation and structured
presentation in varied contexts and demonstrate skilled communication.

Course Outcomes

1	Demonstrate the skill to comprehend, analyze and interpret information. (**BL 3**)
2	Demonstrate the skill of structured thinking. (**BL 3**)
3	Demonstrate Competency to summarize and paraphrase content in different materials. (**BL 3**)
4	Demonstrate application of the skills of presentation in writing, meeting the requirement of the concept of constructive presentation. (**BL 3**)
5	Demonstrate understanding of the nuances in group communication (**BL 3**)

SYLLABUS

Unit I	**VOCABULARY ENRICHMENT**: Understanding the meaning of a word by identifying the context – The technique; presenting an idea using a set of words; Vocabulary mind mapping; word choice & Connotation. Collocations. Understanding Jargon.	**5 hrs**
Unit II	**THE ART OF READING**: Understanding the process of reading; Reading an article and assimilating the rhetoric; Skimming & scanning a piece of text; Reading fiction to understand writer's perspective; The art of analyzing and appreciating a literary text.	**5 hrs**
Unit III	**LISTENING & COMPREHENDING:** Understanding the process of listening**;** Watching travel documentaries to master the technique of active listening; making a brochure; watching a film and drafting a review; watching interviews of successful entrepreneurs and sharing the take–away concepts/ideas**;** Watching documentaries on 'Engineering marvels' and sharing impressions.	**6 hrs**
Unit IV	**WRITING FOR COMMUNICATION**: Basics in writing**;** The technique of persuasion; genres of writing - Narrative writing, descriptive writing, expository writing; nuances of Journal writing; Letter Writing & its etiquette**.** Email writing & etiquette	**6 hrs**
Unit V	**EXPRESSING ONESELF**: Introducing oneself; Ted talk and the concept of structured presentation; Case debates on contemporary problems; open discussions on different perspectives of living – Adventures, society & life, science & religion, sports, cinema. Dialogues & language experimentation- Staging skits on relevant social themes.	**6 hrs**

REFERENCE BOOKS:

1	Seely, John. *Oxford guide to effective Writing and Speaking*. Oxford Press. 2022.
2.	Atkins, Ros. *The art of explanation.* Wildfire publications. 2023.

WEB RESOURCES:
1. www.purdueowl.com
2. www.voanews.com
3. www.learningenglish.vn
4. www.prowritingaid.com
5. www.eslcafe.com
6. www.5minutesenglish.com
7. www.livinglanguage.com
8. www.newsinlevels.com

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X

		CONSTITUTIONAL VALUES		L	T	P	C
R24MENGT002	Total Contact Hours	28(L)					
	Pre-requisite	….		**2**	**0**	**0**	**2**

Course Objective

The course aims at creating awareness regarding different provisions enshrined in the Constitution and makes students understand the concept of Fundamental Rights.

Course Outcomes

1	Demonstrate understanding of the principles of the Constitution of India. **(BL 3)**
2	Demonstrate understanding of Constitutional values. **(BL 3)**
3	Demonstrate understanding of Fundamental Rights and their relevance. **(BL 3)**
4	Demonstrate understanding of the role of Judiciary in the interpretation and protection of Fundamental Rights. **(BL 3)**
5	Demonstrate understanding of the role of institutions like National Human Rights Commission in the protection of Fundamental Rights. **(BL 3)**

SYLLABUS

Unit I	Constitution & Democracy; Understanding the spirit of Indian Constitution; Constitutional Values – social, economic and political Justice; Liberty in thought, expression, belief, faith and worship, equality before law; Fraternity.	**5 hrs**
Unit II	Interpretation of Articles 14 -31: Right to equality (Articles 14 - 18); Right to freedom (Articles 19-22); Right against exploitation (Articles 23-24).	**5 hrs**
Unit III	Right to freedom of Religion (Articles 25-28); Cultural and educational Rights (Articles 29-30);	**6 hrs**
Unit IV	Right to Life and personal liberty (Article 21); Right to constitutional remedies (Article 32)	**6 hrs**
Unit V	Role of Judiciary and other institutions in the protection of Fundamental Rights; Case Studies.	**6 hrs**

LEARNING RESOURCES

REFERENCE BOOK:

1	Durga Das Basu, et al., *Introduction to the Constitution of India*, Lexis Nexis, 2022.

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X	X	X	X
CO3	BL3		X	X	X	X
CO4	BL3		X	X	X	X
CO5	BL3					X

	ETHICS AND HUMAN VALUES					
R24MENGT004	Total Contact Hours	28 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	…..	**2**	**0**	**0**	**2**

Course Objective

The course creates awareness regarding the need for the development of a holistic perspective
in understanding the nuances of personal, professional and social life. It enables the student to grasp the ethical principles that govern human existence.

Course Outcomes

After completing this course, the students will be able to

1	Demonstrate Understanding of the relevance of the concepts of Self - Exploration and Natural Acceptance in day-to-day life to achieve continuous happiness and prosperity. (**BL 3**)
2	Demonstrate Understanding of the impact of trust and respect as foundational values in human relationships to achieve comprehensive human goals. (**BL 3**)
3	Demonstrate Understanding of the relevance of ethical theories and their applications in societal living. (**BL3**)
4	Demonstrate Understanding of the concept of ethics in engineering practice **(BL 3)**
5	Demonstrate Understanding of the concepts of ethics in the context of understanding global issues pertaining to different fields. (**BL 3**)

SYLLABUS

Unit I	**UNDERSTANDING THE SELF**	**5 hrs**

Characteristics of Universal Human Values; Self-Exploration– Meaning and Process; Basic Human Aspirations – Meaning and Basic Requirements for fulfilment; Concept of Human Existence – Conscious and Material Entities; Difference between the Conscious and the Material Entities of Human Existence.

Unit II	**UNDERSTANDING THE FAMILY AND SOCIETY**	**5 hrs**

Understanding the importance of harmony in a family; Exploring value of feelings in relationships; Measures to ensure Harmony in the family.
Understanding conflict (meaning, types); Dimensions of Human order for harmony in society – Physical, mental, social and spiritual; Universal values of justice, democracy, respect and gratitude.

Unit III	**ETHICAL THEORIES**	**6 hrs**

Professionalism and ethics; Ethical Theories: Golden mean theory, Rights-based theory, Duty- based theory, Utilitarian theory, Kohlberg's Theory. Moral issues; Moral Dilemmas; Types of Inquiries – Normative, Conceptual, factual/descriptive.

Unit IV	ETHICS AND ENGINEERING	6 hrs
Engineering ethics - Social Experimentation; Safety Responsibility and Rights: Engineers as responsible Experimenters, Concept of Safety and Risk: Engineer's Responsibility for Safety, Risk – Benefit Analysis. **Case Studies**: The challenger disaster, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy, The Titan submersible disaster.		
Unit V	ETHICS AND GLOBAL ISSUES	6 hrs
Ethics and Global Issues: Environmental ethics; computer ethics; Business Ethics; Corporate Social responsibility; Code of ethics.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	R R Gaur, R Sangal, G P Bagaria, "*A Foundation Course in Human Values and Professional Ethics*" Excel Books, New Delhi, 2010.	
REFERENCE BOOKS:		
1	A.N. Tripathi, "*Human Values*", 2nd Edition, New Age International Publishers, 2004.	
2	Charles D. Fleddermann, "*Engineering Ethics*", Pearson Education / Prentice Hall, New Jersey, 2004.	

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X

	PHYSICS					
R24MPHYT001	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Higher Secondary School Physics	**3**	**0**	**0**	**3**

Course Objective

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by
introducing the learners to domains like crystallography, light wave phenomena, coherent radiation, quantum etiquettes, and magneto-dielectric materials.

Course Outcomes

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

1	**Examine** the crystallographic phase of the unknown specimen by using X-ray diffraction method. (**BL4**)
2	**Categorize** the dielectric polarization mechanisms, and **classify** the magnetic material for an intended application. (**BL4**)
3	**Analyze** the intensity variation of light due to interference, diffraction and polarization. (**BL4**)
4	**Analyze** the production of laser in the given medium; and **categorize** the optic fiber for envisioned communication requirements. (**BL4**)
5	Deduce the quantized aspects of a particle in a potential box; **analyze** the semiconductor carrier concentrations, and **inspect** their type by using the Hall effect. (**BL4**)
6	**Elaborate** the crystallographic phase, magneto-dielectric physiognomies, optical phenomena, and the essentials of photonics, quantum confinement effects, and the rudiments of semiconductor band model. (**BL6**)

SYLLABUS

Unit I	CRYSTAL PHYSICS	8 hrs

Space Lattice- Unit cell- Crystal systems; Bravais lattices; Atomic packing fraction-Simple Cubic- BCC- FCC structures; Diamond cubic structure- Calculation of lattice constant; Crystal planes- Directions- Miller indices; Distance between successive h k l planes; X-ray Diffraction- Bragg's law; Powder X-ray diffraction method- Applications.

Unit II	MAGNETIC AND DIELECTRIC MATERIALS	8 hrs

Magnetic dipole moment – Permeability- Magnetization- Atomic origin of magnetism; Dia, Para, Ferro, Anti-ferro and Ferrimagnetic materials; Hysteresis- Soft and Hard magnetic materials; Dielectric constant- Displacement Vector- Dielectric polarization – Relation between the electric vectors; Electronic polarization; Ionic polarization-Orientation polarization (Qualitative); Internal field in dielectrics; Clasius-Mossotti relation in dielectrics;

Unit III	WAVE OPTICS	8 hrs

Principle of Superposition- Theory of interference fringes; Interference in thin film-Cosine law; Newton's rings-Applications; Diffraction at a single slit- Intensity distribution; Diffraction at N- parallel slits; Polarization by reflection- Brewester's law; Double refraction; Quarter and Half wave plates

Unit IV	PHOTONICS	8 hrs
	Absorption, Spontaneous and Stimulated emission of radiation; Einstein coefficients-Relation between the coefficients; Laser- Characteristics- Applications; Population inversion (3-level)- Components of laser system; Ruby laser- Construction- Working-Advantages; Optic fiber- Principle- Components of fiber; Numerical aperture-Acceptance angle- Acceptance cone; Classification of optic fiber- Step Index- Graded Index fibers.	
Unit V	QUANTUM PHYSICS AND SEMICONDUCTORS	8 hrs
	Matter Wave- de Broglie wavelength of matter wave; Uncertainty principle- Wave function- Physical significance; Schrodinger Time-independent wave equation; Particle in a 1D potential box- Energies and Wave functions; Fermi-Dirac distribution function-Distinction between metals, insulators and semiconductors; Intrinsic semiconductors-Carrier concentration-Fermi level; Extrinsic semiconductors- Carrier concentration; Hall effect	

LEARNING RESOURCES

TEXT BOOKS:

1	B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Second edition. Cengage Learning, 2021.
2	M. N. Avadhanulu, P.G.Kshirsagar and TVS Arun Murthy, *A Text book of Engineering Physics*, Eleventh edition. S.Chand Publications, 2019.

REFERENCE BOOKS:

1	Hitendra K. Malik and A.K. Singh, *Engineering Physics*, Second edition. Mc. Graw Hill Publishers, 2017.
2	M.R. Srinivasan, *Engineering Physics,* Second edition. New Age International Publishers, 2021.
3	Shatendra Sharma and Jyotsna Sharma, *Engineering Physics*, First edition. Pearson Education, 2018.

ADDITIONAL REFERENCE MATERIAL:

1	https://www.youtube.com/watch?v=GQ5XpeS3e3U&list=PLLy_2iUCG87B_Tmfs0y2tR8GNIkyRIKpW
2	https://archive.nptel.ac.in/courses/112/106/112106227/
3	https://archive.nptel.ac.in/courses/122/107/122107035/
4	https://archive.nptel.ac.in/courses/104/104/104104085/ https://archive.nptel.ac.in/courses/115/107/115107095/
5	https://archive.nptel.ac.in/courses/115/101/115101107/ https://archive.nptel.ac.in/courses/108/108/108108122/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit-1	Unit-2	Unit-3	Unit-4	Unit-5
CO1	BL4	X				
CO2	BL4		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MMATT004	INTEGRAL TRANSFORMS AND COMPLEX VARIABLES (EEE & ECE)					
	Total Contact Hours	40 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus	**3**	**1**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

1	Estimate the periodic functions as a Fourier series expansion. (**BL5**)
2	Apply Fourier Transforms to solve integral equations. (**BL3**)
3	Utilize Z-Transforms to solve difference equations. (**BL3**)
4	Construct analytic functions and apply them in electrical field problems. (**BL3**)
5	Estimate complex integrals by various methods. (**BL5**)
6	Formulate Mathematical models and estimate appropriate physical quantities. (**BL6**)

SYLLABUS

Unit 1	**FOURIER SERIES**	**8 hr**

Fourier series $(0, 2\pi)$; Fourier series $(-\pi, \pi)$; Fourier series-2π period; Fourier series $(0,2l)$;
Fourier series $(-l, l)$; Fourier series for odd and even functions; Half range Cosine series; Half range Sine series.

Unit 2	**FOURIER TRANSFORMS**	**8 hr**

Fourier integral representations; Fourier Cosine and Sine integral representations; Fourier transforms (FT); Fourier Cosine transforms; Fourier Sine transforms; Inverse Fourier Transforms; Properties of Fourier Transforms; Evaluation of integrals using FTs and applications
of FTs to solve integral equations.

Unit 3	**Z-TRANSFORMS**	**8 hr**

Z-transform of elementary sequences; Linearity property and damping rule; Multiplication by 'n'; Shifting rules; Initial and Final value theorems; Inverse Z-Transforms (Partial fractions
method); Convolution theorem (statement only); Difference equations.

Unit 4	**COMPLEX VARIABLES (DIFFERENTIATION)**	**8 hr**

Limit, continuity and differentiability of $f(z)$; Analytic function; Cauchy-Riemann equations (Cartesian coordinates); Cauchy Riemann equations (Polar coordinates); Harmonic functions and harmonic conjugates; Construction of Analytic function; Milne-Thomson method; Applications
of analytic functions.

Unit 5	**COMPLEX VARIABLES (INTEGRATION)**	**8 hr**

Line integral; Cauchy's theorem; Cauchy's integral formula; Generalized Cauchy's integral formula; Types of singularities; Residues at simple poles; Residues at poles; Cauchy's residue theorem.

LEARNING RESOURCES	
TEXT BOOKS:	
1	B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2	T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition
REFERENCE BOOKS:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011
2	B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
3	T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL 5	x				
CO2	BL 3		x			
CO3	BL 3			x		
CO4	BL 3				x	
CO5	BL 5					x
CO6	BL 6	x	x	x	x	x

	Electrical Circuit Analysis - I				
R24MEEET001	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Physics	**3**	**0**	**0**	**3**

Course Objective

Students will gain the knowledge and skills of various tools for circuit analysis in DC, AC and magnetic circuits, and understand the behavior of various circuit elements

Course Outcomes: Student will be able to

CO1	Apply the basic tools like mesh analysis and nodal analysis for the analysis of the DC circuits. (BL – 3)
CO2	Apply basic concepts of electromagnetism and develop the equivalent electric network for a given magnetic circuit and analyze the behavior. (BL – 3)
CO3	Apply the basic tools like mesh analysis and nodal analysis for the analysis of the AC circuits and understand the concept of impedance, power factor in AC circuits (BL – 3)
CO4	Understand the significance of resonance, apply the basic tools to analyze resonant circuits and develop the locus of current of various circuits for parametric variations. (BL – 3
CO5	Apply various network theorems for the analysis of the electrical circuits. (BL – 3)
CO6	Design and develop the mathematical model of Electric circuits, magnetic circuits and resonant circuits for steady state analysis. (BL-6)

SYLLABUS

Unit 1	**Introduction to Electrical Circuits**	**8hr**

Classification of electrical elements, Basic Concepts of passive elements of R, L, C and their V-I relation; Classification of Sources, Kirchoff's laws; Network reduction techniques (series, parallel, series – parallel); star-to-delta and delta-to-star transformation; Source transformationtechnique; nodal analysis; mesh analysis of DC circuits; super-node and super-mesh analysis.

Unit 2	**Magnetic Circuits**	**8hr**

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

Unit 3	**Single Phase AC Circuits**	**8hr**

Characteristics of periodic functions: Average value, R.M.S. value form factor, peak factor representation of a sine function; concept of phasor, phasor diagrams; Steady state analysis of the response of R, L and C elements to sinusoidal excitations; Power triangle, Power factor; Concept of Impedance; Series RL circuit, series RC circuit and series RLC circuit; Analysis of AC Networks: Mesh analysis; Nodal Analysis.

Unit 4	Resonance and Locus Diagrams	8hr

Locus diagram: RL series circuit; RC series circuits; RLC series circuit; series-parallel RLC circuits. Series Resonance: Characteristics of a series resonant circuit; Q-factor, selectivity and bandwidth, expression for half power frequencies; Parallel resonance: Characteristics of a series resonant circuit; Q-factor, selectivity and bandwidth.

Unit 5	Network Theorems (both DC & AC Excitation)	8hr

Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum Power Transfer theorem; Reciprocity theorem; Millman's theorem; compensation theorem; and Tellegen's theorem.

LEARNING RESOURCES

Text Books:

1	Jack Kemmerly, William Hayt and Steven Durbin, "Engineering Circuits Analysis", Tata Mc Graw Hill Education, 2005, Eighth edition.
2	A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", Mc Graw Hill Education, 2017, Fifth edition
3	A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co., 2018, Seventh Revised Edition.

Reference Books:

1	Charles K. Alexander and Mathew, N.O. Sadiku, "Fundamentals of Electrical Circuits", Mc Graw Hill Education (India), 2013, Fifth Edition
2	Mahmood Nahvi, Joseph Edminister, and K. Rao, "Electric Circuits (Schaum's outline Series)", Mc Graw Hill Education, 2017, Fifth Edition.
3	David A. Bell, "Electric Circuits", Oxford University Press, 2009, Seventh Edition.
4	Robert L Boylestad, "Introductory Circuit Analysis", Pearson Publications, 2023, Fourteenth Edition.
5	G. K. Mithal, "Network Analysis", Khanna Publishers, 2022, Fifteenth Edition.

Online Courses

1	https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2	https://nptel.ac.in/courses/108104139
3	https://nptel.ac.in/courses/108106172
4	https://nptel.ac.in/courses/117106108

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL-3	X				
CO2	BL-3		X			
CO3	BL-3			X		
CO4	BL-3				X	
CO5	BL-3					X
CO6	BL-6	X	X	X	X	X

R24MSCST001	PROCEDURAL PROGRAMMING					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**3**	**0**	**0**	**3**

Course Objective
To develop proficiency in procedural programming using C through fundamental concepts, control structures, arrays, pointers, structures, and file handling.

Course Outcomes	
After completing this course, the students will be able to	
1	**Apply** the basics of software, hardware, number systems, and programming concepts to write simple C programs. **(BL3)**
2	**Implement** decision-making and control structures like if-else, switch, loops, and unconditional statements in C programs. **(BL3)**
3	**Analyze** and **manipulate** arrays and strings, and **design** modular programs using functions and recursion. **(BL4)**
4	**Utilize** pointers for dynamic memory allocation, pointer arithmetic, and complex data structure manipulation in C programs. **(BL3)**
5	**Construct** and **manage** complex data structures like structures and unions, and **develop** file handling operations in C. **(BL6)**
6	**Design** and **develop** comprehensive C programs by integrating various programming concepts to solve complex problems using procedural programming techniques. **(BL6)**

SYLLABUS		
Unit I	**INTRODUCTION TO PROGRAMMING**	**8 hr**
Software, hardware, Number Systems (Binary, Hexadecimal, Octal, Decimal); Algorithms, pseudo code; Flowcharts, Program development steps; Structure of c program with example; Tokens, Basic data types; Operators Arithmetic, logical, relational, bitwise; ternary, increment /decrement, special operators, assignment; Built-in Input/output Functions, Expressions, type casting.		
Unit II	**SELECTION AND CONTROL STATEMENTS**	**8 hr**
Two way selection statements if, if-else with examples; Nested if with examples; Multiway selection statements - switch with examples; Nested switch with examples, else if ladders with examples; Iterative statements while, do-while with examples; for loop with examples; Nested loops with examples; Un conditional statements; break, continue, goto with examples		
Unit III	**INTRODUCTION TO ARRAYS AND STRINGS, MODULAR PROGRAMMING THROUGH FUNCTIONS**	**8 hr**
Array Definition, Declaration and accessing of 1D array; Declaration and accessing of integer 2D array; 2D array applications: matrix addition, multiplication; String definition, declaration and accessing of strings with examples; Function Definition, prototype, declaration and accessing with examples; Parameter passing mechanisms with examples, Scope and Extent of Variables; Storage classes auto, static, Register and extern with examples; Definition of recursion, types of recursion (direct and indirect) Solving problems using recursive approach like finding factorial, Fibonacci series, Towers of Hanoi.		
Unit IV	**POINTERS AND DYNAMIC MEMORY ALLOCATION**	**8 hr**
Definition of pointers, declaration, initialization, Pointer arithmetic; Representing 1D array using pointers with examples; Representing 2D arrays using pointers with examples; Pointer to pointer, constant pointers with examples, Pointer to		

constant variable, void pointer, generic pointer with examples; Pointers to Functions; Difference between static and dynamic memory allocation, Dynamic memory allocation using built-in functions (malloc (), calloc ()) ; Dynamic memory allocation using built-in functions (realloc (), free ()) ; Dangling pointer and unreferenced memory problem		
Unit V	**STRUCTURES, UNIONS AND FILE HANDLING**	**8 hr**
Structure definition, declaration, initialization and accessing structure members; Nested structures with examples, arrays of structures; Pointer to structures with examples, Self-Referential structures; Unions, Bitfields, typedef with examples; Concept of a file and file modes, Formatted I/O; File handling functions; fopen (), fclose (), fscanf (), fprintf (); Random access files handling functions, command line arguments ; Text files, Binary files, Differences between text and Binary files, fread (), fwrite ()		

LEARNING RESOURCES

TEXTBOOKS:

1	Brian W Kernighan and Dennis M Ritchie, *The C programming Language*, Second Edition, Pearson, 2015.
2	Pradip Dey, Manas Ghosh, *Programming In C*, 2nd Edition, Oxford Higher Education, 2011.

REFERENCE BOOKS:

1	Dr Reema Thareja, *Programming in C*, Third Edition, Oxford Press, 2023.
2	Byron Gottfried, *Programming with C*, Third Edition. Schaums Outlines Series, 2017.
3	Ajay Mittal, *Programming in C - A Practical Approach*, Pearson, 2010.

ONLINE COURSES

1	https://mvgrce.codetantra.com
2	www.netacad.com

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL4			X		
CO4	BL3				X	
CO5	BL6					X
CO6	BL6	X	X	X	X	X

R24MMECD001	COMPUTER AIDED ENGINEERING DRAWING					
	Total Contact Hours	14(T)+28(P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**1**	**0**	**2**	**2**

Course Objective: To enable the students to learn various concepts of engineering graphics using the CAD tool.

Course Outcomes

1	Sketch the two-dimensional drawings using draw, modify, and annotation commands in CAD software
2	Draw the projections and solve the problems in projections of points, lines, planes & solids.
3	Create orthographic projections and isometric projections and create composite solids using CAD software.

SYLLABUS:

Module 1:
Overview of CAD Software:
Computer technologies that impact graphical communication, Demonstrating knowledge of CAD software such as The Menu System, Toolbars, Command window, and Status Bar.
Set up the drawing page and the printer, Scale settings, setting up of units and drawing limits, standards for annotations, and 3D Modeling.

Module 2:
Introduction to Orthographic Projections: Projections of points, straight lines, planes and simple solids

Module 3:
Development of surfaces of simple solids, isometric views, Conversion of isometric views to orthographic views. And create complex compound solids in CAD

List of Exercises

1	Creation of simple 2-D geometries
2	Creation of complex 2-D geometries & Engineering Curves –Generic method for Conic sections
3	Engineering Curves – Cycloids & Involutes
4	Orthographic Projection of Points
5	Projection of lines in simple positions and inclined to one plane
6	Projection of lines inclined to both planes
7	Projection of planes is simple and inclined to one plane
8	Projection of planes inclined to both planes
9	Projection of solids simple positions
10	Development of simple Solids (Prisms, Pyramids, Cylinder & Cone)
11	Conversion of orthographic views to isometric views
12	Modeling of complex 3D geometries and their conversion to orthographic views

LEARNING RESOURCES

TEXT BOOKS:	
1	N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 2016.
2	Dhananjay Jolhe, *Engineering Drawing with an Introduction to AutoCAD*, Tata McGraw Hill, 2017
REFERENCE BOOKS:	
1	K.L. Narayana and P. Kannaiah, *Engineering Drawing*, Tata McGraw Hill, Third Edition, 2013.
2	M.B.Shah and B.C. Rana, *Engineering Drawing*, Pearson Education Inc,2009.
ADDITIONAL REFERENCE MATERIAL	
1	https://nitc.ac.in/imgserver/uploads/attachments/Ed__5c3343c5-c3f9-468a-b114-8f33556810b4_.pdf

		PHYSICS LAB				
R24MPHYL001	Total Contact Hours	28(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Higher Secondary School Physics	**0**	**0**	**2**	**1**

Course objectives

- To complement the classroom learning with laboratory experiments.
- Calibration of instruments like travelling-microscope, spectrometer, cathode-ray-oscilloscope, magnetometer, etc. and to make precise measurements.
- Understand the physical principles involved in the conduct of experiment and measure the relevant experimental variables.
- Apply the analytical techniques and graphical analysis to experimental data and draw necessary conclusions.
- Prepare a concise and clear technical report to communicate his/her experimental understanding.

Course outcomes

After completion of course, the students will be able to

1	Interpret the given XRD pattern to analyze crystallographic phase of the given unknown specimen.
2	Conduct experiments to reconnoiter the interference and diffraction patterns of light.
3	Find the signature variation of magnetic field due to current, and the specifics of magneto-dielectric materials.
4	Estimate the wavelength of coherent radiation, the coercing parameter of optic fiber, and the perpetual aspects of a semiconductor diode.
5	Measure the elastic modulus of the material and determine the unknown fork frequency.

LIST OF EXPERIMENTS

1	Determination of the lattice constant and crystallographic phase of the unknown by using XRD patterns.
2	Determination of the Hysteresis energy loss of a ferromagnetic material by forming B-H curve.
3	Find the signature variation of magnetic field along the axis of a current carrying circular coil-Stewart and Gee's Method.
4	Determination of radius of curvature of a given plano-convex lens by forming Newton's rings.
5	Determination of thickness of the object by forming parallel interference fringes
6	Determination of the wavelength of spectral lines by using a plane transmission grating in normal incidence configuration.
7	Determination of wavelength of the Laser by using a diffraction grating.
8	Determination of numerical aperture and acceptance angle of the optic fiber.
9	Determination of energy gap of the semiconductor p-n junction diode.
10	Plot the I/V characteristics of Zener diode under forward and reverse conditions.

ADDITIONAL EXPERIMENTS

1	Determination of dielectric constant of solid dielectric.
2	Determination of rigidity modulus of the of the material of the wire- Torsional pendulum
3	Determination of frequency of the electrical vibrator- Melde's experiment

LEARNING RESOURCES	
TEXT BOOK:	
1	C.S. Robinson and Dr. Ruby Das, *A Textbook of Engineering Physics Practical*, First edition. Laxmi Publications Pvt. Ltd., 2016.
REFERENCE BOOK:	
1	S. Balasubramanian and M.N. Srinivasan, *A Textbook of Practical Physics*, First edition. S. Chand Publishers, 2017
ADDITIONAL REFERENCE:	
1	www.vlab.co.in

	PROCEDURAL PROGRAMMING LAB					
R24MSCSL002	Total Contact Hours	28 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**0**	**0**	**2**	**1**

Course Objective

To get practical exposure to the Structured Programming with hands-on experience in
laboratory for solving real world problems using C

Course Outcomes

After completing this course, the students will be able to

1	Students will write and execute simple C programs, demonstrating understanding of basic input/output operations and program structure.
2	Students will use various operators and control structures to perform decision-making and repetitive tasks.
3	Students will declare, initialize, and perform operations on one-dimensional and multi-dimensional arrays, as well as handle string operations.
4	Students will define, call, and pass parameters to functions, including recursive functions, to solve problems in a modular and efficient manner.
5	Students will use pointers for dynamic memory allocation, manipulate structures and unions, and perform file operations for reading and writing data in text and binary formats.

LIST OF EXPERIMENTS

1	Week-1: Introduction to Programming with operators
	    1. Write a C program to print "Hello, World!" and understand the structure of a basic C program.
	    2. Write a C program to demonstrate the use of basic I/O statements (printf, scanf)
	    3. Write a C program for calculating the sum of two numbers.

2	Week-2: Expressions and Operators
	    1. Write a C program to finding the maximum of three numbers using conditional operator.
	    2. Write a C Program to convert temperature from Celsius to Fahrenheat and vice versa
	    3. Write a C Program to to calculate simple and compound interest

3	Week 3: Selection Statements
	    1. Write a C program to find the largest of three numbers using if-else statements.
	    2. Write a program to demonstrate the use of switch-case statements to perform arithmetic operations based on user choice.
	    3. Write a program to demonstrate the use of else-if ladder to grade student marks.

4	Week-4: Loops
	    1. Write a C program to print sum of the digits of the given number.
	    2. Write a C program to print the Fibonacci series up to n terms using a for loop.
	    3. Write a C program to check the given number is a palindrome or not.

	4. Write a C program to calculate the factorial of a number using a while loop.
5	Week-5: Nested Loops and branching 1. Write a C program to print a pyramid patterns using nested loops. 2. Write a C program to print prime numbers between 1 to 100 3. Write a C program to demonstrate the use of break and continue statements within loops.
6	Week 6: Arrays 1. Write a C program to find the sum of all elements in a 1D array. 2. Write a C program to read and print the 2D Array elements in a matrix form. 3. Write a C program to perform matrix addition using 2D arrays. 4. Write a C program to find the transpose of a given matrix.
7	Week-7: String Handling 1. Write a program to demonstrate string operations (copy, concatenate, compare, length) using built-in functions. 2. Write a C program to count the number of vowels in a string. 3. Write a C program to concatenate two strings without using the library function strcat.
8	Week-8: Functions 1. Write a program to define and use a function to find the sum of two numbers. 2. Write a C program to check the given number is prime or not using a function. 3. Demonstrate passing of an array to a C function.
9	Week-9: Recursive Functions 1. Write a recursive program to generate Fibonacci series. 2. Write a C program to find the GCD of two numbers using a recursive function. 3. Write a C Program to find the nCr value for the two positive numbers where n > r using recursion.
10	Week-10: Pointers & Dynamic Memory Allocation 1. Write a program to demonstrate pointer arithmetic. 2. Write a program to use pointers to access elements of an array. 3. Write a program to dynamically allocate memory for an array using malloc and calloc. 4. Write a program to demonstrate the use of realloc and free for dynamic memory allocation.
11	Week-11: Structures & Unions 1. Write a program to define, declare, and access members of a structure. 2. Write a program to demonstrate the use of nested structures. 3. Write a C program to store and display student information using structures.
12	Week-12: File Handling 1. Write a program to demonstrate file handling functions (fopen, fclose, fscanf, fprintf). 2. Write a program to read and write data to a binary file using fread and fwrite.

	3. Write a C program to simulate copy command using command line arguments.	

LEARNING RESOURCES	
TEXTBOOKS:	
1	Brian W Kernighan and Dennis M Ritchie, *The C programming Language*, Prentice Hall.
2	Pradip Dey, Manas Ghosh, *Programming In C*, Oxford Higher Education.
REFERENCE BOOKS:	
1	Dr Reema Thareja, *Programming in C*, Third Edition, Oxford Press
2	Byron Gottfried, *Programming with C*, Schaums Outlines Series, Third Edition.
3	Ajay Mittal, *Programming in C - A Practical Approach*, Pearson
ONLINE COURSES	
1	https://www.tutorialspoint.com/learn_c_by_examples
2	

	HEALTH & WELLNESS					
R24MENGT003	Total Contact Hours	28(L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**2**	**0**	**0**	**2**

Course Objective

This course aims to help students grasp the significance of a healthy diet, yoga, and stress management techniques in fostering their overall well-being.

Course Outcomes

After completing this course, the students will be able to

1	Demonstrate understanding of the current ways of living and develop a plan of action that promotes overall well-being. (**BL 3**)
2	Demonstrate Understanding of the importance of nutrition, a balanced diet and scheduled sleeping hours for maintaining a healthy lifestyle **(BL3)**
3	Demonstrate Understanding of the use of yoga as a holistic tool in improving physical and mental health **(BL3)**
4	Demonstrate Understanding of various stress management techniques for better physical and mental health **(BL3)**
5	Demonstrate Understanding of the importance of Emotional intelligence in the aspects of stress relief, general health and social wellness **(BL3)**

SYLLABUS

Unit I	**Introduction to Health and wellness and Wellness planning**	**5 hrs**

Understanding Health and Wellness as holistic concepts encompassing Physical, Mental, Emotional, Social and environmental well-being – need to develop personalized wellness plans, set goals, and track progress toward a healthier lifestyle.

Unit II	**Healthy lifestyle choice**	**5 hr**

Examine topics such as sleep, hygiene, substance abuse prevention, and the impact of lifestyle choices on health.

Unit III	**HOLISTIC WELLNESS: INTRODUCTION TO YOGA**	**5 hr**

Explore the interconnectedness of physical, mental, and emotional health and the importance of balance by introducing Yoga

Unit IV	**EMOTIONAL INTELLIGENCE AND STRESS MANAGEMENT**	**5 hr**

Regulation and management of feelings and emotions effectively-
Methods of stress management include unhooking; Acting on Your Values, Being Kind, Making Room for deep breathing, Taking a break; Making time for hobbies; Talking about your problems and Meditation.

Unit V	**SELF-CARE**	**5 hrs**

Formulate practical self-care routines and strategies to maintain optimal physical and mental health, encompassing a holistic approach that addresses physical, emotional, intellectual, social, spiritual, and environmental well-being.

	LEARNING RESOURCES
	TEXTBOOKS:
1	B.K.S. Iyengar, *Yoga The Path to Holistic: The Definitive Step-by-step Guide,* DK Publishers, 2021.
2	C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian, *Nutritive value of Indian foods (NVIF),* National Institute of Nutrition, India, 2023.
3	ICMR-*National Institute of Nutrition, Short summary report of nutrient requirements for Indians,* 2020.
4	Emily Attached & Marzia Fernandez*, Mental Health Workbook,* 2021.
	REFERENCE BOOKS:
1	C. Nyambichu & Jeff Lumiri, *Lifestyle Diseases: Lifestyle Disease Management*, 2018.
2	Nashay Lorick, *Mental Health Workbook for Women: Exercises to Transform Negative Thoughts and Improve Well-Being,* 2022.
3	Angela Clow & Sarah Edmunds, *Physical Activity and Mental Health*, 2013.
	ADDITIONAL REFERENCE MATERIAL
1	B.K.S. Iyengar, *Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority*, 2006.
2	Claude Bouchard, Steven N. Blair, William L. Haskell, *Physical Activity and Health*, Human Kinetics*,* 2012.
	ONLINE COURSES
1	http://vikaspedia.in/health/nutrition
2	https://yoga.ayush.gov.in/Yoga-Course/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL2		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL2					X

		Engineering Workshop					
R24MMECW001	Total Contact Hours	14 (L) + 28(P)		**L**	**T**	**P**	**C**
	Pre-requisite	Nil		**1**	**0**	**2**	**2**

Course Objective
To familiarize students with different useful trades widely used in day- today practice.

Course Outcomes	
Student able to	
1	Identify various trades and perform related work at a preliminary level.
2	Select and use proper tools for the different tasks
3	Address troubleshoots in real-life and get rid of dependency.
4	Ability to design and model different prototypes using different trades
5	Demonstrate the safety practices to be applied on different trades

Module 1	**Carpentry shop** 1.1. Introduction to various types of wood such as Teak, Mango, Sheesham, etc. (Demonstration and their identification). 1.2. Demonstration, function and use of commonly used hand tools. Care, maintenance of tools and safety measures to be observed. Job I Marking, sawing, planning and chiselling & their practice 1.3. Introduction to various types of wooden joints, their relative advantages and uses. Preparation of half lap joint, Preparation of Mortise and Tenon Joint 1.4. Safety precautions in carpentry shop. 1.5 Hands on experience in carpentry for making duster. 1.6 Hands on experience in carpentry for making day-today used products and wood requirement.
Module 2	**Plumbing:** 2.1. Introduction to plumbing tools, common materials used in plumbing. 2.2. Description and demonstration of simple operations in plumbing 2.3.Care, Safety precautions and maintenance of plumbing tools and setup. 2.4 Design a plumbing layout for domestic applications. 2.5 Address trouble shootings in basic plumbing emergencies.(Spindle replacement in taps, water tap replacement, leakage of a tap)
Module 3	**House wiring – 3** 3.1 Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits. 3.2 Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthing. 3.3 Selection of wires (color code) and identification of electrical components in house hold. 3.4 House wiring for specific requirement from main panel and usage of multimeter. 3.5 Load calculation given connected utilities and cost estimation
Module 4	**Fabrication – 4:** 4.1 Introduction to welding 4.2. Description about fabrication peripherals such as protection shield, welding machine types, electrode nomenclature. 4.3. Safety measures in welding practice 4.4 Fabrication of an useful component/ product using different weld joints.

Module 5	**Assembly and Disassembly:**
	5.1 Introduction to machine parts, tools and accessories used for assembly and disassembly of a machine
	5.2. Functions of all parts and their importance
	5.3 Care and safety precautions during the work.
	5.4 Assembly and disassembly of automobile (Replacement of vehicle tyre)
	5.5 Assembly and disassembly of mechanical unit (machine).

LEARNING RESOURCES

TEXT BOOKS:

1	K.C. John, *Mechanical workshop practice*, second edition, PHI learning, 2010.
2	Bruce J. Black, *Workshop Processes, Practices and Materials*, Routledge publishers, 5th Edn. 2015.
3	B.S. Raghuwanshi, *A Course in Workshop Technology Vol I. & II,* , Dhanpath Rai & Co., 2015 & 2017.

REFERENCE BOOKS:

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

ADDITIONAL REFERENCE MATERIAL

1	https://mrcet.com/downloads/hs/EWS-ITWS%20%20LAB%20MANUAL.pdf
2	https://sjce.ac.in/wp-content/uploads/2018/04/Workshop-Laboratory-Manual.pdf
3	https://manavrachna.edu.in/latest/virtual-lab-workshop-for-first-year-engineering-students-mru/

CODE	Electrical Circuit Analysis - II				
R24MEEET002	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical Circuit Analysis -I, Ordinary Differential Equations and Laplace Transforms	**3**	**0**	**0**	**3**

Course Objective

Students will gain the knowledge and skills of various tools for steady state analysis of three phase circuits, transient analysis of R-L, R-C and R-L-C networks, analysis of two port networks and synthesis.

Course Outcomes: Student will be able to

CO1	Apply the basic techniques for the analysis of three phase balanced circuits under steady state conditions and acquire the skills of power measurement in three phase systems (BL-3).
CO2	Apply various techniques to analyse three phase unbalanced circuits under steady state conditions (BL-3).
CO3	Analyze Electrical Circuits with DC and AC excitation under transient conditions and (BL-4).
CO4	Construct the graph diagram for a given electric network, determine the incidence matrices and develop the two port models (Z-parameters, Y-Parameters, ABCD Parameters and h-Parameters) for a given network (BL-3).
CO5	Apply Foster's and Cauer's forms to develop the one-port passive network from its driving point impedance / admittance function (BL-3).
CO6	Design and develop the mathematical model of a given network for steady state analysis and transient analysis. Also build purposeful networks based on their network function (BL-6)

SYLLABUS

Unit 1	Analysis of Three Phase Balanced Circuits	8hr
Advantages of three phase systems over single phase systems, types of three phase connection and phase sequence; star connected systems; delta connected systems; analysis of star connected three phase circuits; analysis of delta connected three phase circuits; Power measurement in three phase circuits: 3-wattmeter method; 2-attmeter Method; reactive power measurement through single wattmeter method.		
Unit 2	Analysis of Three Phase Unbalanced Circuits	8hr

Analysis of delta connected unbalanced Circuits; Analysis of star connected unbalanced circuits with neutral connection; Analysis of star connected unbalanced circuits without neutral connection: Loop method; analysis using Millman's theorem; using star-delta transformation; analysis using symmetrical components.

Unit 3	Transient Response Analysis	8hr

D.C Transient Response of R-L; R-C; R-L-C Series Circuits for D.C Excitation differential equations; Solution Method Using Laplace Transforms. A.C Transient Analysis: Transient Response of R-L; R-C; R-L-C Series Circuits for Sinusoidal Excitations using Differential Equations; and using Laplace Transforms.

Unit 4	Network Topology and Two-port networks	8hr

Definitions, Graph, Tree, co-tree; node incidence matrix; Basic Cut set matrix; and Basic Tie set Matrix for Planar Networks; two port network parameters – Z, Y; transmission and hybrid parameters; inter-relationships of different Parameters; interconnection of Two-Port Networks.

Unit 5	Network Synthesis	8hr

Poles and Zeros of network functions, pole-zero plot; Positive Real Function – properties; basic procedure for network synthesis; LC-Immittance functions; RC-Impedance functions and RL admittance functions; RL-Impedance functions and RC-Admittance functions; Foster's form-I, Foster's form-II; Cauer's form-I, Cauer's form-II.

LEARNING RESOURCES	

Text Books:	
1	Jack Kemmerly, William Hayt and Steven Durbin, "Engineering Circuits Analysis", Tata Mc Graw Hill Education, 2005, Eighth edition.
2	A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", Mc Graw Hill Education, 2017, Fifth edition
3	A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co., 2018, Seventh Revised Edition.

Reference Books:	
1	Charles K. Alexander and Mathew, N.O. Sadiku, "Fundamentals of Electrical Circuits", Mc Graw Hill Education (India), 2013, Fifth Edition
2	Mahmood Nahvi, Joseph Edminister, and K. Rao, "Electric Circuits (Schaum's outline Series)", Mc Graw Hill Education, 2017, Fifth Edition.
3	David A. Bell, "Electric Circuits", Oxford University Press, 2009, Seventh Edition.
4	Robert L Boylestad, "Introductory Circuit Analysis", Pearson Publications, 2023, Fourteenth Edition.
5	G. K. Mithal, "Network Analysis", Khanna Publishers, 2022, Fifteenth Edition.

Online Courses

1	https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2	https://nptel.ac.in/courses/108104139
3	https://nptel.ac.in/courses/108106172
4	https://nptel.ac.in/courses/117106108

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL-3	X				
CO2	BL-3		X			
CO3	BL-4			X		
CO4	BL-3				X	
CO5	BL-3					X
CO6	BL-6	X	X	X	X	X

R24MEEET003	ANALOG ELECTRONIC CIRCUITS				
	Total Contact Hours 42	**L**	**T**	**P**	**C**
	Pre-requisite Engineering Physics, Basic Electrical & Electronics Engineering	3	0	0	3

Course Objective: This course enables the students:
1. An understanding of how basic devices such as semiconductor diodes, bipolar junction transistors and field-effect-transistors are modeled.
2. An understanding of basic Electronics on which analysis and design of electronic circuits and systems are based, including rectifiers and amplifiers.
3. Analyze and design simple electronic circuits.

Course Outcomes: After completing this course, the students will be able to

1	Apply the construction and operation principles of Diode, Zener Diode, BJT, and JFET to design and analyze rectification, regulation, and amplification circuits. (BL3)
2	Design and develop electronic systems by integrating rectifiers with and without filters, Zener regulators, wave shaping circuits and voltage multipliers to meet specified performance requirements.(BL6)
3	Select the appropriate transistor configurations for the amplification of electrical signals. (BL3)
4	Analyze the performance of various biasing and compensating techniques to maintain a stable operating point. (BL4)
5	Design a suitable oscillator for a given frequency range using discrete elements. (BL6)
6	Design an electronic circuit to address practical engineering challenges in real-world applications by utilizing the foundational knowledge of electronic components.(BL6)

SYLLABUS

Unit 1	SEMICONDUCTOR DEVICES	8 hr

BASIC SEMICONDUCTOR DEVICES Construction and Operation of Diode; Zener Diode; BJT; JFET POWER SEMICONDUCTOR DEVICES MOSFET; IGBT; SCR; Switching characteristics of SCR

Unit 2	POWER SUPPLIES	8 hr

RECTIFIERS
Single Phase Half Wave Rectifier; Single Phase Bridge Rectifier; Single Phase Half Wave Rectifier with L, C and LC filter; Single Phase Bridge Rectifier with L, C and LC filter; Zener voltage Regulator Wave Shaping Circuits And Dc Power Supply, Clippers and Clampers; Voltage Doubler; Regulated Power Supply

Unit 3	BIPOLAR JUNCTION TRANSISTOR	8 hr

TRANSISTOR CONFIGURATIONS
Transistor current components; Transistor as an amplifier and switch; Transistor CB configuration; Transistor CE configuration; Transistor CC configuration
HYBRID MODEL TRANSISTOR CONFIGURATIONS Hybrid model of transistor configurations; Conversion of Hybrid model of transistor configurations; Analysis of transistor amplifier using H – parameters

Unit 4	TRANSISTOR BIASING AND THERMAL STABILIZATION	8 hr

TRANSISTOR BIASING Fixed biasing; Collector to base biasing; Collector to base bias with emitter feedback; Self-bias COMPENSATION METHODS Compensation against variation in V_{BE}; Compensation against variation in I_{CO}; Thermistor and Sensistors compensation; Thermal runaway and Condition to avoid

Unit 5	FEEDBACK AMPLIFIERS AND OSCILLATORS	8 hr

FEEDBACK AMPLIFIERS
Classification of Feedback amplifiers; General characteristics of negative feedback amplifiers; Effect of feedback on amplifiers
OSCILLATORS
Condition for Oscillations; RC Phase shift oscillator; Wein bridge oscillator; Hartley and Colpitt's oscillator; Crystal oscillator

LEARNING RESOURCES

TEXT BOOKS:

1	Electronic Devices And Circuits –J.Millman,C.C.Halkias,Tata Mc Graw Hill
2	R.L. Boylestad and L.Nashelsky, Electronic Devices And Circuits Theory, 10th Edition, Prentice Hall,2009
3	A.S.Sedra and K.C.Smith, Microelectronics Circuits,5th Edition, Oxford University Press, 2004

REFERENCE BOOKS:

1	Electronic Devices And Circuits by J.B.Gupta,Dhanpat Rai Publications
2	Integrated Electronics-Jacob Millman,Chritos C.Halkies,Tata Mc Graw Hill
3	Electronic Devices And Circuits-Salivahanan, Kumar, Vallavaraj,Tata Mc Graw Hill

ADDITIONAL REFERENCE MATERIAL

1	https://www.udemy.com/course/complete-course-on-electronic-devices-and-circuits/

ONLINE COURSES

1	http://nptel.iitm.ac.in/
2	http://www.learningware.in/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL6	X	X			
CO3	BL3			X		
CO4	BL4			X	X	
CO5	BL6			X		X
CO6	BL6	X	X	X	X	X

	CONTROL SYSTEMS					
R24MEEET004	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical circuits, differential equations, Laplace transforms.	**3**	**0**	**0**	**3**

Course Objective

- Students will gain understanding of Open loop and Closed loop systems Students will get exposure to stability
- Students will gain understanding of Time domain analysis Students will gain understanding of Frequency domain analysis
- Students will gain understanding of state variable analysis

Course Outcomes

1	Will be able to apply techniques to find Transfer function of a physical system. **(BL3)**
2	Will be able to analyze the transient and steady state performance of the system. **(BL4)**
3	Will be able to analyze stability of LTI systems. **(BL4)**
4	Will be able to evaluate the system performance in time domain and frequency domain. **(BL5)**
5	Will be able to evaluate the performance of SISO systems and MIMO systems. **(BL5)**
6	Will be able develop and design a closed loop control system with good transient and steady state performance. **(BL6)**

SYLLABUS

Unit 1	**Introduction to Control Systems and Transfer Function**	**8 hr**
	Open loop and Closed loop Control Systems; Transfer Function; Mathematical modeling and impulse response; Mechanical systems; Block diagram reduction rules; Transfer Function through BDR techniques; Signal Flow Graphs, Mason's Gain formula; Effects of feedback;	
Unit 2	**Time Response Analysis**	**8 hr**
	Standard signals, First order time response; Second order time response ; Time domain specifications; Steady state error; Static error constants; Dynamic error constants; Effect of P, PI, PID controllers; Servomotors;	
Unit 3	**Stability and Frequency domain**	**8 hr**
	Concept of stability; Routh-Hurwitz Criterion; Special conditions in Routh array; Construction of root loci; Frequency domain specifications; Correlation between time domain and frequency domain; Introduction to compensation; Lag and Lead Compensators;	

Unit 4	**Frequency Response Analysis**	**8 hr**
Bode diagram; Construction of magnitude Plot, Phase plot; Gain Margin and Phase Margin; Adjustment of open loop gain in Bode plot ; Polar plot; Gain margin and phase margin using Polar plot ; Nyquist plot; Stability analysis using Nyquist plot;		
Unit 5	**State Variable Analysis**	**8 hr**
Concept of state , State variables and state model; State model from Transfer function; Transfer function from state model; Solution of state equation; State transition matrix; Properties of state transition matrix; Controllability; Observability;		

LEARNING RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1	A. Nagoor Kani, Control Systems, Third edition. RBA Publications, 2017.
2	B. C. Kuo and Farid Golnaraghi, Automatic Control Systems, Eighth edition. John Wiley and sons , 2003.
3	U. A. Bakshi, V. U. Bakshi, Control Systems Third edition Technical Publications, 2012. , .

ADDITIONAL REFERENCE MATERIAL

1	https://archive.nptel.ac.in/courses/107/106/107106081/
2	https://www.ittchoudwar.org/upload/file_2102232353250.pdf

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc23_ee143/preview
2	https://onlinecourses.nptel.ac.in/noc19_ee42/preview

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X			
CO3	BL4			X	X	
CO4	BL5		X	X	X	
CO5	BL5		X	X	X	X
CO6	BL6	X	X	X	X	X

		ELECTRICAL MACHINES-I				
R24MEEET005	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electric circuit fundamentals and Electro magnetism	**3**	**0**	**0**	**3**

Course Objective

Students will be able
- To learn how to perform basic circuit analysis for DC machines and transformers considering various operating conditions and loads
- To develop an understanding of basic principle and operation of transformers and DC machines
- To analyse and calculate the performance characteristics of electrical machines

Course Outcomes

After completing this course, the students will be able to

1	Analyze the fundamental concepts of electrical machines to determine their impact on operation and performance **[BL4]**
2	Assess suitable materials and methods for design and construction of electrical machines based on the parameters like economic, performance, efficiency and environmental constraints.**[BL5]**
3	Analyze the performance of transformers and DC machines by applying circuit analysis techniques using equivalent circuit diagram **[BL4]**
4	Estimate accepted standards and guidelines to select appropriate electrical machines to meet specified performance requirements [BL4]
5	Investigate control strategies to electrical machines, including speed control and starting methods for motors, and understand the role of controllers in enhancing machine performance**. [BL4]**

SYLLABUS

Unit I	**Fundamentals of rotating electrical machines**	**8 hrs**

Constructional features of electrical machines-Principle of electromagnetic induction- Magnetic field generation by electrical field-Principles of energy conversion-Types of windings-Types of torques developed in electrical machines-Types of windings-Applications of various electrical machines

Unit II	**Single Phase Transformers**	**8 hrs**

. Construction and principle of operation of 1- Φ transformer- Classification of transformers- EMF equation and transformation ratio-Equivalent circuit diagram and voltage regulation- Transformer on no-load and load with phasor diagram- Losses and efficiency of transformer- Condition for maximum efficiency-All day efficiency

Unit III	**Testing and Three Phase Transformers**	**8 hrs**

Working of Auto transformer - Sumpner's test – Separation of core losses - Instrument transformers - Types of special purpose transformers - Construction of three phase transformers and its advantages - Single, two and three winding connections - Types of tap changing transformers

Unit IV	DC Generator	8 hrs

Overview of DC machine construction and working principles-Types of DC machines – Generation of electromotive force (EMF)-Armature reaction and commutation - Characteristics of DC generator-Losses and efficiency of DC generator- Condition for maximum efficiency-Applications of DC generator

Unit V	DC Motor	8 hrs

. Principle of DC motor-Torque equation of DC motor-Types of DC motor-Characteristics of DC motor-Methods of speed control-Starting methods-Swinburne's test-Hopkinson's test

LEARNING RESOURCES

TEXTBOOKS:

1	Kothari. D. P and Nagrath. I. J. *Electrical Machines*, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 5th edition 2002,
2	Bimbra. P. S, *Electrical Machinery*, Khanna Publishers, 7th edition,2010

REFERENCE BOOKS:

1	Fitgerald, A.E., Charles Kingsely Jr. Stephen D. Umans, *Electric Machinery* McGraw Hill Books Company, 6th edition 2002.
2	M.G. Say, *Performance and Design of AC Machines*, ELBS and Pitman&sons, Third edition,2008
3	Hill Stephen, Chapman. J, "*Electric Machinery Fundamentals*", Mc Graw Hill Book Co., New Delhi, 4th edition 2005
4	Albert E Clayton and Hancock. N.N, "*The performance and design of direct current Machines*", Oxford and IBH publishing company Pvt. Ltd., New Delhi 1990

ONLINE COURSES

1	https://youtu.be/D4RFFnzRdkk?si=jbcPs3arI1A_FE4a
2	https://youtu.be/lcpHTBWmJ6U

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	4	X				
CO2	5		X			
CO3	4			X		
CO4	4				X	
CO5	4					X

R24MCSCT001	DATA STRUCTURES (Common to all Branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Programming	**3**	**0**	**0**	**3**

Course Objective

Students will get exposure to use data structures such as arrays, linked lists, stacks, queues, trees, graphs, hashing and will be able to select and implement the appropriate data structures to solve the given problem.

Course Outcomes

1	Will be able to **apply** various searching and sorting techniques and **analyze** their time complexities. **(BL3)**
2	Will be able to **apply** Linked Lists and its variants and **utilize** them for various applications. **(BL3)**
3	Will be able to **compare** arrays and Linked Lists and **conclude** which storage structure is appropriate for the given problem/data structure. **(BL4)**
4	Will be able to **develop** novel **solutions** to small scale programming challenges involving data structures such as stacks, queues, trees and graphs. **(BL6)**
5	Will be able to recognize scenarios where hashing is advantageous, and **design** hash-based **solutions** for specific problems. **(BL6)**
6	Will be able to collaborate in teams to **design** and implement innovative **solutions** by **choosing** and **combining** the appropriate data structure(s). **(BL6)**

SYLLABUS		
Unit I	**INTRODUCTION TO LINEAR DATA STRUCTURES**	**8 hr**

Data Structures- Introduction, need for a data structure, Types of Data Structures; Overview of time and space complexity analysis, asymptotic notations; Recursion-Introduction, Types of recursions; Searching-Linear Search algorithm, Binary Search algorithm
Sorting techniques- Bubble Sort, Selection Sort; Insertion Sort; Quick Sort; Merge Sort.

Unit II	**LINKED LISTS**	**8 hr**

Introduction to Linked List, Variations/Types of Linked Lists, Applications; Single Linked List Operations: creation, insertion; Deletion, Traversal/Search; Circular Linked Lists-Insertion, Deletion, Traversal/Search.
Double Linked Lists and Operations- Creation, Insertion; Deletion, Traversal/Search; Applications of Linked List-Representation of Sparse Matrix using Single Linked List, Representation of Polynomials using Single Linked List; Polynomial Operations (Addition) using Linked List.

Unit III	**STACKS AND QUEUES**	**8 hr**

Introduction to Stack data structures, basic operation, implementation of Stack using array; Stack implementation using Linked Lists, advantages & disadvantages; Applications of Stack: Infix to postfix conversion; postfix expression evaluation, Factorial using Stack.

Introduction to Queue data structures, basic operation, implementation of Queue using array; Queue operations implementation using Linked Lists; Circular Queues using Arrays; Double Ended Queues.

Unit IV	TREE- BINARY TREE, BINARY SEARCH TREE, BALANCED TREE	8 hr

Tree – Introduction, Types of Trees; Binary Tree – Introduction, Properties, Various ways of representing Binary Tree in memory; Recursive Binary tree traversals, Construction of Binary tree given tree traversals (In-order, Pre-order & In-order, Post-order); Tree applications- Heap(Min/Max)

Binary Search tree operations- Creation, Insertion; Deletion, Traversal/Search; Balanced Binary trees – Introduction, Operations on AVL Trees –Insertion; AVL Tree Deletion, Search.

Unit V	GRAPHS AND HASHING	8 hr

Basic concepts, Representation of Graph using Adjacency Matrix and Adjacency List; Graph Traversals (BFS, DFS); minimum spanning tree using Prim's Algorithm; minimum spanning tree using Kruskal's algorithm

Single Source Shortest Distance- Dijkstra's algorithm, transitive closure; Introduction to Hashing, Hash Functions; Collision Resolution Techniques: Open hashing - chaining, Open Addressing- linear probing; quadratic probing, double hashing.

LEARNING RESOURCES

TEXT BOOKS:

1	Mark Allen Weiss, *Data Structures and algorithm analysis in C*, Pearson, 2nd Edition.
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, *Fundamentals of data structures in C*, Silicon Press, 2008.
3	Richard F, Gilberg , Forouzan, Cengage, *Data Structures*, 2/e.

REFERENCE BOOKS:

1	Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.
2	C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3	Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4	Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
5	Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

ADDITIONAL REFERENCE MATERIAL

1	https://www.javatpoint.com/data-structure-tutorial
2	https://www.programiz.com/dsa
3	https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc24_cs45/preview
2	https://www.coursera.org/learn/data-structures
3	https://www.coursera.org/specializations/boulder-data-structures-algorithms

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL4	X	X	X	X	X
CO4	BL6			X	X	X
CO5	BL6					X
CO6	BL6	X	X	X	X	X

R24MCSCT002	**OPERATING SYSTEMS**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basics of computer systems	**3**	**0**	**0**	**3**

Course Objective

Students will be able to understand how an operating system manages a computer's hardware resources like CPU, memory, file and storage providing a user-friendly interface to interact with the system, enabling them to grasp the principles of managing a computer system efficiently.

Course Outcomes

1	Students will be able to analyze the diverse structures and functionalities of operating systems to evaluate their impact on computer system performance. **(BL4)**
2	Students will be able to explain the different process management related aspects of operating system and will be able to analyze various process scheduling algorithms. **(BL5)**
3	Students will be able to perceive the significance of process synchronization and deadlock handling mechanisms in the operating system. **(BL5)**
4	Students will be able to compare and analyze the various memory management techniques. **(BL4)**
5	Students will be able to explain various file management, storage management, protection and security services offered by the operating system. **(BL5)**
6	students will be able to discuss how an operating system manages a computer's hardware resources like CPU, memory, and storage, allowing them to effectively utilize these resources through concepts like process management, memory allocation, file systems. **(BL6)**

SYLLABUS		
Unit I	**COMPUTER SYSTEM AND OPERATING SYSTEM OVERVIEW**	**8 hr**

Overview Computer System Hardware, What Operating System do? Computer System Organization & Computer System Architecture; OS Functions and Services; The Evolution of OS; Computing Environment; OS System Structure; System Calls and types of system calls; User Operating System Interface, Protection and Security.

Unit II	**PROCESS MANAGEMENT**	**8 hr**

Process description, Process States & Transitions, PCB; Process Scheduling-Scheduling queues, Schedulers, Context Switching; Operations on processes; Multithreading-Motivation, Benefits & Multithreading Models; Process Scheduling-Basic Concepts & Scheduling Criteria; Scheduling Algorithms-Non-Preemptive. (FCFS, SJF & Priority); Scheduling Algorithms-Preemptive (Round Robin & Priority). Multilevel Queue Scheduling, Multilevel-feedback Queue Scheduling.

Unit III	**PROCESS SYNCHRONIZATION AND DEADLOCKS**	**8 hr**

Process Synchronization-Background, The Critical section problem; Software-Based Solution (Peterson's Solution), Synchronization Hardware; Semaphores- Usage, Implementation; Classical Problems Synchronization-Bounded Buffer, Readers Writer's problem; Deadlock-System model, Deadlock Characterization; Methods of handling deadlocks, Deadlock Prevention; Deadlock Avoidance; Deadlock Detection, Recovery from Deadlock.

Unit IV	MEMORY MANAGEMENT	8 hr
Background-Basic Hardware, Address Binding, Logical vs Physical; Swapping, Contiguous Memory Allocation; Paging- Basic Method, Hardware; Structure of page tables; Segmentation -Basic Methods, Hardware; Virtual Memory-Background, Demand Paging- Basic Concepts; Page Replacement Algorithm-Basic Page replacement, FIFO, Optimal; Page Replacement Algorithm-LRU, Thrashing-Causes of Thrashing.		
Unit V	FILE & STORAGE MANAGEMENT, PROTECTION AND SECURITY	8 hr
File Concept-File Attributes, File Operations, File Types; Directory Structure-Overview, Single level, Two level, Tree Structure; File Allocation Methods-Contiguous, Linked, Indexed; Mass Storage-Magnetic Disk, Magnetic Tape, Disk Structure; Disk Scheduling; Goals of Protection, Principals of Protection, Access Matrix, ACL; The Security Problems, Program threats- Trojan, Trap Door, Ransomware; User Authentication-Passwords, Password Vulnerabilities, Encrypted Password, OTP, Bio-Metric.		

LEARNING RESOURCES

TEXTBOOKS:

1	Operating systems concepts by Abraham Silberschatz, peter B. Galvin, and Greg Gagne.
2	Operating systems: Internals and design principles by William Stallings.

REFERENCE BOOKS:

1	Modern operating systems by Andrew S. Tanenbaum

ADDITIONAL REFERENCE MATERIAL

1	"Operating Systems: Three Easy Pieces" by Remzi H. Arpaci-Dusseau and Andrea C. ArpaciDusseau (Free online book available at: http://pages.cs.wisc.edu/~remzi/OSTEP/)
2	"Linux Kernel Development" by Robert Love.
3	"File System Forensic Analysis" by Brian Carrier.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

	CONTROL SYSTEMS LABORATORY					
R24MEEEL001	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Prerequisite	Control Systems	**0**	**0**	**3**	**2**

Course Objectives

- To impart hands-on experience on how to model a physical system and find transfer function of it. To understand the performance of basic control system components such as magnetic amplifiers, servo motors, potentiometer and synchros.
- To understand the effect of controllers and compensators on the performance of a control system

Course Outcomes

1	Students will be able to determine the Transfer function of physical systems
2	Students will be able to understand the importance of controllers and compensators.
3	Students will get exposure to servomechanism
4	Students will be able to analyze a control systems in time domain and frequency domain

List of Experiments

1	Time response of 2nd order system.
2	Effect of P, PI, PD, PID controllers on the performance of a 2nd order system.
3	Characteristics of Synchros
4	Characteristics of a magnetic amplifier
5	Characteristics of AC servo motor
6	Characteristics of DC servomotor
7	Transfer function of a DC Generator
8	Transfer function of a DC Motor
9	Obtaining a state space model from transfer function using MATLAB
10	Construction of Bode plot for given transfer function using MATLAB
11	Lag and Lead compensator
12	Temperature controller using P, PI, PD and PID controllers

LEARNING RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

1	A. Nagoor Kani, Control Systems, Third edition. RBA Publications, 2017.
2	U. A. Bakshi, V. U. Bakshi, Control Systems, Third edition. Technical Publications, 2012.

ADDITIONAL REFERENCE MATERIAL

1	http://sparkbangbuzz.com/mag-amp/mag-amp.htm

R24MEEEL002	**Electrical Circuits Lab**		L	T	P	C
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Prerequisite	ECA-I and ECA-II	**0**	**0**	**3**	**2**

Course Objective

This course aims to provide practical exposure and skills of Electrical Circuits and the procedure to verify various laws and network theorems.

Course Outcomes

1	Determine the parameters of a choke coil and determine self inductance, mutual inductance and coefficient of coupling of a magnetically coupled circuit like transformer. (BL – 5)
2	Verify the Kirchoff's Voltage Law and Kirchoff's current law for the analysis of the Electric Circuits. (BL – 5)
3	Verify the network theorems like Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem and Millman's Theorem. (BL – 5)
4	Determine the Current Locus diagrams for R-L and R-C series circuits. (BL – 5)
5	Determine the power consumed by a three-phase balanced and unbalanced circuits. (BL – 5)

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

Additional experiments

1	Measurement of reactive power in a three-phase element with single wattmeter
2	Measurement of power factor of RL, RC, RLC circuits

Demonstration experiments

1	Simulation of given electrical network on SIMULINK
2	Mesh Analysis of a given network on MATLAB
3	Nodal Analysis of a given network on MATLAB

LEARNING RESOURCES

TEXT BOOKS:

1	Jack Kemmerly, William Hayt and Steven Durbin, "Engineering Circuits Analysis", Tata Mc Graw Hill Education, 2005, sixth edition.
2	M. E. Van Valkenburg, "Network Analysis", Pearson Education, 2019, Revised Third Edition

REFERENCE BOOKS:	
1	Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electrical Circuits", Mc Graw Hill Education (India), 2013, Fifth Edition
2	Mahmood Nahvi, Joseph Edminister and K. Rao, "Electric Circuits" (Schaum's outline Series), Mc Graw Hill Education, 2017, Fifth Edition.
3	David A. Bell, "Electric Circuits", Oxford University Press, 2009, Seventh Edition.
4	Robert L Boylestad, "Introductory Circuit Analysis", Pearson Publications, 2023, Fourteenth Edition.
ADDITIONAL REFERENCE MATERIAL	
1	Lab Manual
2	Lecture notes
3	Virtual Labs (vlabs.ac.in)

R24MCSCL001	**DATA STRUCTURES LAB** **(Common to all Branches)**					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Programming	**0**	**0**	**3**	**2**

Course Objective

To get hands-on exposure to linear and non-linear data structures and to identify and apply the suitable data structures for the given real-world problem.

Course Outcomes

1	Student will be able to implement recursive algorithms and will be able to understand the role of linear data structures in organizing and accessing data efficiently using searching and sorting techniques.
2	Student will be able to implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation.
3	Student will be able to develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.
4	Student will be able to apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between linear queues and circular queues, and apply them appropriately.
5	Student will be able to devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, trees, graphs.
6	Student will be able to recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems.

LIST OF EXPERIMENTS

1	**WEEK 1(SEARCH TECHNIQUES)** • Write a C Program to search an element in the given list using Linear Search Technique. (using recursive and non-recursive functions) Write a C Program to search an element in the given sorted list using Binary Search Technique. (using recursive and non-recursive functions)
2	**WEEK 2(SORTING TECHNIQUES)** • Write a C Program using recursive function to sort a given list of integers in ascending order using Bubble Sort Technique. • Write a C Program using recursive function to sort a given list of integers in ascending order using Quick Sort Technique. • Write a C Program using recursive function to sort a given list of integers in ascending order using Merge Sort Technique.
3	**WEEK 3(LINKED LIST)** • Write a C Program to create a Single linked list and perform basic operations on Single Linked List.
4	**WEEK 4 (OTHER VARIANTS OF LINKED LIST)** • Write a C Program to create a Circular linked list and perform basic operations.

	• Write a C Program to create a Double linked list and perform basic operations.
5	**WEEK 5 (STACKS & APPLICATIONS)** • Write a C Program to implement Stack operations using arrays. • Write a C Program to implement Stack operations using linked list. • Write a C Program to implement Infix to postfix conversion using stacks. • Write a C Program to evaluate the Postfix Expression using stacks.
6	**WEEK 6 (QUEUES)** • Write a C Program to implement Queue operations using arrays. • Write a C Program to implement Queue operations using linked list • Write a C Program to implement Circular Queue operations.
7	**WEEK 7 (BINARY TREE)** • Write a C Program to implement Binary Tree Creation. • Write a C Program to implement Recursive Binary Tree Traversals.
8	**WEEK 8 (BINARY SEARCH TREE(BST))** • Write a C Program to implement Binary Search Tree creation. • Write a C program to implement Insertion, Deletion, Search operations on Binary Search Tree.
9	**WEEK 9 (GRAPHS & TRAVERSAL TECHNIQUES)** • Write a C Program to create a Graph (using Adjacency Matrix or Adjacency List). • Write a C Program to implement Graph Traversals -Breadth First Search and Depth First Search.
10	**WEEK 10 (GRAPH APPLICATIONS)** • Write a C Program to implement Prim's & Kruskal's Algorithm for finding Minimum Cost Spanning Tree. • Write a C Program to implement Single Source Shortest Path - Dijkstra's Algorithm.
11	**WEEK 11 (HEAPS)** • Write a C Program to implement Binary Heap (Min Heap or Max Heap).
12	**WEEK 12 (HASHING)** • Write a C Program to implement Collision Resolution Techniques using Linear probing (Open Addressing) Technique using Division method as hash function.
LEARNING RESOURCES	
TEXT BOOKS:	
1	Mark Allen Weiss, *Data Structures and algorithm analysis in C*, Pearson, 2nd Edition.
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, *Fundamentals of data*

	structures in C, Silicon Press, 2008.
3	Richard F, Gilberg , Forouzan, Cengage, *Data Structures*, 2/e.

REFERENCE BOOKS:

1	Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.
2	C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3	Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4	Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
5	Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

ADDITIONAL REFERENCE MATERIAL

1	https://www.javatpoint.com/data-structure-tutorial
2	https://www.programiz.com/dsa
3	https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc24_cs45/preview
2	https://www.coursera.org/learn/data-structures
3	https://www.coursera.org/specializations/boulder-data-structures-algorithms

		SIGNALS & SYSTEMS					
R24MEEET006	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Mathematics, Laplace Transforms, Z - Transforms	**3**	**0**	**0**	**3**

Course Objective

To gain a thorough understanding of signals in time domain and frequency domain and also
understand the characteristics of LTI systems.

Course Outcomes

After completing this course, the students will be able to

1	Explain the different types of signals (continuous-time, discrete-time, analog, digital, periodic, aperiodic) and systems (linear, non-linear, time-invariant, time-variant, causal, non-causal) **(BL2)**
2	Analyze and interpret the frequency components of signals using the results from Fourier series and Fourier transform. **(BL4)**
3	Reconstruct a continuous-time signal from its discrete samples using appropriate reconstruction techniques based on the sampling theorem. **(BL3)**
4	Evaluate the characteristics of different types of filters, including their passband, stopband, and cutoff frequencies. **(BL5)**
5	Evaluate the accuracy and stability of system responses obtained through convolution, identifying potential sources of error or instability. **(BL5)**
6	Design and implement a comprehensive signal processing system. **(BL6)**

SYLLABUS

Unit I	**INTRODUCTION TO SIGNALS AND SYSTEMS**	**8 hr**

Discrete – Time Signals; Elementary Signals – I; Elementary Signals -II; Basic Operations on Signals. Classification of Signals – I; Classification of Signals – II; Classification of Systems – I; Classification of Systems – II

Unit II	**FOURIER SERIES & FOURIER TRANSFORM**	**8 hr**

Review of Fourier series and its exponential representation; Dirichlet's conditions; Review of Fourier transform and its properties; relationship between Fourier transform and Fourier series; Generalized Fourier transform; Amplitude and phase spectra; energy and power spectral density; signal bandwidth.

Unit III	**SAMPLING**	**8 hr**

Representation of continuous time signals by its samples; The sampling theorem; Sampling of Band Pass Signals; Sampling of Band limited signals.
Impulse sampling & Natural and Flat top Sampling; Reconstruction of a signal from its samples using interpolation; The effect of under sampling; aliasing.

Unit IV	**SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS:**	**8 hr**

Linear system & impulse response; frequency response function of a linear system; linear time invariant (LTI) system; Transfer function of LTI system; Filter characteristics of linear systems; Distortion less transmission through a system; Signal bandwidth; Causality and Poly-wiener criterion for physical realization.

Unit V	CONVOLUTION AND CORRELATION OF SIGNALS	8 hr

Concept of convolution in time domain and frequency domain; Graphical representation of convolution; Convolution properties; Cross correlation and Auto correlation of functions; Properties of correlation function; Energy density spectrum & Power density spectrum; Parseval's theorem; comparison between ESD and PSD.

LEARNING RESOURCES

TEXTBOOKS:

1	A. Anand Kumar, *Signals & Systems*, Third edition. PHI Learning Pvt Ltd, 2013.
2	A.V. Oppenheim, A.S. Willsky and S.Hamid Nawab, *Signals & Systems,* Second Edition*.* Prentice Hall International, 2014.

REFERENCE BOOKS:

1	B.P. Lathi, *Signals, Systems & Communications*, Fifth Reprint. B.S Publications 2008.
2	K.Raja Rajeswari, B.Visvesvara Rao, *Signals & Systems*, 1st edition, PHI Publications, 2009.

ADDITIONAL REFERENCE MATERIAL

1	https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring 2011/pages/lecture-notes/

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc21_ee28/preview
2	https://archive.nptel.ac.in/courses/108/106/108106163/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL2	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

	DIGITAL ELECTRONICS					
R24MECET001	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Fundamentals of algebra.	**3**	**0**	**0**	**3**

Course Objective

Students will gain understanding of analysis and design of combinational and sequential logic circuits

Course Outcomes

1	Will be able to apply Boolean algebra theorems and postulates in solving switching functions **(BL3)**
2	Will be able to apply minimization techniques to simplify Boolean functions **(BL3)**
3	Will be able to apply the implementation procedures in switching functions **(BL3)**
4	Will be able to design the programmable logic devices for given logical requirement **(BL6)**
5	Will be able to apply state assignment and state reduction techniques **(BL3)**
6	Will be able to analyze and/or design an appropriate combinational or sequential circuit to meet specific requirement **(BL6)**

SYLLABUS

Unit 1	**Number system and Boolean algebra**	**8 hr**

Number systems and conversions; Binary arithmetic; Complements of numbers; Binary codes Boolean algebra-theorems and postulates; De Morgan's laws – complements and simplification;
Logic gates ; Universal gates – implementation of simple switching functions;

Unit 2	**Minimization of switching functions**	**8 hr**

SOP, POS and Canonical form; Two level and multilevel implementations; Karnaugh Maps; Simplification of Boolean functions using k-map up to 4 variables;
Don't care conditions; 5, 6 variable k-maps; Prime implicants and essential prime implicants; Tabular minimization;

Unit 3	**Combinational circuits and Programmable Logic Devices**	**8 hr**

Design of adder and subtractor; Decoder; Multiplexer; De-multiplexer and Encoder
Introduction to PLDs; Programmable Read Only Memory; Programmable Logic Array; Programmable Array Logic;

Unit 4	**Sequential Circuits - I**	**8 hr**

Introduction to sequential circuits, basic latch working ; RS flip-flop, D flip-flop; JK flip-flop, T flip-flop; conversion of flip-flops; Shift registers; Bi-directional Shift registers and Universal shift register ; Design of ripple counters; Johnson counter and ring counter;

Unit 5	Sequential Circuits - II	8 hr

Design of synchronous counters; Analysis of clocked sequential circuits; Design of clocked sequential circuits; State Assignment and State Reduction; Mealy and Moore models; Conversion from Mealy machine to Moore machine; Conversion from Moore machine to Mealy machine; Partition method

LEARNING RESOURCES

TEXT BOOKS:

1	Morris Mano, Digital Design, Fourth edition. Pearson Education Pvt. Ltd., 2009.
2	A. Anand Kumar, Switching Theory and Logic Design, Third edition. PHI learning Pvt. Ltd., 2016.

REFERENCE BOOKS:

1	R. P. Jain, Modern Digital Electronics, Fourth edition. Tata McGraw Hill education Pvt. Ltd., 2009.
2	A. P. Godse, D. A. Godse, Digital Electronics, First edition. Technical publications, 2014

ADDITIONAL REFERENCE MATERIAL

1	https://www.ee.iitb.ac.in/~sequel/ee101/ee101_dgtl_1.pdf
2	https://www.ee.iitb.ac.in/~sequel/ee101/ee101_dgtl_2.pdf

ONLINE COURSES

1	https://archive.nptel.ac.in/courses/108/105/108105132/
2	https://nptel.ac.in/courses/117106086

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X	X	X	X
CO3	BL3			X	X	X
CO4	BL6			X		
CO5	BL3				X	X
CO6	BL6	X	X	X	X	X

R24MEEET007	**ELECTRICAL MACHINES - II**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Prerequisite	Electrical Machines-1	**3**	**0**	**0**	**3**

Course Objective
Students will gain understanding of the construction and operational principles of AC machines, understand various starting methods, analyze phasor diagrams and equivalent circuits, apply speed control methods, analyze load-sharing characteristics for parallel operation of synchronous machines, and make informed decisions on machine selection based on characteristics and performance parameters.

Course Outcomes	
1	Will be able to apply the principle of operation of three phase AC machines to analyze torque and power equations. (**BL4**)
2	Will be able to analyze the performance of AC Machines using the phasor diagrams and equivalent circuits. (**BL5**)
3	Will be able to analyze the parallel operation and load-sharing characteristics of synchronous machines. (**BL5**)
4	Will be able to analyze the equivalent circuit of single-phase induction motors, conduct performance analysis, and understand the methods of self-starting.(**BL5**)
5	Will be able to design and evaluate starting methods and speed control techniques for AC motors.(**BL6**)
6	Will be able to Choose the appropriate machine for application by observing the various characteristics and performance parameters of AC Machines.(**BL6**)

SYLLABUS		
Unit 1	**THREE PHASE INDUCTION MOTOR -I**	**8hr**
Construction and principle of operation of three phase Induction motor; Power flow analysis; Torque equations; Torque - slip characteristics; No load and blocked rotor tests; equivalent circuit; performance calculation from circle diagram; Double cage rotor – Induction generator		
Unit 2	**THREE PHASE INDUCTION MOTOR –II**	**8hr**
Need for starting — Types of starters — DOL starter; Rotor resistance starter and Autotransformer starter; Star/delta starters; Speed control — Voltage control, Frequency control; pole changing control-Rotor Resistance control; Cascaded connection-V/f control; Slip power recovery scheme; Cogging & Crawling -Braking of three phase induction motor		
Unit 3	**SINGLE PHASE MOTORS**	**8hr**
Single phase induction motors – Double revolving field theory; Torque- Speed Characteristics and Equivalent circuit; No load and Blocked rotor test; Performance analysis; Methods of Self-starting – Shaded pole motor; Capacitor start-capacitor run motor; repulsion motor; AC series Motor.		

Unit 4	**SYNCHRONOUS MACHINES-I**	**8hr**

SYNCHRONOUS GENERATOR: Constructional Features of round rotor and salient pole machines and principal of operation: E.M.F Equation; Armature reaction - phasor diagram- load characteristics; Regulation by synchronous impedance method;
M.M.F. method; Z.P.F. method; Synchronizing alternators with infinite bus bars; synchronizing power torque;

Unit 5	**SYNCHRONOUS MACHINES-II**	**8hr**

PARALLEL OPERATION OF SYNCHRONOUS MACHINES: – parallel operation and load sharing; Effect of change of excitation and mechanical power input; two reaction theory; slip test;
SYNCHRONOUS MOTORS: Theory of operation – phasor diagram; Variation of current and power factor with excitation; synchronous condenser – Mathematical analysis for power developed; hunting and its suppression and Methods of starting

LEARNING RESOURCES

TEXT BOOKS:

1	Nagarath. I. J. and Kothari. D. P., "*Electric Machines*", *T.M.H. Publishing Co Ltd., New Delhi, 3th edition 2006*.
2	Bimbra .P.S, *Electrical Machinery, Khanna Publishers*
3	I L Kosow, "*Electrical Machines & Transformers*", *Prentice Hall of India. 2nd edition 2003.*

REFERENCE BOOKS:

1	Fitzgerald Kingsley and Umans, *"Electric Machinery" 6th Edition, McGraw Hill Books co., New Delhi, 2002.*
2	*Performance and Design of AC Machines* by M.G. Say
3	Gupta. "*Theory and Performance of Electrical Machines*", *Kataria and Sons, 14th edition 2009*

ONLINE COURSES

1	https://nptel.ac.in

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X		X		X
CO2	BL5	X		X	X	
CO3	BL5		X		X	
CO4	BL5			X		
CO5	BL6		X			
CO6	BL6	X	X	X	X	X

	LINEAR DIGITAL INTEGRATED CIRCUITS				
R24MEEET008	**Total Contact Hours**	42	**L**	**T**	**P**	**C**
	Pre-requisite	Analog Electronic Circuits	3	0	0	3

Course Objective: This course enables the students to:
1. Generation and process of sinusoidal and non-sinusoidal signals.
2. Differentiate between Ideal and Non-Ideal Op-Amp
3. Design and analysis of various multi-vibrator circuits
4. Design various Active filters and explain the operation of A/D and D/A Converters

Course Outcomes: After completing this course, the students will be able to

1	Develop a linear circuit using the operational amplifier **(BL6)**
2	Design a non-linear circuit and can elaborate different oscillator circuits with the help of operational amplifier **(BL6)**
3	Design a voltage regulator circuit and can discuss the different types of filters and Phase Locked Loops **(BL6)**
4	Discuss the concept of analog to digital and digital to analog converter circuits **(BL6)**
5	Design the different waveform generating circuits using 555 timers and op-amp **(BL6)**

SYLLABUS

Unit 1	**BASICS OF OPERATIONAL AMPLIFIERS**	**8 hr**

OPERATIONAL AMPLIFIER
Block diagram representation of OP-AMP; DC and AC performance characteristics; Open and close loop configurations; Sign, Scale Changer, Phase Shift Circuit and Voltage Follower
LINEAR APPLICATIONS OF OP-AMP
Adder and Subtractor; V-to-I and I-to-V converters; Instrumentation amplifier; Transducer bridge Amplifiers

Unit 2	**NON-LINEAR OP-AMP APPLICATIONS & OSCILLATORS**	**8 hr**

Logarithmic and Antilogarithmic amplifier; Integrator and Differentiator; Precision rectifier (full wave & half wave); Peak detector and Comparator;
Clippers and Clampers; RC phase shift Oscillator; Wein bridge Oscillator; Colpitt's oscillators and Hartley oscillators

Unit 3	**FILTERS, PHASE LOCKED LOOPS AND VOLTAGE REGULATORS**	**8 hr**

1st Order LPF and HPF; 2nd Order LPF and HPF; Band pass; Band reject; All Pass filters; Block Diagram of PLL - Phase Detector, low pass filter, error amplifier and Voltage controlled oscillator; Three terminal fixed and adjustable voltage regulators; IC 723 general purpose regulator

Unit 4	**ANALOG TO DIGITAL & DIGITAL TO ANALOG CONVERTERS**	**8 hr**

ANALOG TO DIGITAL CONVERTER
Introduction to Analog and Digital Data Conversions; Weighted resistor type ADC; R 2R Ladder ADC; High speed sample-and-hold circuits
DIGITAL TO ANALOG CONVERTER
Flash type ADC; Successive Approximation type ADC; Single Slope type ADC; Dual Slope type ADC

Unit 5	TIMERS AND WAVEFORM GENERATORS	8 hr

TIMERS

Introduction to 555 timers and functional diagram; Monostable Multi-vibrator; Astable Multi- vibrator; Frequency to Voltage and Voltage to Frequency converters

WAVEFORM GENERATORS

Schmitt trigger; Triangular wave generator; Saw-tooth wave generator; ICL8038 function generator

LEARNING RESOURCES

TEXT BOOKS:

1	Op-Amps &Linear ICs - Ramakanth A. Gayakwad, PHI, 1987.
2	Linear Integrated Circuits -D. Roy Chowdhury, New Age International (p)Ltd, 3" Ed., 2008.
3	Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd Edition, Tata McGraw-Hill, 2007

REFERENCE BOOKS:

1	J.Michael Jacob, Applications and Design with Analog Integrated Circuits, Prentice Hall of India, 1996.
2	B.S.Sonde, System design using Integrated Circuits, New Age Pub, 2nd Edition, 2001.

ADDITIONAL REFERENCE MATERIAL

1	https://www.udemy.com/course/linear-integrated-circuits-and-applications-for-all-levels

ONLINE COURSES

1	https://nptel.ac.in/courses/108108111
2	https://www.udemy.com/course/operational-amplifiers-linear-integrated-circuits/

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL6	X				
CO2	BL6		X			
CO3	BL6			X		
CO4	BL6				X	
CO5	BL6					X

R24MCSCT003 (EOEC-T3)	**PYTHON PROGRAMMING** **(Common to all branches)**				
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic C Programming	**3**	**0**	**0**	**3**

Course Objective

Students will gain knowledge on the basic programming constructs of python language to develop both desktop and Graphical user applications.

Course Outcomes

1	Students will be able to apply the basic building blocks of python language.(**BL3**)
2	Students will be able to distinguish between various conditional control statements and simplify the problems using functions.(**BL4**)
3	Students will be able to experiment with various non-scalar data types.(**BL3**)
4	Students will be able to examine the data using file operations and pandas library.(**BL4**)
5	Students will be able to decide suitable widgets to implement Graphical User applications.(**BL5**)
6	Students will be able to design and develop real time applications using Python Programming constructs and GUI tkinter module. (**BL6**)

SYLLABUS

Unit I	**BASICS – DATA TYPES, OPERATORS, BUILT-IN MODULES**	8 hr

Data Types, Escape Sequences, Variables and Basic Input/Output; Assignment Statements, Operators; Arithmetic Expressions, Operator precedence, Type Casting, Program Comments and Docstrings; Program Format and Structure, REPL, IDLE, Running a Script from a Terminal Command Prompt;
Built-In Functions and Modules; User Defined modules creation and importing a user defined module; NumPy – Functions on 1D arrays, Functions on 2D arrays; Pandas Module- Creation of Series, DataFrames, indexing objects;

Unit II	**DECISION-MAKING STATEMENTS, LOOPS AND USER-DEFINED FUNCTIONS**	8 hr

Conditional Statements; While loop, for loop; range () function, nested loops; While-else, For- else, break, continue, pass;
Functions: Syntax and basics of function and usage; Passing Parameters, arguments in a function – Default, keyword, positional and Variable - length arguments; local and global scope of variable; return statement, recursive function, recursion vs iteration;

Unit III	**STRINGS, LISTS, TUPLES AND DICTIONARIES**	8 hr

Strings- A String is a sequence, Strings are immutable, String slice, String methods; Membership and Identity operators, String search; List- Lists are mutable, List operations; Lambda functions, Map, filter and reduce;
Tuples- Tuples are immutable, Tuple operations; Tuple as return values, List Comprehension, Comparison of Lists and tuples; Dictionaries – Dictionary Creation, operations, Looping through dictionaries; Dictionary Comprehension, Applying dictionary methods to counter objects, Reverse Lookup dictionary;

Unit IV	**FILES AND PANDAS**	8 hr

Introduction to Files, modes, types of files, File handling functions: open(), close(), read(), readline(), readlines(); write(), writeline(), append(); seek(), tell(), flush(); file copy using shutil (), delete a file (os.remove ());
Pandas-DataFrame creation with dictionaries, list of dictionaries, dictionary of series, renaming columns and rows labels; Importing data from CSV to DataFrame (Pandas), Inspecting data in DataFrame (head (), tail (), info()), Statistical summary (describe ());

Slicing and Sorting in Pandas; Modifying DataFrames, Data Cleaning in Pandas;		
Unit V	**TKINTER GUI, EVENT DRIVEN PROGRAMMING, WIDGETS**	**8 hr**

The Behavior of Terminal-Based Programs and GUI-Based Programs, Label, Entry and Button widget; Tkinter Geometry methods (pack(), grid(), place()); Event-Driven Programming, Command Buttons and Responding to Events; CheckButton and Radiobutton widgets;

Menu and Menu button widgets; Listbox and Scrollbar widgets; Messagebox and Toplevel widget; File Dialog widget;

LEARNING RESOURCES

TEXTBOOKS:

1	Kenneth A. Lambert. ‑Fundamentals of Python: First Programs‖, 2nd Edition, Publisher: Cengage Learning
2	Reema Thareja.-Python Programming using Problem Solving Approach
3	R. Nageswara Rao, -Core Python Programming

REFERENCE BOOKS:

1	Wesley J. Chun. –Core Python Programming - Second Edition‖, Prentice Hall
2	John V Guttag. –Introduction to Computation and Programming Using Python‖, Prentice Hall of India

ONLINE COURSES

1	https://www.w3schools.com/python/
2	https://www.tutorialspoint.com/python/index.htm
3	https://docs.python.org/3/tutorial/
4	https://www.pythontutorial.net/tkinter
5	https://www.python-course.eu/python3_course.php
6	https://www.geeksforgeeks.org/python-tkinter-tutorial/
7	https://www.tutorialspoint.com/python/python_gui_programming.htm
8	https://www.programiz.com/python-programming

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MCSCT004 (EOEC-T4)	DATABASE MANAGEMENT SYSTEMS (Common to all branches)					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**3**	**0**	**0**	**3**

Course Objective

Students will get Exposure on basics of designing relational Database without having any redundancy and also gain the knowledge on handling transaction data in concurrent way and recovering from the failures.

Course Outcomes

1	Students will be able to *choose* and appreciate the RDBMS over file system and also be able to *apply* the knowledge of ER Modeling design the database from the client requirements. (**BL3**)
2	Students Will be able to *analyze* the SQL query pattern and classify the query patterns based on the client requirements. (**BL4**)
3	Students will be able to *Examine* the database design and classify the different levels of dependencies using Normal Forms and students will be able to identify how triggers are useful in data auditing purpose.(**BL4**)
4	Students will be able to *compare and choose* different indexing mechanisms to store data in secondary storage devices as per the requirements. (**BL5**)
5	Students will be able to *justify* the importance of concurrency and recovery Management. (**BL5**)
6	Students will be able to *design* the complete database without redundant storage and able to solve the user queries. (**BL6**)

SYLLABUS

Unit I	INTRODUCTION TO DATABASE MANAGEMENT SYSTEM, ER MODELING	8 hr

Need for DBMS, Advantages of DBMS over File Systems, Database applications; Database Users, Different Data Models; 3 Levels of Abstraction in DBMS (External, Conceptual & Physical Schema) and data independence, Database Management System Structure.; Introduction to ER Model, Entity, Entity Set, Attribute – Entity Vs Attribute; Relationship & Relationship Set – Entity Vs Relationship – Binary Relationship, Ternary Relationship; Introduction to Keys (Candidate Key, Primary Key, Super Key, Unique Key, Not Null Key) – Modeling Key Constraints; Modeling Weak Entities – Mapping concept of Weak Entities to Composite, Primary Key Concept, Referential Integrity Constraint (include cascaded operations of Delete & Update) ; Modeling Participation Constraints – Cardinality, Full participation & Partial, Modeling Class Hierarchies – Mapping concept of class Hierarchies to covering constraints, Modeling Aggregation – Ternary Vs Aggregation;

Unit II	RELATIONAL ALGEBRA & RELATIONAL CALCULUS	8 hr

Introduction to Relational Model (Translating Entity Set & Relationship set into Tables) ; Introducing Basic operations on Relations: Selection and Projection , Cartesian product, examples;   Introducing Basic operations on Relations : Joins, Set Operations and examples ; Introducing Basic operations on relations: Division & Renaming and example; Syntax & Semantics of Tuple Relational Calculus (notations used to represent a query using DRC); Syntax & Semantics of Domain Relational Calculus (notations used to represent a query using DRC); TRC, DRC Query representations using AND, OR, NOT OPERATORS; IMPLIES operator , Comparison between TRC and DRC;

Unit III	SQL (STRUCTURED QUERY LANGUAGE)	8 hr

Basic Structure of SQL queries(Basic format of select query, DDL,DML commands) ; Integrity and Referential constraints (Includes syntax for all key constraints, Translating Constraints associated with ER into Tables); Additional Basic Operations(Arithmetic, logical, relational,

pattern matching); Functions(String, Date, Numeric); Aggregate Functions, Clauses and Set Operations**;** Join Expressions; Nested Queries, Correlated Queries; Introduction to Views, Destroying/Altering/Updating of views, Handling Null values;

Unit IV	NORMALIZATION	8 hr

FDs and Decomposition: Problems caused by redundancy, FD (definition), Armstrong 's axioms; FD identification from relations, Equivalence of two FD sets; Dependency preserving Decomposition, examples; Lossless join, verification, examples;
Normal Forms: First normal form, partial dependency, Second normal Form; Transitive dependency, third normal form, Motivation for BCNF; BCNF, Multivalued dependency, Fourth normal form.; Triggers;

Unit V	INDEXING, TRANSACTION MANAGEMENT, CONCURRENCY CONTROL & RECOVERY MANAGEMENT	8 hr

Types of indexes (Clustered index, un clustered index primary index, secondary index), Tree based index versus and Hash based index; ISAM, B+ Tree construction (Insertion and Deletion of nodes); Transaction concept, Transaction states, ACID properties of transaction; Transactions and Schedules, Concurrent executions of transactions (anomalies);
Serializability, Testing for serializability,2PL; Strict 2PL, Deadlocks, timestamp based protocols; Recoverability, Introduction to Log based recovery, check pointing and shadow paging; ARIES algorithm;

<u>LEARNING RESOURCES</u>

TEXTBOOKS:	
1	Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition. McGrawHill.
2	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke

REFERENCE BOOKS:	
1	Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
2	An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III.

ADDITIONAL REFERENCE MATERIAL	
1	https://docs.oracle.com/cd/B19306_01/server.102/b14200/toc.htm
2	<u>https://dev.mysql.com/doc/refman/8.0/en/select.html</u>

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X	X		
CO3	BL4				X	
CO4	BL5					X
CO5	BL5					X
CO6	BL6	X	X	X	X	

		ELECTRICAL MACHINES LAB				
R24MEEEL003	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Understanding of circuit analysis, electrical machines fundamentals, and principles of electromagnetism	**0**	**0**	**3**	**2**

Course Objectives:

Students will get exposure to:
1. In operating and testing electrical machines
2. The skills to analyze the performance characteristics of electrical machines

Course Outcomes: Students will be able to

1	Apply theoretical knowledge to assess and evaluate the performance parameters of electrical machines
2	Develop skills in conducting experiments, collecting data, and employing relevant instrumentation to analyze and interpret results related to electrical machines.
3	Demonstrate the ability to diagnose and troubleshoot common issues in electrical machines
4	Design and conduct experiments on single phase induction motors, three phase induction motors, alternators and synchronous motors, as well as to analyze and interpret data

List of experiments

1	Determination of constant losses using Swinburne's test
2	Determination of load characteristics of DC shunt motor
3	Speed control of DC shunt motor
4	Determination of efficiency and voltage regulation of single-phase transformer through open circuit and short circuit tests
5	Separation of core losses of single phase transformers
6	No load and blocked rotor tests on three phase squirrel cage induction motor to develop the circle diagram and thereby study the behavior of the machine.
7	Determination of performance characteristics of three phase slip ring induction motor by direct test.
8	Determination of direct axis reactance (X_d) and quadrature axis reactance (X_q) for a three-phase salient pole alternator and determination of voltage regulation.
9	Determination of voltage regulation of three phase alternator through emf method and

	MMF method and comparison of results
10	Determination of 'V' and 'Λ' curves of three phase synchronous motors
11	Determination of equivalent circuit parameters and thereby determination of behavior of the single-phase induction motor by conducting no load and blocked rotor tests.
12	Speed control of three phase slip ring induction motor through rotor resistance control technique.

LEARNING RESOURCES:	
TEXT BOOKS:	
1	H. Cotton, Advanced electrical machines, Reem Publications Pvt. Ltd.
2	A. E. Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans, Electrical Machine Design: The Design and Specification of Direct and Alternating Current Machinery, McGraw Hill Education
3	D. P. Kothari, I. J. Nagrath, Electric Machines, 5th edition, McGraw Hill Education
REFERENCE BOOKS:	
1	Vincent Del Toro, Electrical Engineering fundamentals, PHI publication
2	M. G. Say, Performance and Design of A.C. Machines, CBS Publishers

R24MEEEL004	**ANALOG ELECTRONICS AND INTEGRATED CIRCUITS LAB**					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Analog Electronic Circuits Linear and Digital ICs	**0**	**0**	**3**	**2**

Course Objectives:
This course enables the students to: 1. Generation and process of sinusoidal and non-sinusoidal signals.   2. Differentiate between Ideal and Non-Ideal Op-Amp   3. Design and analysis of various multi-vibrator circuits   4. Design various Active filters and explain the operation of A/D and D/A Converters

Course Outcomes: Students will be able to	
1	Develop a linear circuit using the operational amplifier (BL6)
2	Design a non-linear circuit and elaborate different oscillator circuits with the help of an operational amplifier(BL6)
3	Design a voltage regulator circuit and can discuss the different types of filters and Phase Locked Loops(BL6)
4	Discuss the concept of analog-to-digital and digital-to-analog converter circuits(BL6)
5	Design the different waveform-generating circuits using 555 timers and op-amp(BL6)

	List of experiments
1	Characteristics of PN Junction Diode and Zener Diode
2	Clippers and Clampers
3	Frequency response of CE amplifier
4	IC 741 OP AMP applications: Adder, Subtractor and Comparator
5	Frequency response of Active low pass filter
6	Frequency response of Active High pass filter
7	Log & anti log amplifier
8	Wien Bridge Oscillator using IC 741 Op-Amp
9	RC Phase Shift Oscillator using IC 741 Op-Amp.
10	IC555 – mono-stable circuit, Astable circuit
11	Schmitt trigger using IC 741 Op-Amp
12	Voltage regulator using IC 723
13	4-bit DAC using 741 Op-Amp
14	IC 565 – PLL applications

LEARNING RESOURCES:	
TEXT BOOKS:	
1	Op-Amps &Linear Ics – Ramakanth A. Gayakwad, PHI, 1987.
2	Linear Integrated Circuits -D. Roy Chowdhury, New Age International (p)Ltd, 3" Ed., 2008.
3	Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd Edition, Tata McGraw-Hill, 2007
REFERENCE BOOKS:	
1	J.Michael Jacob, Applications and Design with Analog Integrated Circuits, Prentice Hall of India, 1996.
2	B.S.Sonde, System design using Integrated Circuits, New Age Pub, 2nd Edition, 2001.

R24MCSCL002 (EOEC-L2)	**PYTHON PROGRAMMING LAB** **(Common TO ALL Branches)**					
	Total Contact Hours	42(P)	**L**	**T**	**P**	**C**
	Pre-requisite	C Programming	**0**	**0**	**3**	**2**

Course Objective

Students will implement python programming constructs which are used to develop both desktop and graphical user applications.

Course Outcomes

1	Students will be able to apply the basic building blocks of python language like variables, operators and modules.
2	Students will be able to apply conditional control statements and functions.
3	Students will be able to apply various file operations and analyze the data using pandas library.
4	Students will be able to choose and decide the suitable widgets to design and develop Graphical User Interface (GUI) applications.

List of Experiments

1	**Week – 1: DATA TYPES, OPERATORS, BUILT-IN FUNCTIONS** 1. Write a python script to illustrate data types (int, char, float, string). 2. Write a python program to perform the following expressions using operator precedence (1) 5+3*2 (2) 2*3**2 (3) 2**3**2 (4) (2**3)**2 3. Write a python program to illustrate type conversion functions 4. Write a python program to illustrate pi, sqrt, cos, sin functions of math module
2	**Week – 2: PROGRAMS WITHOUT CONTROL STATEMENTS** 1. Write a program to calculate simple interest 2. Write a python program to calculate compound interest 3. Write a python program to print ASCII value of a character 4. Write a python program to find the area of a circle 5. Write a python program to find the area of a triangle 6. Write a program to perform string concatenation
3	**Week – 3: PROGRAMS ON NUMPY MODULE** 1. Write a program to work with 1D array operations including indexing and slicing. 2. Write a program to work with 2D array operations
4	**Week – 4: PROGRAMS ON CONTROL STATEMENTS** 1. Write a python program find the power of a number without built-in functions. 2. Write a python program to count the number of even and odd numbers upto the given range. 3. Write a python program to print the multiplication table for a given number. 4. Write a python program to display minimum and maximum among three numbers.
5	**Week – 5: PROGRAMS ON FUNCTIONS** 1. Write a python program to find if a number is prime or not with and

	without recursion.
	2. Write a python program to display Fibonacci series using iteration and recursion.
	3. Write a python program to find the factorial of a number with and without recursion.
6	**Week – 6: PROGRAMS ON STRINGS**
	1. Write a program to work with string built-in functions
	2. Write a python program to determine number of times a given letter occurs in a string
	3. Write a python program to check if a string is a palindrome or not.
	4. Illustrate in operator and write a python program to count number of lowercase characters in a string.
	5. Write a program to replace all the occurrences of letter 'a' with letter 'x' in a string.
7	**Week – 7: PROGRAMS ON LISTS**
	1. Write a program to implement the following list functions a)len() b)extend() c)sort() d) append() e)insert() f)remove()
	2. Write a program to pass list as an argument to a function
	3. Write a python program to find the largest and smallest number in a list.
	4. Write a python program to merge two lists and sort it.
	5. Write a python program to remove the duplicate items from a list.
	6. Write a python program to find sum of elements in a list
8	**Week – 8: PROGRAMS ON TUPLES , DICTIONARIES**
	1. Write a program to create a list of tuples with the first element as the number and the second element as the square of the first element.
	2. Write a python program that takes the list of tuples and sorts the list of tuples in increasing order by the last element in each tuple.
	3. Write a program to implement the following dictionary methods a) keys() b) values() c)items() d) pop() e)delete()
	4. Write a python program to add a key value pair to a dictionary and update the dictionary based on the key.
	5. Write a Program to do a reverse dictionary lookup in python.
9	**Week – 9: PROGRAMS ON FILES**
	1. Write a program to implement read(), readline(), readlines(), write(), writelines() methods on files.
	2. Write a program to implement seek(), tell() and flush() methods with different arguments in a file.
	3. Write a program to generate 20 random numbers in the range of 1 to 100 and write to a file.
10	**Week – 10: PROGRAMS ON PANDAS MODULE**
	1. Write a program to import data from CSV to DataFrame and inspect data in DataFrame using head(),tail (), info() and describe() functions in pandas.
	2. Write a program to perform sorting and slicing operations in pandas.
	3. Write a program to perform dataframe modification and data cleaning in pandas.
11	**Week – 11: PROGRAMS ON GUI**
	1. Design and develop a GUI application to display -Hello World.
	2. Design and develop a GUI application using Label, Entry and Button widgets.
	3. Design and develop a GUI application using Tkinter Geometry methods

	pack(),grid(), place().
	4. Design and develop a GUI application using CheckButton and Radiobutton widgets.
12	**Week – 12: PROGRAM ON GUI CONTI…**
	1. Design and develop a GUI application using Menu and Menubutton widgets.
	2. Design and develop a GUI application using Listbox and Scrollbar widgets.
	3. Design and develop a GUI application using Messagebox and File Dialog widget

Demonstration experiments	
1	Demonstration of Python IDLE to implement solutions.
2	Demonstration on Colab notebook to read, access and display data from google drive.
3	Demonstration on jupyter notebook to link and access data.

LEARNING RESOURCES

TEXTBOOKS:	
1	Kenneth A. Lambert. ‑Fundamentals of Python: First Programs‖, 2nd Edition, Publisher: Cengage Learning
2	Reema Thareja.-Python Programming using Problem Solving Approach
3	R. Nageswara Rao, -Core Python Programming‖

REFERENCE BOOKS:	
1	Wesley J. Chun. -Core Python Programming - Second Edition‖, Prentice Hall
2	John V Guttag. ‑Introduction to Computation and Programming Using Python‖, Prentice Hall of India.
3	Python Practice Book Release 2014, Anand Chitipothu.

ADDITIONAL REFERENCE MATERIAL	
1	https://www.w3schools.com/python/
2	https://www.tutorialspoint.com/python/index.htm
3	https://docs.python.org/3/tutorial/
4	https://www.pythontutorial.net/tkinter
5	https://www.python-course.eu/python3_course.php
6	https://www.geeksforgeeks.org/python-tkinter-tutorial/
7	https://www.tutorialspoint.com/python/python_gui_programming.htm
8	https://www.programiz.com/python-programming

	Power Generation, Operation and Control					
R24MEEET009	Total Contact Hours	42 (L)		**L**	**T**	**P**	**C**
	Pre-requisite	Basics of Electrical Engineering and Control Systems	**3**	**0**	**0**	**3**

Course Objective

To analyze and apply the principles of power generation, system operation, and control to ensure reliable, efficient, and sustainable electrical energy delivery.

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

1	Analyze the principles, working mechanisms, and key technologies of various power generation systems to determine their suitability for different applications. (BL4)
2	Use appropriate mathematical models to solve the economic and operational issues of real time generation system operation and evaluate their impact on system efficiency. (BL3)
3	Analyze the control actions that are implemented to meet the minute-to-minute variation of system real power demand. (BL4)
4	Analyze the compensators for reactive power control. (BL4)
5	Make use of advanced technology and tools for system analysis and monitoring. (BL3)
6	Estimate the real time operation of the electric power system. (BL6)

SYLLABUS

Unit 1	**Power Generation Systems**	**8 hr**

Layout and operation of Thermal power generation; Layout and operation of Hydro power generation; Layout and operation of Nuclear power generation; Layout and operation of Solar power generation;
Layout and operation of Wind power generation; Fuel cells; Layout and operation of Biomass power generation; Layout and operation of Ocean Thermal Energy Conversion (OTEC) and Geothermal energy;

Unit 2	**Optimization and Economic Aspects of Power System Operation**	**8 hr**

System load variation; Economic load factors; Cost of generation & Tariff; Economic load dispatch - I;
Economic load dispatch - II; Unit commitment (UC) problem; Priority list method for UC; Dynamic programming for UC;

Unit 3	**Real Power - Frequency Control**	**8 hr**

Speed regulation of two generators in parallel; Real power – Frequency control mechanism; Load Frequency Control (LFC) of single area representation; Static and dynamic analysis of LFC single area system;
LFC two area system; Static and dynamic analysis; Integration of economic dispatch control with LFC; Renewable energy impact on frequency stability;

Unit 4	**Reactive Power - Voltage Control**	**8 hr**

Principles of reactive power control; Automatic voltage regulator; Brushless AC excitation systems; Static & Dynamic analysis;
Stability compensation; Uncompensated and compensated transmission lines; Voltage drop in transmission line; Reactive power injection methods;

Unit 5	**Computer Control of Power Systems**	**8 hr**

Need of computer control of power systems; Phasor measurement units (PMU); System monitoring; System hardware configurations;
SCADA and EMS functions; Power System operating states; State estimation in

Power Systems; Power system security;	

LEARNING RESOURCES	

TEXT BOOKS:

1	Olle.I.Elgerd, '*Electric Energy Systems theory - An introduction*', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2	Allen. J. Wood and Bruce F. Wollen berg, '*Power Generation, Operation and Control*', John Wiley & Sons, Inc., 2016.

REFERENCE BOOKS:

1	Kothari D.P. and Nagrath I.J., '*Power System Engineering*', Tata McGraw-Hill Education, Second Edition, 2008.
2	Hadi Saadat, '*Power System Analysis*', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3	Kundur P., "*Power System Stability and Control*", McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4	Abhijit Chakrabarti and Sunita Halder, '*Power System Analysis Operation and Control*', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

ADDITIONAL REFERENCE MATERIAL

1	https://www.mdpi.com/journal/electronics/special_issues/Operation_Control_Power_Systems

ONLINE COURSES

1	NPTEL: Electrical Engineering - Power Systems Operation and Control
2	Udemy - The Complete Electrical Power Control and Protection
3	https://npti.gov.in/en/power-system-operation

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	4	X				
CO2	3		X			
CO3	4			X		
CO4	3				X	
CO5	3					X
CO6	6	X	X	X	X	X

R24MEEET010	AI TOOLS TECHNIQUES AND APPLICATIONS					
	Total Contact Hours	32 (L), 20 (P)	**L**	**T**	**P**	**C**
	Prerequisite	Basic understanding of logic, Set theory calculus, linear algebra, and probability / statistics.	**2**	**0**	**2**	**3**

Course Objective

This course aims to introduce students to Artificial Intelligence, Machine Learning, and Image Processing, covering their historical development, current status, and engineering applications.

Course Outcomes

1	Apply fundamental neural network concepts and models to solve application-specific problems. (BL3)
2	Analyze various neural network architectures and training algorithms to assess their effectiveness for different tasks. (BL4)
3	Design fuzzy rule-based systems using fuzzification and defuzzification for complex decision-making applications. (BL6)
4	Evaluate machine learning algorithms and solutions for real-world problem scenarios by leveraging data analysis. (BL5)
5	Develop practical machine learning models for effective data-driven solutions. (BL6)
6	Create image processing and computer vision solutions for fault detection and automation in electrical engineering. (BL6)

SYLLABUS

Unit 1	Fundamentals of AI and Neural Networks	8 hr

Human Brain & Artificial Neuron Model; Terminologies of Neural Networks; Biological vs. Artificial Neural Networks; Neural Network Evolution & Characteristics;
Learning Methods-Supervised, Unsupervised, Reinforcement; Neural Network Architectures & Taxonomy; Learning rules and activation functions; Neural Network Applications.

Unit 2	Supervised and Unsupervised Neural Networks	8 hr

McCulloch - Pitts Neuron Model; Hebb Network; Perceptron Network; Delta Learning Rule;
Backpropagation Network; Associative Memory Network; Hopfield Network; Boltzmann Based Learning.

Unit 3	Fuzzy Logic and Fuzzy Systems	8 hr

Classical Set Operations and Properties; Mapping Classical Sets to Functions; Fuzzy Sets and Membership Functions; Fuzzy Set Operations and Properties;
Classical vs. Fuzzy Relations; Fuzzification and Defuzzification Methods; Fuzzy Toolbox in MATLAB; Fuzzy-Based PID Controller and DC Motor Speed Control;

Unit 4	Machine Learning	8 hr

Introduction to Machine Learning; Simple and Multiple Linear Regression; Model Evaluation Metrics; Non-Linear Regression Techniques; Classification Methods and KNN; Decision Trees and Support Vector Machines; Logistic Regression for Classification; Clustering: K-Means, Hierarchical, Density-Based;

Unit 5	Image Processing Applications in Electrical Engineering	8 hr
Basics of Image Processing; Image representation and formats; Basic Morphological operations; Filtering and Edge Detection; Image Segmentation for Analysis; Feature Extraction from Images; Applications in Automation and Agriculture; Applications in Electrical engineering;		

LEARNING RESOURCES	
TEXT BOOKS:	
1	Simon S. Haykin, Neural Networks and Learning Machines Pearson 2019
2	Timothy J. Ross Fuzzy Logic with Engineering Applications" by Timothy J. Ross willey 2010
3	Andreas C. Müller and Sarah Guido Introduction to Machine Learning with Python:A Guide for Data Scientists. Oreially 2017
4	Rafael C. Gonzalez and Richard E. Woods Digital Image Processing 2002
REFERENCE BOOKS:	
1	S. N. Sivanandam, S. N Deepa *Introduction to Neural Networks Using Matlab 6.0*
2	S. Rajasekaran, A.Vijayalakshmi Pai *Neural networks, fuzzy logic and genetic algorithm: synthesis and Applications* PHI learning 2011
3	Aurelien Geron *Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow* Oreially *2nd edition* 2019
4	R C Gonzalez, R E Woods & S L Eddins, DIP using MATLAB, 2nd Ed
ADDITIONAL REFERENCE MATERIAL	
1	https://www.iitg.ac.in/rkbc/CE602/CE602/Genetic%20Algorithms.pdf
2	https://onlinecourses.nptel.ac.in/noc22_ee21/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4	X	X			
CO3	BL6			X		
CO4	BL5	X			X	
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

	Power Electronics					
R24MEEET011	Total Contact Hours	42 (L)		L	T	P	C
	Pre-requisite	Analog Electronics, Electrical circuit analysis	3	0	0	3

COURSE OBJECTIVE

Students will gain understanding of the fundamental principles of converting electrical energy from one form to another, such as AC to DC, DC to AC, AC to AC and DC to DC, using various power electronic circuits and devices.

COURSE OUTCOMES: Students will be able to

1	Analyze the triggering and protection circuits of SCR (BL4)
2	Evaluate the performance of phase-controlled rectifiers. (BL5)
3	Analyze and evaluate the operation of AC-AC converters (BL5)
4	Design DC-DC converter for a given application. (BL6)
5	Analyze and evaluate the operation of DC-AC converters. (BL5)
6	Select, analyze and design a suitable power electronic converter for a given application. (BL6)

SYLLABUS

UNIT 1	INTRODUCTION	8 hr

Introduction to Power Electronics; Construction and V-I characteristics of SCR; Turn ON methods; Switching characteristics of SCR; Gate Triggering circuits; Thyristor ratings; protection; commutation circuits for SCR;

UNIT 2	AC – DC CONVERTERS	8 hr

Single-phase half wave-controlled converter; Single-phase fully-controlled converter – I; Single-phase fully-controlled converter – II; Single-phase semi converter;

Three- phase half wave-controlled converter; Three- phase fully-controlled converter; Effect of source inductances; Single phase and Three phase dual converters.

UNIT 3	AC -AC CONVERTERS	8 hr

Introduction-Applications and control strategies of AC Voltage Controllers; Single phase AC voltage controllers-I; Single phase AC voltage controllers -II; Three phase AC voltage controllers;

Single phase Cyclo-converters: step-up converter (mid-point type); step-down converter (mid-point type); step-up converter (Bridge type); step-down converter (Bridge type);

UNIT 4	DC - DC CONVERTERS	8 hr

Introduction-Applications and control strategies; Basic principles of step-down chopper, Step-up chopper; Buck converter-I; Buck converter-II;
Boost converter; Buck-Boost converter-I; Buck-Boost converter-II; Cuk Converter;

UNIT 5	DC - AC CONVERTERS	8 hr

Introduction – Applications, performance parameters; Single phase half bridge inverters; Single phase full bridge inverters; Three phase voltage source inverters - 180^0 mode; Three phase voltage source inverters 120^0 mode; PWM techniques - single PWM; Multiple PWM; Sinusoidal PWM;

	LEARNING RESOURCES

TEXT BOOKS:

1	M.H. Rashid, "*Power Electronics: Circuits, Devices and Applications*", Pearson Education, Third Edition, New Delhi, 2004.

2	P.S.Bimbra "*Power Electronics*" Khanna Publishers, third Edition, 2003.

REFERENCE BOOKS:

1	Joseph Vithayathil, "*Power Electronics, Principles and Applications*", McGraw Hill Series, 6th Reprint, 2013.
2	Philip T. Krein, "*Elements of Power Electronics*" Oxford University Press, 2004 Edition.
3	L. Umanand, "*Power Electronics Essentials and Applications*", Wiley, 2010.
4	Ned Mohan Tore. M. Undel and, William. P. Robbins, "*Power Electronics: Converters, Applications and Design*", John Wiley and sons, third edition, 2003.
5	R. W. Erickson and D. Maksimovic, "*Fundamentals of Power Electronics*", Springer Science & Business Media, 2007.

ADDITIONAL REFERENCE MATERIAL

1	Lecture Notes

ONLINE COURSES

1	https://nptel.ac.in/courses/108101126
2	https://nptel.ac.in/courses/108101038
3	https://nptel.ac.in/courses/108102145

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL6				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

	POWER TRANSMISSION AND DISTRIBUTION					
R24MEEET012	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical circuits, electrical machines, Electromagnetic fields	**3**	**0**	**0**	**3**

Course Objective

The Power Transmission and Distribution course covers the principles, design, and operation of power systems, including transmission line parameters, performance analysis, and mechanical considerations. It also explores substation classification, distribution system design, and efficient power delivery.

Course Outcomes

1	**Analyse** the impact of conductor resistance, inductance, and capacitance on the performance of transmission lines. *(BL4)*
2	**Evaluate** the efficiency and voltage regulation of short, medium, and long transmission lines using appropriate models. *(BL5)*
3	**Apply** mechanical design principles to determine sag, insulation resistance, and capacitance of transmission cables. *(BL3)*
4	**Analyse** different substation configurations and their suitability for various power system applications. *(BL4)*
5	**Evaluate** the performance of different distribution system configurations based on load conditions and power supply reliability. *(BL5)*
6	Design an optimized power transmission and distribution system ensuring efficiency and reliability. (BL6)

SYLLABUS

Unit 1	**TRANSMISSION LINE PARAMETERS**	**8 hr**

Structure of the power system, Resistance of the line; Types of the Conductors; Inductance of the 1-phase transmission line; Flux linkage of one conductor in a group of conductors; Inductance of composite conductors; Inductance of 3-phase line; Capacitance of 1-phase transmission line; capacitance of 3-phase transmission line;

Unit 2	**PERFORMANCE OF TRANSMISSION LINES**	**8 hr**

Characteristics and performance of transmission lines; Short transmission line; Medium transmission line-Nominal -pi method; Medium transmission line-Nominal -T method; Long Transmission lines; Ferranti effect, Skin effect, Proximity effect; Corona loss; factors effecting corona;

Unit 3	**MECHANICAL ASPECTS OF TRANSMISSION LINES & CABLES**	**8 hr**

Properties of Insulators; Types of Insulators; String efficiency; Methods of improving string efficiency; Sag; Construction of cables; Insulation resistance of single core cable; Capacitance of single core cable;

Unit 4	**SUBSTATIONS**	**8 hr**

Classification of substations; Layout of substation; Equipment used in substation; Transformer substation; Pole mounted substation; Single bus bar arrangement; Single bus bar with sectionalization; Double bus bar system;

Unit 5	**DISTRIBUTION SYSTEMS**	**8 hr**

Classification of Distribution system; Radial, Ring main, interconnected system; Types of Distributors; DC Distributor fed at one end-concentrated loading;
DC Distributor fed at two ends-concentrated loading; Uniformly Loaded Distributor Fed at One End; Uniformly Loaded Distributor Fed at both Ends; AC Distributor;

	LEARNING RESOURCES	
TEXT BOOKS:		
1	C.L.Wadhwa, *"Electrical Power Systems"*, New Age International (P) Ltd, New Delhi, 4thEdition.	
2	J.B. Gupta, *"Transmission & Distribution of Electric Power"*, S.K.Kataria & Sons, January 2009.	
3	*Generation, Distribution and Utilization of Electric Energy* by C.L.Wadhawa, New Age International (P) Limited, New Delhi, 2015.	
REFERENCE BOOKS:		
1	*'Electrical Power Distribution Systems'* by V.Kamaraju, Tata McGraw Hill, New Delhi, 2009.	
2	*'Elements of Electrical Power Station Design'* by M.V.Deshpande, PHI Learning, New Delhi, 2009.	
3	J. B. Gupta – *"Switchgear and Protection*" S.K. Kataria & Sons; 2013th edition	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.electricaltechnology.org/2013/05/typical-ac-power-supply-system-scheme.html	
2	https://eepower.com/technical-articles/understanding-advances-in-transmission-and-distribution/#	
ONLINE COURSES		
1	https://archive.nptel.ac.in/courses/108/102/108102047/	
2	https://www.coursera.org/specializations/power-system-generation-transmission-and-protection	
3	https://www.edx.org/learn/smart-grids	

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL5		X			
CO3	BL3			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

	UTILIZATION OF ELECTRICAL ENERGY					
R24MEEET017	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical Machines, Basics of Electrical engineering	**3**	**0**	**0**	**3**

Course Objectives

This course explores applications and efficient usage of electrical power across various sectors, focusing on the conversion of electrical energy into useful forms like heat, light, and mechanical power through devices like electric motors, heating elements, and lighting systems, with an emphasis on selecting appropriate equipment and design considerations for optimal energy utilization in industrial, commercial, and domestic settings.

Course Outcomes

Student will be able to

1	Judge the suitability of different motor drives to be used for a specific purpose (BL5)
2	Design an electrical heating system that incorporates the appropriate heating method (resistance, induction, arc, dielectric, infrared, or microwave) for a particular industrial application. (BL5)
3	Demonstrate how to control welding processes in AC and DC machines by adjusting settings according to welding requirements. (BL3)
4	Select, and apply appropriate techniques for designing indoor & outdoor lighting schemes (BL3)
5	Implement the principles of mechanics and train movement to calculate the output power available at the driving wheel in specific operational scenarios. (BL3)
6	Design and develop an integrated electric system incorporating optimized electric drives, advanced heating methods, efficient welding techniques, intelligent illumination systems, and sustainable electric traction models to enhance industrial performance, energy efficiency, and environmental sustainability. (BL6)

SYLLABUS

Unit 1	**SELECTION OF MOTORS**	**8 hr**

Concept of Drive - Block Diagram of Electric Drive; Classification - Advantages of electric drives; Characteristics of different mechanical loads- Types of motors used as electric drive; Selection of motors for different types of domestic loads;
Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc.; Types of industrial loads - continuous, intermittent and variable
loads; rating and heating of motors; Load equalization;

Unit 2	**ELECTRIC HEATING**	**8 hr**

Advantages of electrical heating - Heating Methods; Resistance heating – direct and indirect resistance heating; properties of resistance heating elements - Calculation of resistance heating elements; Induction heating- principle of core type and coreless induction furnace.
Electric arc heating - direct and indirect arc heating, construction, working and applications of arc furnace; Dielectric heating, applications in various industrial fields; Infra-red heating and its applications (construction and working of two

appliances); Microwave heating and its applications (construction and working of two appliances);

Unit 3	**ELECTRIC WELDING**	**8 hr**

Advantages of electric welding - Welding method; Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment; Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications;
Advantages of using coated electrodes - comparison between AC and DC arc welding; welding control circuits; Welding of aluminium and copper; Supply Requirements – Safety – AC welding machines and welding transformers;

Unit 4	**ILLUMINATION**	**8 hr**

Nature of light, Characteristics & Definitions, Laws of illumination; Different type of lamps, construction and working of incandescent lamps, discharge lamps – their characteristics; fluorescent lamp, halogen lamp, neon lamp; compact filament lamp (CFL)-Concepts of LED;
Calculation of number of light points for interior illumination - calculation of illumination at different points; Lighting schemes; Main requirements of proper lighting-absence of glare, contrast and shadow; General ideas about time switches, Design of street lighting, flood lighting;

Unit 5	**ELECTRIC TRACTION**	**8 hr**

Advantages of electric traction - Different systems of electric traction - DC and AC systems -Special features of Traction motors; Different accessories for track electrification such as overhead catenary wire, conductor rail system, current collector-pentagraph; Electrical block diagram of an electric locomotive with description of various equipment and accessories used; Types of motors used for electric traction -Power supply arrangements, Introduction to EMU and metro railways;
Mechanics of train movement - Output power available at driving wheel; Types of services – urban, sub-urban, and main line and their speed-time curves; average and schedule speed, Factors affecting scheduled speed; tractive effort, specific energy consumption, factors affecting specific energy consumption, adhesive weight and coefficient of adhesion;

LEARNING RESOURCES

TEXT BOOKS:

1	H Partab, "*Art and science of Utilization of electrical energy*", Dhanpat Rai and sons
2	JB Gupta, "*Utilization of Electrical Energy*", Kataria Publications, Ludhiana
3.	H Partab, "*Modern Electric Traction*", Dhanpat Rai & Sons, Delhi

REFERENCE BOOKS:

1	N.V. Suryanarayana, "Utilization *of electrical power including electrical drives and electrical traction*", New Age International (P) Ltd.
2	C.L.Wadwa, "*Generation Distribution and utilization of Electrical Energy*", New Age International Ltd.
3	G.C.Garg, "*Utilization of Electric power and Electrical Traction*", Khanna Publishers.

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL5	X				
CO2	BL5		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	SPECIAL ELECTRICAL MACHINES					
R24MEEET026	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical Machines-I & II Control Systems Power Electronics	**3**	**0**	**0**	**3**

Course Objective

Students will understand the construction, operation, torque equations, and control strategies of various electrical machines (Stepper, Switched Reluctance, PMDC, PMSM, Brushless DC, and Linear Machines). They will gain proficiency in selecting power converters, controllers, and evaluating performance to make informed decisions for choosing and applying special electrical machines in modern applications

Course Outcomes

1	Will be able to Compare and contrast the characteristics of different types of motors. (BL5)
2	Will be able to select suitable power converters for different types of special machines. (BL5)
3	Will be able to select suitable controllers for special electrical machines as per the application requirement. (BL5)
4	Will be able to apply the knowledge of single sided & double-sided linear induction motors in electric traction systems. (BL3)
5	Will be able to analyze the process of Electronics commutation and the generation of Hall signals according to the rotor position of BLDC motors. (BL4)
6	Will be able to Choose the appropriate machine for application by observing the various characteristics and performance parameters of special electrical machines. (BL6)

SYLLABUS

Unit 1	STEPPER MOTORS	8hr

Constructional features – Principle of operation; Types of stepper motors – Permanent magnet stepper motor; Variable Reluctance stepper motor; and Hybrid stepper motor and comparisons;
Mode of excitations - Full step on mode, two phase ON mode, Half step mode; Torque equations – Characteristics; control of stepper motors – Open loop; Closed loop control- Applications;

Unit 2	SWITCHED RELUCTANCE MOTORS	8hr

Constructional features – Rotary and Linear SRM - Principle of operation; Frequency of Variation of the inductance of each phase winding; operating modes–one pulse and PWM modes; Power Converters and their controllers;
Voltage and Torque equation- Steady state performance prediction- Analytical method;
torque-speed characteristics-merits, demerits and applications; Methods of Rotor position sensing – Sensor less operation; Current control schemes-Hysteresis and duty cycle control-Microprocessor based or Computer based control of SRM;

Unit 3	PERMANENT MAGNET MOTORS	8hr

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics; Constructional features -Principle of operation; Types of PMDC motors– Magnetic circuit analysis; torque equation-Equivalent circuit-applications; Permanent Magnet Synchronous Motors (PMSM)-Constructional features -Principle of operation; EMF and Torque equations; phasor diagram;

Power controllers – performance characteristics – Applications;	

Unit 4	**PERMANENT MAGNET BRUSHLESS DC MOTOR (PMBLDC)**	**8hr**
Constructional features–Principle of operation; Electronic commutation-Comparison between electronic and mechanical commutation; Rotor position sensing and block diagram of BLDC Drive; types of BLDC motors; Voltage equation: Torque equation -Motor characteristics; BLDC controllers: advantages and disadvantages – Applications;		

Unit 5	**LINEAR ELECTRICAL MACHINES (LEM) and OTHER SPECIAL MACHINES**	**8hr**
Linear induction motor- Construction– principle of operation; performance parameters – advantages and disadvantages-applications; Linear synchronous motor: Construction – principle of operation; Characteristics- advantages-disadvantages- applications; Synchronous reluctance motor-construction-principle of operation-classification; phasor diagram-torque-speed characteristics- advantages-disadvantages- applications; Universal motor-Construction– principle of operation-characteristics- Applications; Hysteresis motor-Constructional features – Principle of operation and Characteristics-application;		

	LEARNING RESOURCES
TEXT BOOKS:	
1	*Special Electrical Machines by* K.Venkata Ratnam, *University Press, 2009, New Delhi.*
2	*Special Electrical Machines by* E.G.Janardanan, *PHI Learning Pvt. Ltd., 2014, Delhi.*
REFERENCE BOOKS:	
1	*Principles of Electrical Machines by* V.K.Mehta & Rohit Mehta, *S.Chand Publishers, New Delhi.*
2	*Electric Machines by* Kothari and Nagarath, *TMH Publications, 3rd Edition.*
3	*Theory of Electrical Machines by* R.K.Rajput, *LP Publications*
ONLINE COURSES	
1	htpps://nptel.ac.in

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL5	X	X	X	X	X
CO2	BL5	X	X	X	X	X
CO3	BL5	X	X	X	X	X
CO4	BL3				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MCSCT005	SOFTWARE ENGINEERING					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Prerequisite	Nil	**3**	**0**	**0**	**3**

Course Objective

This course introduces students to fundamental Software Engineering principles, including software processes, requirements engineering, design, testing, quality assurance, and risk management.

Course Outcomes

After completing this course, the students will be able to

1	Students will have the ability to apply the core concepts of software engineering, including the nature of software, layered technology, and common software myths, to analyze real-world software development scenarios. (BL3)
2	Students will have the ability to analyze various software process models to determine their suitability for different types of projects. (BL4)
3	Students will have the ability to apply requirements engineering techniques to elicit, document, and validate software requirements and utilize software design models. (BL3)
4	Students will evaluate various software testing strategies, assess the effectiveness of black box and white box testing methods, and recommend improvements in testing strategies based on product metrics and testing outcomes to optimize software quality. (BL5)
5	Students will have the ability to analyze software project risks and develop strategies for risk mitigation and management. (BL6)
6	Students will write the entire software engineering process, assess the effectiveness of each phase from requirements gathering to deployment, and recommend improvements for optimizing the overall workflow and activities involved in software engineering. (BL6)

SYLLABUS

Unit I	INTRODUCTION TO SOFTWARE ENGINEERING	8 hr

The Nature of Software; Software Engineering - A Layered Technology; Software Engineering Practice; Software Myths; A Generic Process Model, Software Process Framework; Process flow, Identifying Task set, Process pattern; Process Assessment and Improvement (SCAMPI, CMM-IPI, SPICE, ISO 9001:2000); The Capability Maturity Model Integration (CMMI);

Unit II	PROCESS MODELS & SOFTWARE REQUIREMENTS	8 hr

The Waterfall Model, Incremental Process Models; Evolutionary Process Models: The Prototype Model, Spiral Model; Unified Process, Personal And Team Process Models; Agile Process Model; Feasibility Studies, User Requirements and System Requirements; Functional and Non - Functional Requirements; The software requirements document; Requirements engineering processes;

Unit III	REQUIREMENTS ENGINEERING & DESIGN ENGINEERING	8 hr

Establishing The Groundwork, Requirements Elicitation; Requirement Analysis - DFD, Data Dictionaries; Developing Use Cases, Use Case Diagrams; Requirements Negotiation and Validation; Requirements Management; Preparation of SRS; Design Concepts - Abstraction, Architecture, Patterns, Separation of concerns and Modularity; The Design Model - Data Design Elements, Architectural Elements-Interface, Component and Deployment design elements;

Unit IV	TESTING STRATEGIES & METRICS	8 hr

A Strategic Approach to Software Testing, Test Strategies for Conventional Software - Unit and Integration Testing; Testing Strategies - Validation Testing, System Testing; Black Box Testing - Graph-Based Testing Methods; White box testing - Basis path testing; A Framework for Product Metrics - Measures, Metrics, and Indicators; Metrics for the Requirements Model - Function-Based Metrics; Metrics for the Design Model-Architectural Design Metrics and Metrics for Source Code; Metrics for Testing;

Unit V	QUALITY MANAGEMENT & RISK MANAGEMENT	8 hrs

Quality Management - Software Quality (McCall's software quality factors); Review Techniques - Informal and Formal Review Techniques; Software Quality Assurance - Elements of SQA, SQA Tasks, Goals and Metrics; Statistical SQA, ISO 9000 Quality Standards; Reactive vs. Proactive Risk Strategies; Software Risks; Risk Identification; Risk Projection, Risk Refinement; RMMM Plan;

LEARNING RESOURCES

TEXTBOOKS:

1	Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th Edition, McGrawHill International Edition.
2	Software Engineering- Sommerville, 7th edition, Pearson education.

REFERENCE BOOKS:

1	Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers

ADDITIONAL REFERENCE MATERIAL

1	https://ocw.mit.edu/courses/16-355j-software-engineering-concepts-fall-2005/pages/lecture-notes/

ONLINE COURSES

1	https://nptel.ac.in/courses/106101061

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X	X			
CO2	BL4		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL6					X
CO6	BL6	X	X	X	X	X

R24MEEEL005	POWER ELECTRONICS LAB					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Prerequisite	Nil	**0**	**0**	**3**	**2**

Course Objective

Aim to provide students with practical hands-on experience and skills in designing, implementing, and analyzing power electronic circuits and systems.

Course Outcomes

1	Analyze various gate drive circuits for SCR. (BL4)
2	Analyze the behavior of AC-DC controlled converters for R, RL load. (BL4)
3	Analyze the performance of single-phase AC voltage controller and Cyclo-converter for R, RL load. (BL4)
4	Analyze the performance of DC-DC converters. (BL4)
5	Analyze the performance of Inverters (BL4)
6	Design and implement basic power electronic converter for a specific purpose (BL6)

List of Experiments

1	Gate drive circuits for SCR
2	Single-phase AC Voltage Controller with R & R-L Loads using TRIAC and SCR
3	Single-phase Cyclo-convertor with R and RL Load
4	Single-phase PWM inverter
5	Parallel Bridge Inverter
6	DC–DC Buck Converter.
7	DC–DC Boost Converter.
8	Single-phase Fully controlled bridge Converter with R, RL load
9	Single-phase Dual Converter with R, RL load
10	Four Quadrant Chopper
11	Three-phase Fully controlled bridge Converter with R, RL load
12	Determination of V-I characteristics of SCR, MOSFET and IGBT.

Additional experiments

1	Microcontroller based DC-DC Converter
2	MPPT Controller for Solar PV System
3	CUK converter

LEARNING RESOURCES

TEXT BOOKS:

1	M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third Edition, New Delhi, 2004.
2	P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.
3	Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.

REFERENCE BOOKS:

1	L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.
2	Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.
3	R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.

ADDITIONAL REFERENCE MATERIAL

1	Lab Manual
2	Lecture notes

R24MCSCL003	DATABASE MANAGEMENT SYSTEMS LAB (Common to all Branches)					
	Total Contact Hours	42(P)	L	T	P	C
	Pre-requisite	-	0	0	3	2

Course Objective

Students will gain exposure on ER model, R- Model to design the database, Data Retrieval using SQL and Procedural SQL. Students will be able to explore view level of data abstraction levels.

Course Outcomes

After completing this course, the students will be able to

1	Students will be able to design the database for the given client requirements using ER- Model and also be able to convert the ER design to R model by covering all sorts of constraints
2	Students will be able to retrieve the data for any given user constraints using SQL features group by, nested Queries and joins
3	Students will be able to design the different views and also able to identify the execution differences between a query and query as a view.
4	Students will be able to identify the importance of data and auditing.

List of Experiments

1,2	Designing of ER model for the given constraints
3	Conversion of entities to relational tables with constraints using DDL statements (CREATE, ALTER, DROP)
4	Conversion of relations to relational tables with referential integrity constraint (using ON DELETE CASCADE and ON UPDATE CASCADE) and DML operations (INSERT, DELETE, UPDATE)
5	Querying the data using SELECT, WHERE, AND, BETWEEN, LIKE
6	Applying string, number and date functions while querying the data
7	Querying the data using set operations(UNION, UNION ALL, INRESECT, MINUS/EXCEPT) and GROUPBY, HAVING clauses
8	Querying the data using Nested Queries (Correlated Queries- EXISTS, NOT EXISTS, independent queries- IN, NOT IN, ANY, ALL, =, > and <).
9	Querying the data using JOINS and Handling NULL values using JOINS
10	Designing views for different user perspectives (updatable views and non-updatable views),
11	Designing of procedures and functions in PL/SQL
12	Design of Triggers

Additional experiments

1	Sequence generation and its usage as primary key
2	Verifying DCL-grant, revoke
3	Verifying TCL commands- commit, roll back and save point.

Demonstration experiments

1	Case study - Library Management system
2	Case study- E-commerce store management
3	Case Study- Hospital management

LEARNING RESOURCES	
TEXTBOOKS:	
1	Data base System Concepts, Silberschatz, Korth, McGraw hill,

	Sixth Edition. McGrawHill.
2	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke
3	Learning SQL, Alan Beaulieu, O'Reilly Media, Inc., 3rd Edition,
ADDITIONAL REFERENCE MATERIAL	
1	https://docs.oracle.com/cd/B19306_01/server.102/b14200/toc.htm
2	https://dev.mysql.com/doc/refman/8.0/en/select.html

R24MEEET013	**POWER SEMICONDUCTOR DRIVES**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Power Electronics, Electrical Machines	**3**	**0**	**0**	**3**

COURSE OBJECTIVE

To understand and analyze the operation of electric motor drives using power electronic converters to achieve precise speed control in various industrial applications. By the end of the course, students will be proficient in evaluating the electric drive systems, showcasing their ability to apply theoretical knowledge to industrial applications.

COURSE OUTCOMES

1	Understand the various drive systems and choose an electrical braking system for a DC motor drive. (BL3)
2	Apply controlled rectifiers to control the speed of DC motors (BL3)
3	Apply choppers to control the DC motors (BL3)
4	Apply power electronic converters to control the speed of induction motors (BL3)
5	Apply power electronic converters to control the speed of synchronous motors (BL3)
6	Evaluate the motor and develop a power converter for a specific application. (BL6)

SYLLABUS

UNIT 1	INTRODUCTION	8 hr

Electrical Drive System; Choice, selection, advantages and classification of drives; Fundamental torque equation, characteristics of different loads; review on speed control of DC and AC motors; Multi- quadrant operation- Four quadrant operation of DC motor; Electrical braking – Plugging, Dynamic and Regenerative braking operation of dc separately excited dc motor-1; Plugging, Dynamic and Regenerative braking operation of dc separately dc motor-2; Plugging, Dynamic and Regenerative braking operation of dc series motor;

UNIT 2	DC MOTOR DRIVES	8 hr

Single phase fully controlled converter fed dc separately excited motor- continuous current operation; Single phase fully controlled converter fed dc separately excited motor- discontinuous current operation; Single phase fully controlled converter fed dc series motor – continuous current operation; Single phase fully controlled converter fed dc series motor – discontinuous current operation -output voltage and current waveforms, speed torque characteristics;
Three phase fully controlled converter fed dc separately excited motor- continuous current operation; Three phase fully controlled converter fed dc separately excited motor- discontinuous current operation; Three phase fully controlled converter fed dc series motor – continuous current operation - output voltage and current waveforms, speed torque characteristics; four quadrant operation of dc motor by dual converter;

UNIT 3	CHOPPER FED DC DRIVES	8 hr

Applications, Advantages of chopper fed dc motors, Time ratio control and current limit control; Single (class A) quadrant chopper fed dc separately excited motor; Single (class A) quadrant chopper fed dc series motor; Single (class B) quadrant chopper fed dc separately excited motor and series motor– continuous and discontinuous current operation;
Two (class C) quadrant chopper fed dc separately excited motor; Two (class C) quadrant chopper fed dc series motor – continuous and discontinuous mode of

operation; Two (class D) quadrant chopper fed dc separately excited motor and series motor; Four (class E) quadrant chopper fed dc separately excited motor and series motor – continuous and discontinuous mode of operation. – output voltage and current waveforms, speed - torque expressions and characteristics;

UNIT 4	INDUCTION MOTOR DRIVES	8 hr

Speed control of 3 phase Induction motors – Stator control methods; variable frequency control; Voltage Source Inverter fed Induction Motor drive using PWM technique, closed loop speed control; Rotor side control methods;
Static control of rotor resistance using DC chopper, closed loop speed control; slip power recovery methods – Scherbius drives; Static Krammers drive; Introduction to vector-controlled Induction Motor drives.

UNIT 5	SYNCHRONOUS MOTOR DRIVES	8 hr

Open loop and self-control of synchronous motor; control of synchronous motor from fixed frequency supply; Self-control of synchronous motor drive employing load commutated thyristor inverter - 1; Self-control of synchronous motor drive employing load commutated thyristor inverter - 2;
Cyclo converter fed synchronous motor drive; Permanent magnet synchronous motor -closed loop control; speed control of brushless direct current motor (BLDC) drives by current control using hall effect sensors and its applications; BLDC motor drive for servo applications;

LEARNING RESOURCES

TEXT BOOKS:

1	G.K Dubey, *Fundamentals of Electric Drives,* Narosa Publishing House, 2010
2	Krishnan R, *Electric Motor Drives Modeling, Analysis and Control,* Pearson, 2015.
3	S.K. Pillai, *A First course on Electric Drives,* New Age Publishers, 2012

REFERENCE BOOKS:

1	Bimal K. Bose, *Power Electronics and Variable Frequency Drives,* Wiley IEEE Press, 2010.
2	Jan A. Melkebeek, *Electrical Machines and Drives: Fundamentals and Advanced Modeling*", Springer, 2018.
3	De Doncker, Rik, Pulle, Duco W J, Veltman, Andre,*Advanced Electrical Drives –Analysis, Modeling, Control*, Springer, 2011
4	W.Shephered, L N Hulley Cambride,'Power Electronics & Control of Motor' , University Press,2005.
5	Chilikin M, 'Electric drives' , Mir publications, 2nd edition,1976

ADDITIONAL REFERENCE MATERIAL

1	Extract of D. W. Novotny and T. A. Lipo, 'Vector Control and Dynamics of AC Drives', Oxford University Press,1996

ONLINE COURSES

1	https://nptel.ac.in/courses/108108077 NTEL course on Industrial Drives - Power Electronics, Prof. K. Gopakumar , IISc Bangalore

Bloom's level and-Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	POWER SYSTEM ANALYSIS					
R24MEEET014	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Power Transmission and distribution, Electrical circuit analysis	**3**	**0**	**0**	**3**

Course Objective

Students will enhance the knowledge on the need of "power system analysis" and select various power system tools to analyze the power system network under steady state and transient conditions.

Course Outcomes: Students will be able to

1	Develop mathematical model of any given power system network (BL3)
2	Analyze the steady state condition of Power System network by using numerical techniques (BL4)
3	Analyze the behavior of the power system under symmetrical fault condition (BL4)
4	Examine the behavior of the power system for unbalanced faults using symmetrical components. (BL4)
5	Inspect the stability of power system under transient conditions and compute the stability of the system with the help of equal area criteria (BL4)
6	Develop a power system network by modeling and analyzing it under steady state and transient conditions (BL6)

SYLLABUS

Unit 1	**POWER SYSTEM OVERVIEW**	**8 hr**

Representation of Power System components; Single Line Diagrams for various voltage levels; Importance of Per Unit (p.u.) system and expressing power system quantities in p.u;

Single Line Diagrams on p.u. basis; p.u. impedance diagram and p.u. reactance diagram; Network graph, Bus incidence matrix; Formation of Y_{BUS} matrix- Direct inspection; Primitive network, Formation of Y_{BUS} matrix- singular transformation;

Unit 2	**POWER FLOW ANALYSIS**	**8 hr**

Introduction of load flow studies; Development of load flow equations; Gauss method; Gauss-Seidel Method;

Modification of GS method when PV Buses are also present; Newton-Raphson Method-1; Newton-Raphson Method-2; Fast Decoupled Load Flow (FDLF)

Unit 3	**SYMMETRICAL FAULT ANALYSIS**	**8 hr**

Importance of short circuit studies - Assumptions in short circuit analysis; Transients in AC circuit and transmission line under short circuit; 3- Φ Short circuit Fault on a synchronous machine under no load; 3- Φ Short circuit Fault on a synchronous machine under load;

Symmetrical short circuit analysis using Thevenin's theorem; Symmetrical fault analysis through bus impedance matrix algorithm; Short circuit capacity and selection of circuit Breaker; Post fault bus voltages, Fault level, Current limiting reactors;

Unit 4	**UNSYMMETRICAL FAULT ANALYSIS**	**8 hr**

Introduction to symmetrical components; Sequence Networks; Sequence impedances of transformers; Sequence impedances of a symmetrical transmission line;

Analysis of unsymmetrical faults: Single-line- to-ground; Line-to-line; Double-line-to-ground; Case studies on unsymmetrical fault analysis;

Unit 5	**STABILITY ANALYSIS**	**8 hr**

Importance of stability studies - Classification of power system stability; Power angle characteristics and steady state stability limit; Transient stability limit; Swing Equation of single machine;
Swing Equation of two machines; Equal area criterion and its assumptions; Applications of Equal area criterion; Calculation of critical clearing time and angle;

LEARNING RESOURCES

TEXT BOOKS:

1	John J. Grainger, William D. Stevenson, Jr, '*Power System Analysis*', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2	Kothari D.P. and Nagrath I.J., '*Power System Engineering*', Tata McGraw-Hill Education, Second Edition, 2008.
3	Hadi Saadat, '*Power System Analysis*', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010

REFERENCE BOOKS:

1	Pai M A, '*Computer Techniques in Power System Analysis*', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2	J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, '*Power System Analysis & Design*', Cengage Learning, Fifth Edition, 2012. 42
3	Gupta B.R., '*Power System - Analysis and Design'*, S. Chand Publishing, 2001.
4	Kundur P., '*Power System Stability and Control*', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
5	Stagg & E.I.Abiad "*Computer Methods in power Systems*", International Student Edition

ADDITIONAL REFERENCE MATERIAL

1	Power Engineering: Power System Analysis - Part 1	Udemy

ONLINE COURSES

1	Power System Analysis - Course (nptel.ac.in)

Bloom's level and-Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X	X	X	X	X
CO2	BL4		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MEEETT015	MICROPROCESSORS AND AVR MICROCONTROLLERS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	STLD	3	0	0	3

Course Objective

This course helps the students to grasp the basics of Microprocessors and Microcontrollers. It enables the students to interface different devices using I/O, memory, interrupt and serial communication, and ADC features of microcontrollers to implement real time applications.

Course Outcomes: After completing this course, the students will be able to

1	Explain the architecture, memory organization, and instruction set of the 8086 microprocessor and AVR microcontroller. (BL3)
2	Develop assembly language and embedded C programs for 8086 and AVR microcontrollers, covering basic input/output operations, timers, and interrupts. (BL4)
3	Demonstrate the ability to interface AVR microcontrollers with peripherals such as LEDs, switches, LCDs, sensors, and communication modules. (BL5)
4	Implement serial communication protocols and data transfer techniques for real-time embedded applications. (BL5)
5	Apply AVR microcontrollers in automation, motor control, and power management applications. (BL6)
6	Design and develop embedded systems integrating 8086 microprocessors and AVR microcontrollers for real-world applications, including IoT, automotive, and industrial control. (BL6)

SYLLABUS

Unit 1	Introduction to 8086 Microprocessor	8 hr

Architecture and features of the 8086 microprocessors; Register organization; Memory segmentation; Pin configuration;
I/O Addressing Capability, Special Processor Activities; Timings of Signals in Minimum and Maximum Mode of 8086 System; Addressing Modes of 8086-I; Addressing Modes of 8086-II;

Unit 2	8086 Microprocessor Features and Programming	8 hr

Instruction Set of 8086-I; Instruction Set of 8086-II; Assembler Directives & Operators, Stack Structure of 8086; Interrupts and interrupt Handling;
Procedures and Macros; Machine Language Instruction Formats, Machine Level Programs; Assembly Language Programming tools, Programming with an Assembler; Illustrative Assembly Level Language Programs;

Unit 3	Introduction to AVR Microcontroller & programming	8 hr

Block diagram of architecture of AVR and registers; Addressing Modes; Instruction set of AVR-1; Instruction set of AVR-2;
Digital Input and Output Programming of I/O Ports; Peripherals and pipelining in AVR; Basic programs using Assembly Language Programming-1; Assembly Language Programming-2 and WinAVR, AVRSTUDIO IDE usage;

Unit 4	Timers/Counters, Interrupts and Serial Communication programming of AVR Microcontroller	8 hr

Digital Input and Output Programming of I/O Ports; Timers; Waveform Generation in AVR and Inputs Capture Control; Analog Comparator;
counters; Serial Communication using RS232 & UART; Serial Communication using SPI & TWI; Analog-to-Digital Conversion;

Unit 5	Interfacing with AVR Controller and Applications	8 hr

Hardware Interfacing Input Devices - Switches, Keypads; Sensors - Interfacing voltage and current sensors; Interfacing Output Devices- LED, Seven-Segment LED Displays, Dot Matrix Display; Interfacing LCD, BUZZER;
Software Interfacing- USB, EEPROM; Interfacing DS1307 RTC with AVR; 7. Interfacing of DC Motor to AVR; Wireless solutions with AVR;

LEARNING RESOURCES	
TEXT BOOKS:	
1	*"Advanced Microprocessors and Peripherals"* by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2nd edition, 2009.
2	*"Atmel AVR Microcontroller Primer: Programming and Interfacing"*, Steven F. Barrett, Morgan & Claypool, 2008
3	*"The AVR Microcontroller & Embedded Systems Using Assembly & C"*, Muhammad Ali Mazidi, Sarmad Naimi, And Sepehr Naimi, Prentice Hall, 2011.
REFERENCE BOOKS:	
1	*"Microprocessor and Interfacing"* by Douglas V.Hall, 2nd Edition, TMH, 2006.
2	*"Programming And customizing the AVR Microcontroller"*, Dhananjay V. Gadre, The McGraw-Hill
ADDITIONAL REFERENCE MATERIAL	
ONLINE COURSES	
1	https://www.youtube.com/playlist?list=PLnZLfHvLkNN2ttBlIgzvo6lGFprOoanEl
2	https://www.youtube.com/watch?v=_qxueXKHg04&list=PLDe416SoceX2lUjvXKaeAfnq04WqH91Bk

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X			
CO3	BL5			X		
CO4	BL5				X	
CO5	BL6				X	X
CO6	BL6	X	X	X	X	X

R24MCSCT006	**OOP WITH JAVA** **(for MEC, ECE, EEE, CIV and CHE)**					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	DataStructures	**3**	**0**	**0**	**3**

Course Objective

Studentswillhave the abilitytounderstand, design, integrate, and evaluate complex Java systems by combining object-oriented principles, multithreading, GUIs, exception handling, and collections to create efficient, scalable, and robust applications.

Course Outcomes

1	Students will be able to **apply** object-oriented concepts, Java programming constructs, and control structures.**(BL3)**
2	Students will be able to **analyze** and implement constructors, access control, static and final keywords, nested classes, and string handling. **(BL4)**
3	Students will be able to **apply** inheritance concepts, interfaces, access control, and Java standard libraries to develop modular and reusable Java programs. **(BL3)**
4	Students will be able to **Evaluate** and design robust Java applications by implementing effective exception handling, thread lifecycle management, multithreading, synchronization, and custom exception handling to ensure performance, stability, and efficient concurrency. **(BL5)**
5	Students will be able to **apply** the Delegation Event Model, AWT and Swing components, layout managers, and collections to create interactive Java applications with event handling and efficient data management. **(BL3)**
6	Students will be able to **design** and implement advanced Java applications by integrating OOPS principles, inheritance, polymorphism, exception handling, multithreading, GUIs, and collections for efficient problem-solving. **(BL6)**

SYLLABUS

Unit I	BASICS OF JAVA	8 hr

Deficiencies with Structured Programming in C, History and Evolution of Java; OOP Principles - abstraction, encapsulation, inheritance and polymorphism; Java virtual machine, features of java, A First Simple Java Program(Command lines,scanner class) Compilation, execution, CLASS PATH; Data Types, Literals, Variables; Type Conversion, Operators, Precedence, Associativity; Control Statements – Selection; Control Statements - Iteration statements; Arrays (One Dimensional, Multi-Dimensional).

Unit II	CLASS FUNDAMENTALS	8 hr

Class fundamentals, Declaring objects, Introducing Methods; Constructors, parameterized constructors; this keyword, garbage collection, returning objects, Access control; understanding static (static variable, static method, static block); final keyword, nested and inner classes; String Class, String Methods; String Buffer Class, Passing Arrays as parameters to methods; Method overloading, overloading constructors.

Unit III	INHERITANCE, INTERFACES AND ABSTRACT CLASS	8 hr

Inheritance Basics – Base class, sub class, types of inheritance; Member Access,

Method overriding; super keyword, Using final with inheritance; Abstract classes, Multiple inheritance issues; Interfaces – Defining an interface, implementing interfaces; Packages - Defining a Package, Finding Package with CLASSPATH, importing packages, Access Protection; Exploring java.util Package (Random, String Tokenizer, Scanner); Exploring java.io package (Byte and Character streams, File class).

Unit IV	EXCEPTION HANDLING AND MULTITHREADING	8 hr

Exception Handling Fundamentals, Exception Types, Uncaught Exceptions; Using Try and Catch, Multiple Catch Clauses, Nested Try Statements; Throw, Throws and Finally; Handling of User Defined Exceptions; The Java Thread Model, Thread Life Cycle, Comparison of Thread and Process. The Main Thread; Creating a Thread: Implementing Runnable Interface, Extending Thread class; Creating Multiple Threads, isAlive () and join(); Synchronization (Keyword and Block), Thread Priorities;

Unit V	EVENT HANDLING, AWT, SWING	8 hr

Delegation Event Model: Events, Event sources, Event Listeners; Event Classes, Event Listeners (Action Listener, Window Listener); Key Listener, keyboard events; Mouse Listeners, mouse events; AWT classes, AWT Controls (Button, Text Field, Label, Checkbox); Layout manager: BorderLayout, GridLayout, FlowLayout; Swings: JLabel, JButton, JTextField, JCheckbox; Collections: Array List, iterator.

LEARNING RESOURCES

TEXTBOOKS:

1	Herbert Schildt, "Java The Complete Reference" 9th Edition, Oracle Press
2	Paul Deitel and Harvey Deitel, "Java How to Program", 11th Edition, Pearson.

REFERENCE BOOKS:

1	Herbert Schildt, "Java: A Beginner's Guide", 9th Edition, McGraw Hill, 2022
2	Bruce Eckel, "Thinking in Java", 9th Edition, Mind View, 2022.

ADDITIONAL REFERENCE MATERIAL

1	https://www.w3schools.com/java
2	https://docs.oracle.com/javase/tutorial/
3	https://www.geeksforgeeks.org/java/

ONLINE COURSES

1	https://www.udemy.com/courses/search/?q=java
2	https://www.coursera.org/specializations/java-programming

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	DISTRIBUTION SYSTEM AND AUTOMATION					
R24MEEET018	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basics of Power Systems	**3**	**0**	**0**	**3**

Course Objective

To gain the awareness of the problems and challenges of the existing distribution system. To understand the need for Distribution Automation (DA) and appreciate its role in overcoming existing problems of distribution system.

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

1	Apply fundamental concepts of electrical distribution system to ensure efficient operation. (BL3)
2	Apply voltage drop and power loss calculations to AC and DC distribution system, ensuring best performance and efficient voltage regulation. (BL3)
3	Analyze the impact of capacitive compensation and power factor correction on power distribution systems. (BL4)
4	Analyze distribution automation systems and technologies to assess their impact on forecasting, monitoring, and control of power distribution networks. (BL4)
5	Apply energy auditing methods and automation tools to improve efficiency and communication in power distribution systems. (BL3)
6	Design and develop distribution systems by integrating automation and optimization techniques to enhance efficiency, reliability, and sustainability. (BL6)

SYLLABUS

Unit 1	**Distribution Systems Fundamentals**	**8 hr**

Basic definitions; Relation between Load and Loss factor; Classification of loads and characteristics; Distribution Design considerations of primary system;
Design considerations of secondary system; Distribution Transformer; Distribution sub-stations-I; Distribution sub-stations-II;

Unit 2	**AC and DC Distribution Systems and Analysis**	**8 hr**

AC distribution systems; DC distribution systems; Voltage drop calculations in AC Distribution systems-I; Voltage drop calculations in AC Distribution systems-II;
Voltage drop calculations in DC Distribution systems-I; Voltage drop calculations in DC Distribution systems-II; Power loss calculation in AC & DC systems; Voltage regulation;

Unit 3	**Compensation for Power Factor Improvement & Voltage Control**	**8 hr**

Capacitive compensation for power factor control; Types of power capacitors; Effect of shunt capacitors; Power factor correction, capacitor allocation;
Economic justification; Capacitor location determination; Voltage control; Line drop compensation;

Unit 4	**Distribution System Planning and Advanced Grid Control**	**8 hr**

Distribution system automation; Short-Term Load Forecasting; Long-Term Energy Forecasting; Enabling technologies in Distribution Automation;
SCADA system; Substation automation, Feeder automation; Remote metering;

Unit 5	Energy Auditing, Management and Intelligent DA	8 hr

Energy auditing – Types and Steps; Need Based Energy Management; Demand Side Management (DSM); Economic analysis of Distribution Automation; CIS and GIS; Application of AI to DA; Communication in DA – requirement & difficulties; Techniques used in communication;

LEARNING RESOURCES

TEXT BOOKS:

1	Turan Gonen, "*Electric Power Distribution system, Engineering*", Mc Graw-hill Book Company.
2	C.L Wadhwa, "*Electric Power Generation Distribution and Utilization*", New Age International (P) Ltd., 2005
3	James. Northcote – Green Robert Wilson, *Control and Automation of Electrical Distribution Systems,* CRC Press
4	Dr. M. K. Khedkar, Dr. G.M.Dhole, *Electric Power Distribution Automation,* University Science press.

REFERENCE BOOKS:

1	A. S. Pabla, "*Electric Power Distribution*", 5th Edition, Tata Mc Graw-Hill Publishing Company, 1997.
2	Anthony J Pansini, "*Electrical Distribution Engineering*", The Fairmont Press, INC, 2007
3	D. Bassett, K. Clinard, J. Grainger, S. Purucker, and D. Ward, *Tutorial Course: Distribution Automation,* IEEE Tutorial Publication 88EH0280-8-PWR, 1988.
4	James Northcote-Green, Robert Wilson, *Control and Automation of Electrical Power Distribution Systems*, CRC Press, Taylor and Francis Group, 2007
5	James A. Momoh, *Electric Power Distribution, Automation, Protection, and Control*, CRC Press, Taylor and Francis Group, 2007

ADDITIONAL REFERENCE MATERIAL

1	IEEE Academy on Smart Grid Distribution Automation

ONLINE COURSES

1	https://nptel.ac.in/courses/117103149
2	https://npti.gov.in/en/distribution-automation
3	https://www.coursera.org/specializations/powerdistributionandautomation

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	3	X				
CO2	3		X			
CO3	4			X		
CO4	4				X	
CO5	3					X
CO6	6	X	X	X	X	X

R24MEEET027	ADVANCED POWER ELECTRONIC CONVERTERS					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Power Electronics	**3**	**0**	**0**	**3**

Course Objective

To provide students with advanced knowledge and tools for analyzing, designing, and implementing advanced power electronic converters used in various industrial applications.

Course Outcomes

After completing this course, the students will be able to

1	Apply advanced Power factor correction converter topologies for specific applications. (BL3)
2	Apply advanced power converters such as resonant converters, Z-source inverters, and multi-level converters for specific application. (BL3)
3	Analyze and model power electronic systems using dynamic modeling methods. (BL3)
4	Apply analog and digital control strategies for converters, including voltage-mode and current-mode controls for power converters. (BL3)
5	Evaluate various control tools for converters, (BL5)
6	Design the various components of power electronic converters. (BL6)

SYLLABUS

Unit I	ADVANCED AC-DC CONVERTER TOPOLOGIES	8 hr

Diode Rectifier with Passive Power Factor Correction (PFC); Boost Converter-Based Active Power Factor Correction (APFC); Bridgeless Boost Converter; Bridgeless SEPIC Converter; Bridgeless Cuk Converter; Interleaved Boost Converter; Totem-Pole Power Factor Correction (TP-PFC); Vienna Rectifier;

Unit II	ADVANCED DC- DC AND DC –AC CONVERTER TOPOLOGIES	8 hr

LLC Resonant Converter; Soft Switching (ZVS-ZCS) Converters; High-Gain Switched-Capacitor /Inductor Converters; Z-Source Inverter; Bidirectional Buck-Boost Converter; Dual Active Bridge converter; Multilevel and Modular Multi-Level Converters; Grid-Tied Inverter;

Unit III	MODELING APPROACHES FOR POWER ELECTRONIC CONVERTERS	8 hr

Introduction; Basic AC modeling approach; State space averaging for DC-DC Converters; Circuit averaging; Averaged switch modeling; Canonical circuit modeling; Converter transfer functions for buck, boost and buck-boost topologies; Simulation using MATLAB/LTSPICE/PLECS/PSIM;

Unit IV	CONTROL STRATEGIES OF POWER ELECTRONIC CONVERTERS	8 hr

Design by Tuning of PI controller; System identification for calculation of transfer function; Pole Zero plots- Bode plots- Ziegler Nichols Method; Lead lag control; Inverter control; Rectifier control; Voltage and current mode control of buck, boost and buck boost converter; PLL single and 3 phase control;

Unit V	DESIGN OF POWER ELECTRONIC CONVERTERS	8 hr

Design of inductor; Selection of filter capacitors and input filter design; Design of current transformer; Selection of ratings for devices; Thermal design; Embedded coder and PWM Control methodology using MATLAB/SIMULINK; Timer, ePWM, ADC and interrupt features of DSP Controller; Industrial Applications like EV, DC Microgrids and Data Centers etc;

	LEARNING RESOURCES
TEXT BOOKS:	
1	Mohan, N., Undeland, T. M., & Robbins, W. P**.,** *Power Electronics: Converters, Applications, and Design.,* John Wiley & Sons, 2002.
2	Rashid, M. H., *Power Electronics: Circuits, Devices, and Applications,*Pearson Education, 2014.
3	Robert W. Erickson, Dragan Maksimovic, *Fundamentals of Power Electronics,* Springer; 2nd ed., 2001
REFERENCE BOOKS:	
1	Simone Buso, Paolo Mattavelli, Digital Control in Power Electronics, 2nd Edition, Springer Cham, publishers ,2015
2	Mattia Rossi, Nicola Toscani, Marco Mauri, Francesco Castelli Dezza, Introduction to Microcontroller Programming for Power Electronics Control Applications: Coding with MATLAB® and Simulink® , CRC Press, 2021
3	Corradini, Luca; Maksimović, Dragan; Mattavelli, Paolo; Zane, Rega, Digital control of high frequency switched mode power converters, Wiley-IEEE Press, 2015

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL 3	X				
CO2	BL 3		X			
CO3	BL 3			X		
CO4	BL 3				X	
CO5	BL 5				X	
CO6	BL 6	X	X	X	X	X

R24MEEET019	DISTRIBUTED GENERATION AND MICROGRID			**L**	**T**	**P**	**C**
	Total Contact Hours	42 (L)					
	Pre-requisite	Power transmission and distribution, Electrical Circuits		**3**	**0**	**0**	**3**

Course Objective

To develop a conceptual introduction to various distributed generation systems, micro grids and their control

Course Outcomes

1	Demonstrate the Different types Distributed Generation plants and energy storage systems. (BL3)
2	Compare Distributed and Traditional central station power generation of DGs. (BL4)
3	Compare different energy storage technologies. (BL4)
4	Investigate the different types of interfaces for Grid integration of DGs. (BL4)
5	Compare different types of micro-grids and interfacing with power electronic units. (BL5)
6	Device the control methods and protection system suitable for the Micro-grids. (BL6)

SYLLABUS

Unit 1	Over view of DG & Interface with the Grid	8 hr

Power System Structure, Traditional Grid, Conventional power generation: advantages and disadvantages, Energy crises; Distributed energy resources; Energy storage systems; Distributed generations, topologies & Selection of DG; Interface with grid; Impact of Distributed Generation on the Power System; Regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547; Economic issues of distribution generation;

Unit 2	Impact of Distributed Generation	8 hr

Overloading & losses; Voltage margin and design of distribution feeders; Probabilistic Methods for Design of Distribution Feeder; Numerical Approach to Voltage Variations, Tap Changers with Line-Drop Compensation & Hosting capacity (Voltage variation);
Low & High frequency harmonics due to DG; DG impact on Protection, over current protection, fault currents; Generator protection; Bus bar protection, Increasing hosting capacity (In terms of Protection)

Unit 3	Microgrid Converters & Modeling	8 hr

Overview of micro grid, Concept of micro grids; Microgrid and distributed generation, Micro grid Vs Conventional power system; AC and DC microgrid with distributed energy resources; Power electronics converters for micro grid;
Modulation techniques of PE converters in Micro-grid applications; Modeling of converters in Microgrid; Modeling of Wind energy, PV systems; Modeling of Energy storage systems;

Unit 4	Microgrid Dynamics & DC Micro grid Dynamics	8hr

Microgrid Dynamics; Micro grid Operation modes and Standards; Microgrid Control Architecture; Intelligent micro grid operation and control;
Energy management system in micro grid; DC microgrid Architecture and AC interface; DC microgrid Dynamics; DC microgrid modeling;

Unit 5	DC Microgrid Control and Analysis	8 hr

Control of Micro grid systems; Control of DC Micro grid; & Stability of Microgrid; Stability analysis of DC micro grid;

DC microgrid stabilization strategy - passive damping method; DC microgrid stabilization strategy- Impedance and Admittance criteria; Stabilization using nonlinear techniques; Micro grid applications;

LEARNING RESOURCES

TEXT BOOKS:

1	"Integration of Distributed Generation in the Power System", Math H. Bollen, John Wiley & Sons.
2	G.B. Gharehpetian and S. Mohammad Mousavi Agah, "Distributed Generation Systems. Design, Operation and Grid Integration" - Elsevier Inc-2017
3	Felix A. Farret M. Godoy Simo˜ Es, "Integration of Alternative Sources of Energy", IEEE- John Wiley & Sons, Inc. A-2006

REFERENCE BOOKS:

1	H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2	Nikos Hatziargyriou, Microgrids Architectures and Control-IEEE- John Wiley and Sons Ltd-2014
3	Rajeev Kumar Chauhan, Kalpana Chauhan, Distributed Energy Resources in Microgrids: Integration, Challenges and Optimization-Elsvier-2019

ADDITIONAL REFERENCE MATERIAL

1	https://www.sciencedirect.com/science/article/pii/B9780128217245000064
2	https://www.altenergymag.com/article/2009/04/distributed-generationmicro-grids/565/

ONLINE COURSES

1	NPTEL:: Electrical Engineering - Power Electronics and Distributed Generation
2	NPTEL:: Electrical Engineering - NOC:Dc Microgrid and Control System
3	https://www.edx.org/learn

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X	X			
CO2	BL4	X	X			
CO3	BL4	X				
CO4	BL4		X	X		
CO5	BL5				X	
CO6	BL6	X	X	X	X	X

	FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)					
R24MEEET028	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical circuits-Power electronics-Power transmission and distribution	**3**	**0**	**0**	**3**

Course Objective

Flexible AC Transmission Systems (FACTS) is an advanced course designed to enhance the understanding of modern power systems. It emphasizes the use of power electronic devices and systems to improve the reliability, stability, and efficiency of AC transmission networks. FACTS controllers are crucial in addressing challenges like increased power demand, network congestion, and the integration of renewable energy sources.

Course Outcomes

1	Apply the knowledge of series, shunt, and combined FACTS controllers to determine suitable devices for enhancing power transfer capability and stability in transmission lines. (BL3)
2	Analyze the performance of different converter topologies. (BL4)
3	Analyze the role of SVC & STATCOM in improving the power system dynamics. (BL4)
4	Adapt FACTS devices for power-flow control and discuss the working principles of Shunt and Series compensators. (BL6)
5	Explore the application of Thyristor-Controlled Braking Resistor (TCBR) for system damping. (BL4)
6	Design advanced solutions using FACTS devices like STATCOM, UPFC, and IPFC to enhance power system stability, optimize power flow, improve reliability, and support renewable energy integration. (BL6)

SYLLABUS

Unit 1	**FACTS CONCEPTS**	**8 hr**

Transmission interconnections; Power flow in an AC System; Loading capability limits; Dynamic stability considerations;
Importance of controllable parameters; Basic types of FACTS controllers; Shunt Controllers, Series controllers; Combined Shunt and series controllers; Benefits of FACTS;

Unit 2	**FUNDAMENTALS OF CONVERTERS**	**8 hr**

Concept of Voltage Sourced Converters; Single Phase Full Wave Bridge Converter; Three Phase Full Wave Bridge Converter; Transformer Connections for 12-Pulse Operation, 24 and 48-Pulse Operation;
Three Level Voltage Sourced Converter; Pulse Width Modulation (PWM) Converter; Thyristor based Converter; Concept of Current Sourced Converters;

Unit 3	**STATIC SHUNT COMPENSATORS**	**8 hr**

Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation; Methods of Controllable VAR Generation; Variable Impedance Type Static VAR Generators; Switching Converter Type VAR Generators;
Hybrid VAR Generators; SVC and STATCOM; Transient Stability Enhancement and Power Oscillation Damping; V-I, V-Q Characteristics.

Unit 4	**STATIC SERIES COMPENSATORS**	**8 hr**

Objectives of Series Compensation; Variable Impedance Type Series Compensators; GTO Thyristor Controlled Type Series Capacitor (GCSC); Thyristor

Switched Series Capacitor (TSSC); Thyristor-Controlled Series Capacitor (TCSC); Switching Converter Type Series Compensators; The Static Synchronous Series Capacitor (SSSC); Transmitted Power Versus Transmission Angle Characteristic.		
Unit 5	**EMERGING FACTS CONTROLLERS**	**8 hr**

Static synchronous compensators (STATCOM); The Unified Power Flow Controller (UPFC); Basic operating principles; Independent real and reactive power flow control;

Basic Control system for P and Q; Interline power flow controller (IPFC); Sub synchronous resonance; Thyristor-Controlled Braking resistor (TCBR);

	LEARNING RESOURCES
TEXT BOOKS:	
1	Understanding FACTS – Concepts and technology of Flexible AC Transmission systems, Narain G. Hingorani, Laszlo Gyugyi, IEEE Press, WILEY, 1st Edition, 2000, Reprint 2015.
2	FACTS Controllers in Power Transmission and Distribution, Padiyar K.R., New Age International Publishers, 1st Edition, 2007.
REFERENCE BOOKS:	
1	Mohan Mathur, R., Rajiv. K. Varma, "*Thyristor – Based Facts Controllers for Electrical Transmission Systems*", IEEE press and John Wiley & Sons, Inc.
2	A.T.John, "*Flexible AC Transmission System*", Institution of Electrical and Electronic Engineers (IEEE), 1999.
3	Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz, Bikash Pal, Springer, 2012, First Indian Reprint, 2015.
ADDITIONAL REFERENCE MATERIAL	
1	https://www.electrical4u.com/facts-on-facts-theory-and-applications/
2	https://www.electricaltechnology.org/2020/06/facts-flexible-ac-transmission-system.html
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc23_ee58/preview
2	https://nptel.ac.in/courses/108107114
3	https://www.gevernova.com/grid-solutions/services/catalog/hv-mv-courses/flexible-ac-transmission-system-facts-e-learning.htm
4	https://ekeeda.com/degree-courses/electrical-engineering/flexible-ac-transmission-system

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X		X	X	X
CO2	BL4		X			
CO3	BL4			X		X
CO4	BL6			X	X	X
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MEEEL006	**MICROPROCESSORS AND AVR MICROCONTROLLERS LAB**					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	STLD,MPMC	**0**	**0**	**3**	**1.5**

Course Objective

1. Students will gain understanding of hardware architecture and functional blocks of 8086 microprocessor and AVR microcontroller.
2. Students will get exposure to the programming of 8086 Microprocessor and AVR Microcontroller.

Course Outcomes

1	Will be able to write programs using MASM and WinAVR/IDE.
2	Will be able to assemble/compile and debug the programs
3	Will be able to simulate/execute programs on 8086 Microprocessor and AT Mega boards

List of Experiments

1	Arithmetic Operations on 16-bit Data using 8086 (Addition, Subtraction, Multiplication, Division) in 8086 Assembly Language on MASM.
2	Signed Multiplication and Division in 8086 Assembly Language on MASM.
3	Counting the Number of Positive and Negative Elements in an Array using 8086 Assembly Language on MASM.
4	Sorting a List of 8-bit Unsigned Numbers in Ascending/Descending Order using 8086 Assembly Language on MASM.
5	Checking Whether a Given String is a Palindrome using 8086 Assembly Language on MASM.
6	Interfacing 8255 PPI with 8086 Kit: Configure Port A and B as input/output ports using Port Programming.
7	Reading from and Writing to a Port using WinAVR/IDE/Simulator
8	al Communication using UART in AT Mega Microcontroller (Transmitting a Character) with WinAVR/IDE/Simulator
9	erating a PWM Signal using the Timer/Counter of AT Mega Microcontroller with WinAVR/IDE/Simulator
10	rfacing Switches and LEDs with AT Mega Microcontroller: I/O Port Programming.
11	log to Digital Conversion using AT Mega Microcontroller: Potentiometer as Analog Input.
12	rfacing a 16x2 LCD with AT Mega Microcontroller for Displaying Text.

Additional experiment

1	Interfacing EEPROM with AT Mega Microcontroller using the I2C Protocol.

Demonstration experiment

1	Real-Time Clock (RTC) Interfacing using DS1307 and Displaying Time on LCD.
2	DC Motor or Servo Motor Control using PWM from AT Mega Microcontroller.

LEARNING RESOURCES

TEXT BOOKS:

1	nced Microprocessors and Peripherals by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2nd edition, 2009.
2	The AVR Microcontroller And Embedded Systems Using Assembly And C Muhammad Ali Mazidi, Sarmad Naimi, And Sepehr Naimi, Prentice Hall, 2011.
3	oprocessor and Interfacing by Douglas V.Hall, 2nd Edition, TMH, 2006.

REFERENCE BOOKS:	
1	gramming And customizing the AVR Microcontroller, Dhananjay V. Gadre, The McGraw-Hill
2	Atmel AVR Microcontroller Primer: Programming and Interfacing, Steven F. Barrett, Morgan & Claypool,2008
ADDITIONAL REFERENCE MATERIAL	
1	://matthieu.benoit.free.fr/cross/data_sheets/8086_family_Users_Manual.pdf
2	https://edge.edx.org/c4x/BITSPilani/EEE231/asset/8086_family_Users_Manual_1_.pdf

R24MCSCL004	OOP WITH JAVA LAB (for MEC, ECE, EEE, CIV and CHE)					
	Total Contact Hours	42(P)	L	T	P	C
	Pre-requisite	-	0	0	3	2

Course Objective

Students will have the ability to apply object-oriented programming concepts in Java to develop and implement modular and reusable software solutions.

Course Outcomes

1	Students will be able to implement object-oriented programming concepts such as classes, inheritance, polymorphism, and exception handling to build modular Java applications.
2	Students will be able to examine and debug Java programs to identify and resolve logical errors, ensuring correctness and efficiency.
3	Students will be able to assess the design and performance of Java applications, optimizing for scalability, maintainability, and resource management.
4	Students will be able to design and develop advanced Java applications by integrating OOP principles, multithreading, GUIs, and data structures to solve real-world problems.

ListofExperiments

1	**Week 1: Introduction to Java and Structured Programming** 1. Write a simple Java program that prints "Hello, World!" to the console. 2. Write a Java program that takes user input using the Scanner class. 3. Write a Java program to demonstrate all primitive data types. 4. Implement a Java program that converts a floating-point number to an integer. 5. Create a Java program that uses the final keyword to define constants.
2	**Week 2: Operators, Control Statements - Selection** 1. Implement a Java program that uses arithmetic, relational, and logical operators. 2. Write a Java program to find the largest of three numbers using if-else statements. 3. Use the ternary operator to implement a simple conditional check.
3	**Week 3: Control Statements - Iteration** 1. Write a Java program that prints all even numbers between 1 and 100 using a for loop. 2. Create a Java program that calculates the factorial of a given number using a while loop. 3. Write a JAVA program to display the Fibonacci sequence. 4. Implement a menu-driven program using a do-while loop.
4	**Week 4: Arrays** 1. Write a Java program to reverse a one-dimensional array of integers. 2. Write a Java program to search for an element in an array. 3. Implement a Java program to find matrix multiplication using two-dimensional arrays.

5	**Week 5: Classes and Methods**
	1. Create a class with fields and methods, then instantiate and use it.
	2. Implement a method to calculate the area of a rectangle (accepting length and width as parameters).
	3. Create a program that returns the area of different shapes (circle, square, rectangle) using method overloading.
6	**Week 6: Constructors, this Keyword, and Garbage Collection**
	1. Implement a class with parameterized constructors and demonstrate object initialization.
	2. Use 'this' keyword to resolve variable shadowing within methods and constructors.
	3. Write a program that simulates garbage collection using System.gc() and observe the results.
7	**Week 7: Inheritance and Polymorphism**
	1. Create a superclass and subclass to demonstrate basic inheritance.
	2. Override a method in the subclass and call it from the main method.
	3. Use the super keyword to call the parent class constructor and method.
8	**Week 8: Abstract Classes and Interfaces**
	1. Write an abstract class with an abstract method and a concrete method.
	2. Implement an interface and demonstrate how to implement it in a class.
	3. Create a scenario where interfaces solve the multiple inheritance problem.
9	**Week 9: Exception Handling**
	1. Write a program that demonstrates basic exception handling using try-catch blocks.
	2. Implement a program that handles multiple exceptions using multiple catch clauses.
	3. Create a custom exception class and use it to handle a specific error in a program.
10	**Week 10: Multithreading**
	1. Implement a thread by extending the Thread class and demonstrate thread execution.
	2. Create a program that demonstrates thread life cycle and state transitions.
	3. Implement thread synchronization to avoid race conditions in a multi-threaded environment.
11	**Week 11: Event Handling, AWT**
	1. Create a simple AWT program that displays a window with a button, text field, and label.
	2. Implement mouse and keyboard event listeners in an AWT program.

12	**Week 12: Swings**
	1. Create a Swing-based GUI with a JFrame, JButton, and JLabel, demonstrating layout managers like FlowLayout or BorderLayout.
	2. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.

LEARNING RESOURCES

TEXTBOOKS:

1	Herbert Schildt, "Java The Complete Reference" 9th Edition, Oracle Press
2	Paul Deitel and Harvey Deitel, "Java How to Program", 11th Edition, Pearson.

REFERENCEBOOKS:

1	Herbert Schildt, "Java: A Beginner's Guide", 9th Edition, McGraw Hill, 2022
2	Bruce Eckel, "Thinking in Java", 9th Edition, Mind View, 2022.

ADDITIONAL REFERENCE MATERIAL

1	https://www.w3schools.com/java
2	https://docs.oracle.com/javase/tutorial/
3	https://www.geeksforgeeks.org/java/
4	https://www.javatpoint.com/java-tutorial
5	https://www.udemy.com/courses/search/?q=java
6	https://www.coursera.org/specializations/java-programming
7	https://www.freecodecamp.org/news/tag/java/
8	https://www.tutorialspoint.com/java/index.htm

R24MMATT007	**QUANTITATIVE PROBLEM-SOLVING TECHNIQUES**					
	Total Contact Hours	28 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**2**	**0**	**0**	**2**

Course Objective

The course aims to equip the students with standard concepts and techniques of arithmetic and logical thinking to handle various real-world problems and their applications.

Course Outcomes: After completing this course, the students will be able to

1	Enhance the aptitude and reasoning round clearing ability.
2	Solve real-time problems for performing job functions easily.
3	Improve individual decision–making abilities, how to think critically, and logically and analyze information as corporate company-based decisions.
4	Acquire satisfactory competency in the use of VERBAL REASONING as well as LOGICAL REASONING.
5	Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.

SYLLABUS

Unit I	**ARITHMETIC ABILITY**	**5 hr**

Number System; LCM & HCF; Ratio & Proportion; Percentages; Profit & Loss; Mixture and Allegation.

Unit II	**ALGEBRAIC ANALYSIS**	**5 hr**

Quadratic & Linear eq's; Set theory; Inequalities; Speed, Time and Distance; Time and Work; Simple Interest & Compound Interest.

Unit III	**ADVANCED MATHS**	**5 hr**

Circles, lines & angles; Triangles, quadrilaterals & polygons; Co-ordinate geometry; Areas & perimeter-2D; Surface area & volumes-3D; Trigonometry.

Unit IV	**MODERN MATHS**	**5 hr**

Probability; Permutation and Combination; Surds & Indices; Functions; Logarithms.

Unit V	**DATA INTERPRETATION & ELEMENTARY STATISTICS**	**5 hr**

Tables, charts & pie-diagrams; Venn diagrams; Data sufficiency; Mean, median & mode; Standard deviation & variance; Case studies.

LEARNING RESOURCES

TEXTBOOKS:

1	ARIHANT Publications - RAJESH VERMA, Fast Track Objective Arithmetic (Revised Edition)
2	MC GRAW HILL Education- ABHIJIT GUHA, Quantitative aptitude (6th edition)
3	ARIHANT Publications - B.S. SIJWALI & INDU SIJWALI Verbal, Non-verbal & Analytical reasoning
4	ARIHANT SERIES - JAI KISHAN & PREM KISHAN, Verbal, Non-verbal & Analytical reasoning
5	R. S. Aggarwal - S. Chand Publications, Quantitative Aptitude for Competitive Examinations

REFERENCE BOOKS

1	A SURE SHOT GUIDE TO CRACK SSB: YES, YOU HAVE IT IN YOU(MAJ GEN VPS BHAKUNI (Author), VSM (Author), KAVITA MODI (Author)) https://amzn.in/d/9QFY0oF
2	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC

	Tier I & II | Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author)) https://amzn.in/d/3OTZ5uI
3	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (Adda247 Publications (Author)) https://amzn.in/d/4aMMHvq
4	Ultimate Guide to SSC CGL - Combined Graduate Level - Tier I & Tier II Exam with Previous Year Questions & 5 Online Practice Sets 9th Edition | Combined Graduate Level Prelims & Mains| PYQs https://amzn.in/d/9IEwmYc (Disha Experts (Author))
5	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC Tier I & II | Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author)) https://amzn.in/d/3OTZ5uI
6	Quantitative Aptitude for CAT 2025 | 11th Edition (Latest) | Quant | CAT Preparation Exam Book with Solved Previous Years Papers (PYQ) | McGraw Hill edge Access: Mock Tests, Expert Sessions & Strategies (Arun Sharma (Author)) https://amzn.in/d/9OQMQBX
7	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (Adda247 Publications (Author)) https://amzn.in/d/4aMMHvq

	SWITCHGEAR AND PROTECTION				
R24MEET016	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical machines-Power transmission and distribution	**3**	**0**	**0**	**3**

Course Objective

The course on "Protection and Switchgear in Power Systems" aims to provide students with a comprehensive understanding of power system protection, including the need for protection, types of faults, and protective relays. It covers neutral grounding practices, overvoltage protection, and protection schemes for generators, transformers, feeders, and busbars. Students will also gain insights into electromagnetic relays, static relays, numerical relays, and various circuit breaker types, focusing on interruption techniques and their applications in maintaining power system reliability and safety.

Course Outcomes

1	Apply protection system concepts to identify faults and choose suitable relays with coordination in modern smart grids. (BL3)
2	Apply the knowledge of circuit breaker types and arc phenomena to select and evaluate suitable breakers and switchgear for various power system applications. (BL3)
3	Analyze different protection schemes for generators, transformers, busbars, and transmission lines to improve system reliability and security in modern power networks. (BL4)
4	Analyze advanced protection technologies and their integration with IoT, AI, and digital systems to enhance the reliability and adaptability of modern power networks. (BL4)
5	Analyze protection system performance and coordination using standards, software tools, and case studies to address emerging challenges in modern power systems. (BL4)
6	Design effective power system protection solutions using modern technologies, coordination methods, and industry standards. (BL6)

SYLLABUS

Unit 1	**Fundamentals of Power System Protection**	**8 hr**

Introduction to Protection Systems; Types of Faults in Power Systems; Types of Protective Relays: Current Transformers (CT) & Potential Transformers (PT); Protection Coordination & Selectivity; Modern Microprocessor-Based Relays; IEC 61850 & Smart Grid Protection; Artificial Intelligence (AI) in Protection Systems;

Unit 2	**Circuit Breakers & Arc Interruption Technology**	**8 hr**

Basics of Circuit Breakers: Arc Phenomenon in Circuit Breakers; Types of Circuit Breakers; Testing of Circuit Breakers;
HVDC Circuit Breakers; Gas-Insulated Switchgear (GIS); Superconducting Fault Current Limiters (SFCL); Solid-State Circuit Breakers (SSCB);

Unit 3	**Protection of Power System Components**	**8 hr**

Generator Protection; Transformer Protection; Busbar Protection; Transmission Line Protection;
Auto-Reclosing and Sectionalization; FACTS-Based Protection; Wide-Area Protection Systems (WAPS); Cyber security in Power System Protection;

Unit 4	**Recent Advances in Switchgear & Protection**	**8 hr**

Smart Circuit Breakers – IoT-enabled monitoring and control; Digital Substations – Role of IEC 61850 and SCADA integration; Adaptive Protection Schemes – Self-healing and real-time adjustments; Grid-Connected Renewable Energy

Protection; Protection of Micro grids; High Voltage DC (HVDC) Protection; Artificial Intelligence (AI) and IoT in Switchgear; Energy Storage System Protection;

Unit 5	Practical Aspects & Case Studies	8 hr

Switchgear Failure Analysis; Protection Coordination in Industrial Systems; Testing and Maintenance of Relays and Circuit Breakers; Relay Coordination Software (ETAP, Dig SILENT, PSCAD) – Practical applications; Case Study: Major Grid Failures & Protection Response – Learning from past events;
Standardization & Regulations in Protection Systems – IEEE, IEC, and national standards; Integration of Electric Vehicles (EV) in Grid Protection – Impact of V2G systems; Future Trends in Switchgear & Protection – AI, block chain, and digital twins;

LEARNING RESOURCES

TEXT BOOKS:

1	Sunil S Rao, Switchgear Protection and Power Systems - Khanna Publishers-14th Edition
2	Badri Ram, D N Vishwakarma, Power System Protection and Switchgear TMH Publishing Company Limited-2nd Edition-2017
3	T.S.Madhava Rao Power system protection- Static Relays with microprocessor applications.TMH-2017

REFERENCE BOOKS:

1	M.V.BAKSHI U.A.BAKSHI-Switchgear & Protection - A Conceptual Approach-Technical publications-2019
2	VK Mehta & Rohit Mehta, Principles of Power System -S Chand publishers-2018
3	**J. B. Gupta -Switchgear and Protection"** S.K. Kataria & Sons; 2013th edition

ADDITIONAL REFERENCE MATERIAL

1	https://www.electrical4u.com/electrical-switchgear-protection/
2	https://mrcet.com/downloads/digital_notes

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc21_ee110/preview
2	https://www.coursera.org/learn/advanced-study-of-protection-schemes-and-switchgear
3	https://www.edx.org/learn/electronics

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4	X				X
CO6	BL6	X	X	X	X	X

	POWER QUALITY					
	POWER QUALITY					
R24MEEET020	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electrical circuits, electrical machines, Electromagnetic fields, Power Electronics	**3**	**0**	**0**	**3**

Course Objective

The objective of this course is to introduce the power quality problems, issues, related international standard, effect of power quality problem in different apparatuses and methods for its correction, which is actually a technology management.

Course Outcomes

1	Examine the causes and consequences of voltage sags and interruptions in power systems. (BL4)
2	Assess the impact of capacitor switching transients and lightning surges on electrical networks. (BL5)
3	Investigate power system response under non-sinusoidal conditions and calculate harmonic indices. (BL4)
4	Assess the role of capacitor banks in voltage regulation and power factor improvement. (BL5)
5	Examine the impact of distributed generation on power quality and voltage stability in distribution networks. (BL4)
6	Develop strategies to improve power quality by analyzing issues like transients, harmonics, voltage variations, and the impact of distributed generation. (BL6)

SYLLABUS

Unit 1	INTRODUCTION	8 hr

Definition and Importance of Power Quality; Major Concerns Related to Power Quality; Classification of Power Quality Problems; Transients and Their Impact on Power Systems; Voltage Variations (Long & Short Duration); Waveform Distortion and Voltage Unbalance; Voltage Sags and Interruptions: Causes and Effects; Nonlinear Loads and Their Impact on Power Quality.

Unit 2	TRANSIENT OVERVOLTAGES	8 hr

Sources and Causes of Transient Overvoltages; Effects of Transients on Power Systems; Principles and Methods of Overvoltage Protection; Devices for Overvoltage Protection (Surge Arresters, MOVs, etc.); Utility Capacitor Switching Transients; Utility Lightning Protection Methods; Load Switching Transient Problems; Introduction to Computer-Based Transient Analysis (PSCAD & EMTP).

Unit 3	HARMONIC DISTORTION AND SOLUTIONS	8 hr

Voltage vs. Current Distortion; Difference Between Harmonics and Transients; Power System Quantities Under Non-Sinusoidal Conditions; Harmonic Indices and Their Significance; Sources and Location of Harmonic Distortion; Effects of Harmonics on Power Systems and Equipment; Harmonic Filters and Control Methods; Harmonic Standards and Compliance Requirements.

Unit 4	LONG DURATION VOLTAGE VARIATIONS	8 hr

Causes and Effects of Long-Duration Voltage Variations; Voltage Regulation Principles and Techniques; Devices for Voltage Regulation (Tap Changers, VAR Compensators, etc.); Utility Voltage Regulator Applications; Capacitor Banks for Voltage Regulation; End-User Capacitor Applications; Impact of Distributed Energy Resources on Voltage Regulation; Voltage Flicker: Causes, Effects, and Mitigation.

Unit 5	Distributed Generation and Power Quality	8 hr

Introduction to Distributed Generation (DG) and Its Resurgence; Types of DG

Technologies (Solar, Wind, Biomass, etc.); Grid Integration of Distributed Generation; Power Quality Issues Due to DG; Operational Conflicts in DG Systems; DG on Low-Voltage Distribution Networks; Interconnection Standards for DG (IEEE 1547, IEC, etc.); Wiring and Grounding Issues in DG Systems and Their Solutions.

LEARNING RESOURCES

TEXT BOOKS:

1	Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw,Hill, 2002.
2	Power Quality Primer, Kennedy B W, First Edition, McGraw,Hill, 2000.
3	Power Quality c.shankaran, CRC Press, 2001

REFERENCE BOOKS:

1	Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
2	Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3	Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York,1993.

ADDITIONAL REFERENCE MATERIAL

1	https://www.smart-energy.com/industry-sectors/smart-grid/what-is-power-quality-and-why-is-it-important/
2	https://www.monolithicpower.com/en/learning/mpscholar/power-electronics/power-quality

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc21_ee103/preview
2	https://www.classcentral.com/course/swayam-power-quality-43647
3	https://edx.univ-relizane.dz/courses/course-v1:UniversityofRelizane+PQEMC1

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL5		X			X
CO3	BL4			X		
CO4	BL5				X	
CO5	BL4	X				X
CO6	BL6	X	X	X	X	X

R24MEET029	**SWITCHED MODE POWER CONVERTERS**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic understanding of logic, Set theory calculus, linear algebra, and probability/ statistics.	**3**	**0**	**0**	**3**

Course Objective

This course aims to introduce students to Artificial Intelligence, Machine Learning, and Image Processing, covering their historical development, current status, and engineering applications.

Course Outcomes

1	Explain the principles of operation and steady-state analysis of various non-isolated and isolated DC-DC converters. **BL3)**
2	Analyze the dynamic behavior of converters using small-signal modeling, transfer functions, and stability considerations. **(BL4)**
3	Design and implement control strategies such as voltage-mode and current-mode control for power converters. **(BL5)**
4	Evaluate the selection and design of magnetics for different converter topologies, including transformers and inductors. **(BL5)**
5	Develop advanced switched-mode power supplies for applications such as battery-operated vehicles, renewable energy systems, and EV charging. **(BL6)**
6	Propose innovative and optimized power conversion solutions for industrial and renewable energy applications. **(BL6)**

SYLLABUS

Unit 1	ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS	**8 hr**

Buck, Boost, Buck- Boost and Cuk converters: Principles of operation; Continuous conduction mode; Concepts of volt-sec balance and charge balance; Analysis and design based on steady- state relationships; Introduction to discontinuous conduction mode; SEPIC topology; design examples - Applications to Battery operated vehicle; PV system.

Unit 2	ANALYSIS OF ISOLATED DC-DC CONVERTERS.	**8 hr**

Introduction – classification; forward; flyback; push-pull; half bridge; full bridge topologies; design of SMPS; Applications to Battery operated vehicle.

Unit 3	CONVERTER DYNAMICS	**8 hr**

AC equivalent circuit analysis; State space averaging; Circuit averaging; Averaged switch modeling; Input filters; Small signal model and Transfer function model for –Buck; Boost; -Buck-boost; and Cuk converters;

Unit 4	CONTROLLER DESIGN	**8 hr**

Review of P, PI, and PID control concepts; gain margin; and phase margin; Bode plot-based analysis; Design of voltage and current mode controller - for Buck; Boost; Buck-boost; and Cuk converters

Unit 5	DESIGN OF MAGNETICS and SMPS APPLICATIONS	**8 hr**

Basic magnetic theory revision; Inductor design; Design of mutual inductance; Design of transformer for isolated topologies- Ferrite core table and selection of area product, wire table, selection of wire gauge; Power Factor Correction in Switching Power Supplies; Low Input SMPS for Laptop Computers and Portable Electronic devices; EV charging systems; Case studies: SMPC simulation using open-source tools

LEARNING RESOURCES

TEXT BOOKS:	
1	Robert W. Erickson and DraganMaksimovic, "Fundamentals of Power Electronics", Springer, 3rd edition, 2020
2	Simon Ang, Alejandro Oliva, "Power-Switching Converters", CRC Press, Vol. No., 3rd Edition, 2010.
REFERENCE BOOKS:	
1	Philip T Krein, "Elements of Power Electronics ", Oxford University Press, 2nd Edition, 2017. 2. Ned Mohan, Undeland and Robbin, "Power Electronics 3ed (An Indian Adaptation): converters, Application and design" Wiley India Pvt Ltd, 3rd Edition, 2022
2	Philip T Krein, "Elements of Power Electronics ", Oxford University Press, 2nd Edition, 2017. 2. Ned Mohan, Undeland and Robbin, "Power Electronics 3ed (An Indian Adaptation): converters, Application and design" Wiley India Pvt Ltd, 3rd Edition, 2022
ADDITIONAL REFERENCE MATERIAL	
1	IssaBatarseh, Ahmad Harb, "Power Electronics- Circuit Analysis and Design, Second edition, 2018
2	NPTEL course on SMPS by DR V Ramnarayanan
3	V.Ramanarayanan, "Course material on Switched mode power conversion", 2007
4	Alex Van den Bossche and VencislavCekovValchev, "Inductors and Transformers for Power

Bloom's level - Units catchment articulation matrix

CO	Bloom's Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4	X	X			
CO3	BL5		X	X		
CO4	BL5			X	X	
CO5	BL6				X	X
CO6	BL6	X	X	X	X	X

	HVDC TRANSMISSION					
R24MEET021	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Power Electronics and Power systems	**3**	**0**	**0**	**3**

Course Objective

Students will gain understanding of HVDC transmission is to enhance the efficiency, reliability, and flexibility of power transmission systems, enabling the integration of renewable energy sources and supporting the development of modern, interconnected electrical grids.

Course Outcomes:

1	Develop the ability to analyze and evaluate different types of HVDC systems and their suitability for specific transmission requirements. **(BL5)**
2	Develop analytical skills to analyze voltage and current waveforms, harmonic content, and power factor in rectifiers and converters. **(BL5)**
3	Ability to analyze the differences between constant current and constant voltage control methods and Ability to initiate and terminate the operation of HVDC converters safely and efficiently. **(BL5)**
4	Ability to diagnose converter faults and implement corrective actions to restore system functionality. **(BL3)**
5	Ability to perform power flow analysis in hybrid AC-DC systems, considering the interaction between AC and DC grids. **(BL3)**
6	Ability to design HVDC systems for the integration of power generation. **(BL6)**

SYLLABUS

Unit 1	**DC Transmission Technology**	**8 hr**

Introduction, Types of HVDC systems; Equipment required for HVDC systems, Comparison of AC and DC Transmission; Comparison of HVDC link with EHVAC link; Analysis of half wave rectifiers;

Analysis of Full wave rectifiers; Types of 6 pulse converters; Twelve pulse converters; Comparison between line commutated converters and voltage source converters.

Unit 2	**Analysis of Converter Circuits**	**8 hr**

Analysis of three phase one way and two-way rectifier; Analysis of six pulse converter (Graetz's circuit) without overlap angle; Analysis of six pulse converter with overlap angle (less than 60 degrees); Inverter operation, Comparisons of inverter and rectifier operation;
Operation of Electrical equivalent circuit of bridge rectifier, inverter and HVDC links; Analysis of twelve pulse bridge converter; Operation and Analysis of VSC; Power Flow in HVDC links.

Unit 3	**Control of HVDC converters and Systems**	**8 hr**

Comparisons of constant current and constant voltage; Control of rectifier; Control of inverter; Voltage dependent current order limit and System Control Hierarchy, Firing angle control;
Equidistant Pulse Control (EPC); Constant current control and Constant excitation angle control; Basic control system for HVDC converters; Starting and Stopping of DC link, Control comparisons;

Unit 4	**Converter Faults and Protection Schemes in HVDC Systems**	**8 hr**

Nature and Types of faults; Faults on AC side of Converter Stations; Converter faults; Faults on DC side of the system;

Protection of HVDC systems; Protection against overcurrent's and overvoltage's; Direct current circuit breaker; Harmonic Analysis: characteristic harmonics and non-characteristic harmonics

Unit 5	Multi Terminal HVDC systems	8 hr

Insulators for HVDC overhead lines; Types of insulators for DC applications; Component Models for the Analysis of AC and DC Systems; Transient stability analysis and Dynamic stability analysis; Power flow analysis of AC-DC systems; Types of Multi terminal Systems (MTDC); Parallel Operation Aspects Of MTDC; Advances in HVDC transmission, HVDC system application in wind power generation.

LEARNING RESOURCES	
TEXT BOOKS:	
1	HVDC Power Transmission Systems: Technology and system Interactions by K.R.Padiyar, New Age International (P) Limited, and Publishers.
2	HVDC Transmission by S.Kamakshaiah, V.Kamaraju Tata McGraw Hill Education Private Limited-2011
3	EHVAC and HVDC Transmission Engineering and Practice – S.Rao
REFERENCE BOOKS:	
1	HVDC Transmission – J.Arrillaga.
2	Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons
3	Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications.
ADDITIONAL REFERENCE MATERIAL	
1	Lecture notes
ONLINE COURSES	
1	https://nptel.ac.in/courses/108104013

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL5	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

R24MEET030	**ELECTRICAL VEHICLE TECHNOLOGY**					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Power Electronics and Electrical Machines	3	0	0	3

Course Objective

Students will get exposure to with a comprehensive understanding of electric vehicle components, including batteries, electric motors, power electronics, and charging infrastructure.

Course Outcomes: Students will be able to

1	Understand the classification of electric vehicles and also identify the differences between electric vehicle and hybrid electric vehicles. **(BL3)**
2	Solve the vehicle dynamics and also distinguish the different drive train topologies. **(BL3)**
3	Examine the various types of batteries and also select the suitable battery for EV applications. **(BL5)**
4	Analysis and select the various types of DC-DC converters for EV applications **(BL5)**
5	Determine the motor characteristics and judge the suitable motor for EV application**(BL5)**
6	Develop a retrofitted electric vehicle by applying the vehicle dynamics and motor **(BL6)**

SYLLABUS

Unit 1	**Introduction To Electric Vehicles**	**8 hr**

A brief History, Types of Electric vehicles in use today; Introduction of EV/ICE Technology and characteristics; Architecture of electric vehicle and hybrid electric vehicle; Introduction to various electric drive train topologies;
Power flow control in electric drive-train topologies; Intro EV Motor Drive Technologies, Intro EV Energy Source Technologies; Intro of power electronic converters used in EV; Intro EV Battery Charging Technologies, Intro EV Vehicle to Grid;

Unit 2	**Electric Vehicle Modelling (Vehicle dynamics)**	**8 hr**

HEV operating modes, Power flow control in electric drive-train topologies in HEV; Series HEV; Parallel HEV; Series- Parallel HEV; Complex HEV.
Calculating the Rolling Resistance; Calculating the Aero Drag and Calculating the grade resistance; Calculating the Acceleration Force and Power calculation;

Unit 3	**Energy Storage and EV Chargers**	**8 hr**

Introduction to Battery Parameters; Various types of batteries; Battery charging and discharging calculation, battery calculations for EV; Battery pack design1; Battery Pack design 2;
EV charging: V2G, G2V, V2B, V2H; Block diagram of charging station; Types of EV chargers

Unit 4	**Power Electronic Converters in Electric Vehicles**	**8 hr**

Non-isolated converters: Analysis of Buck and Boost converter; Analysis of Buck-Boost converters; Analysis of CUK converter; Analysis of SEPIC converter; Charger topology for EV
Fly Back; Forward; Push-Pull, Half Bridge and Full Bridge;

Unit 5	**Electric propulsion unit and Introduction of BMS**	**8 hr**

Electric Propulsion unit: Motor rating calculations; Power -Torque- speed characteristics of all EV motors; controlling methods of EV motors, abc to d-q transformation, dq to abc transformation;
SPWM switching control technique; Battery management system: **Architecture;**

BMS Design of Electric Vehicle - Part 1; BMS Design of Electric Vehicle - Part 2

LEARNING RESOURCES

TEXT BOOKS:

1	James Larminie, " Electric Vehicle Technology Explained" Copyright 2003 John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester ,West Sussex PO19 8SQ, England
2	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals" 2003 CRC press.

REFERENCE BOOKS:

1	C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2	S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3	T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

ADDITIONAL REFERENCE MATERIAL

1	Lecture Notes

ONLINE COURSES

1	https://nptel.ac.in/courses/108106170
2	https://nptel.ac.in/courses/108102121
3	https://nptel.ac.in/courses/108103009

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL5			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MEET016		**MATLAB AND SIMULINK**				
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic knowledge of electrical circuits, control systems, and power electronics	**0**	**0**	**3**	**2**

Course Objective

This course provides hands-on training in MATLAB and Simulink for electrical system modeling, power electronics, control systems, and renewable energy applications. The focus is on industry-relevant simulations used in automotive, power, and industrial automation sectors.

Course Outcomes

1	Apply MATLAB and Simulink to solve electrical engineering problems. (BL3)
2	Analyze circuit behavior and power electronic converters using simulations. (BL4)
3	Design and optimize controllers for power electronics and electrical drives. (BL5).
4	Simulate and evaluate electrical machines under different operating conditions (BL5)
5	Develop and implement renewable energy and power system models for industry applications (BL6)

List of Experiments

1	Solve matrix operations and apply them to electrical circuit analysis using MATLAB.
2	Analyze electrical networks using Kirchhoff's Laws and Thevenin's Theorem in MATLAB
3	Determine the transient and steady-state response of RLC circuits using time and frequency domain analysis.
4	Build and simulate basic electrical circuits in Simulink to verify theoretical concepts.
5	Model and simulate Buck, Boost, and Buck-Boost converters to analyze their performance.
6	Implement SPWM techniques for three-phase inverter control and analyze their industrial applications.
7	Design and tune a PID controller for power electronic applications and validate its performance.
8	Simulate induction and synchronous machines to study their dynamic and steady-state behavior
9	Perform fault analysis in power systems by simulating short-circuits and relay coordination.
10	FFT analysis in MATLAB to study harmonic distortion and improve power quality.
11	Develop a simulation model for a PV system with MPPT control and analyze grid integration.
12	Model an EV powertrain, including battery, motor drive, and power electronics and to evaluate system performance over a drive cycle

Additional experiment

1	Design of EV charger topology
2	To implement a Battery Management System for an EV
3	Build an AI based model for an autonomous EV
	LEARNING RESOURCES

TEXT BOOKS:	
1	MathWorks, *Simulink User Guide* (Latest Edition).
2	Stephen J. Chapman, *MATLAB Programming for Engineers*, Cengage, 2020.
3	Agam Kumar Tyagi , *MATLAB and SIMULINK for Engineers*, OXFORD Press,2013
REFERENCE BOOKS:	
1	Gonzalez, R E Woods & S L Eddins, DIP using MATLAB, 2nd Ed
ADDITIONAL REFERENCE MATERIAL	
1	http://www.mathworks.com/matlabcentral/cody
2	https://matlabacademy.mathworks.com/details/power-systems-simulation-onramp/orps
3	https://matlabacademy.mathworks.com/details/power-electronics-simulation- onramp/powerelectronics

R24MCSCT007	COMPUTER NETWORKS				
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisites	DLD, CAO	3	0	0	3

Course Objective

Students will gain an ability to identify and design network architecture and apply the essence of various protocols.

Course Outcomes

1	Students will be able to analyze and **apply** key concepts of data communication, including network topologies, layering, and protocols; the OSI and TCP/IP reference models in order to design and evaluate efficient communication systems. (BL4)
2	Students will be able to **describe**, **demonstrate**, and **analyze** various data link layer techniques and apply this knowledge to design and evaluate reliable data communication systems. (BL4)
3	Students will be able to **identify**, **explain**, and **apply** random access methods and assess their impact on the performance and evolution of network communication systems. (BL3)
4	Students will be able to **describe**, **compare**, and **apply** the roles of connecting devices (switches, hubs, routers, bridges, gateways), **analyze** and **evaluate** various routing algorithms and **assess** the effectiveness of flooding in network communication. (BL5)
5	Students will be able to **compare**, and **apply** the TCP and UDP datagram formats, congestion control techniques and flow control methods and their roles in Internet communication. (BL4)
6	Students will be able to design and evaluate efficient, reliable and effective network communication systems. (BL6)

SYLLABUS

Unit I	OVERVIEW OF DATACOMMUNICATION AND NETWORKING	8 hr

Introduction to Data Communication**,** Network Topologies; Layering and Protocols, Reference-Model: OSI Reference Model; TCP/IP Reference Model, Addressing; Physical Layer-Different types of Transmission Media-Guided; Different types of Transmission Media-Unguided; Multiplexing-TDM, FDM, WDM; Line Encoding (NRZ, NRZI, Manchester, AMI, 4B/5B); Switching and Taxonomy: Circuit Switched, Packet Switched;

Unit II	DATALINK LAYER: ERROR CONTROL & FLOW CONTROL	8 hr

Error Detection: CRC, Checksum; Error Correction: Hamming Distance, Linear Block Codes; Framing: Bit and Byte Stuffing; Flow Control: Noiseless-Simplest, Stop and Wait; Noisy: Stop and wait ARQ; Go Back N, Selective repeat; PPP, HDLC; Random Access: Aloha: Pure and Slotted;

Unit III	DATALINK LAYER	8 hr

Random Access: CSMA, CSMA/CD; Random Access: CSMA/CA; Controlled Access-Reservation, Polling and Token passing; Channelization-FDMA, TDMA and CDMA; Standard Ethernet-MAC; Standard Ethernet-Physical Layer; Changes in the Standard- Fast Ethernet; Gigabit Ethernet,10 Gigabit Ethernet;

Unit IV	NETWORK LAYER	8 hr

Connecting Devices - Switches, Hubs, Routers, Bridges, Gateways;

IPv4addressing - Classful, Classless; IPv4 Datagram Format; IPv6 Datagram Format; Address Mapping: ARP; RARP,BOOTP, DHCP; Routing: Routing table, Optimization, Distance Vector Routing ; Link State Routing, Path Vector Routing;

Unit V	TRANSPORT LAYER AND APPLICATION LAYER	8 hr

TRANSPORT LAYER:

TCP Datagram Format; UDP Datagram Format; Congestion Control: Data Traffic, Open Loop, Closed Loop; Quality of Service: Flow characteristics, Scheduling; Flow Control: Leaky Bucket and Token Bucket;

REMOTE LOGIN & APPLICATION LAYER:

Telnet, Electronic Mail; DNS, Distribution of Name Space, DNS in the Internet; WWW and HTTP;

LEARNING RESOURCES

TEXTBOOKS:

1	Data Communications and Networking, Behrouz Forouzan, 4th Edition, McGrawHill.

REFERENCE BOOKS:

1	Computer Networks –Andrew S Tanenbaum,4th Edition, Pearson Education/PHI.
2	Computer Networking: *A Top Down Approach-James F Kurose and Keith W Ross,* 6th Edition, Pearson Education.

ADDITIONAL REFERENCE MATERIAL

1	https://www.geeksforgeeks.org/computer-network-tutorials
2	https://www.javatpoint.com/computer-network-tutorial
3	https://www.tutorialspoint.com/data_communication_computer_network

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc22_cs19
2	https://www.coursera.org/learn/illinois-tech-computer-networking

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MCSCT008	ARTIFICIAL INTELLIGENCE: PRINCIPLES AND TECHNIQUES					
	Total Contact Hours	42	L	T	P	C
	Pre-requisite	Data Structures	3	0	0	3

Course Objective

This course aims to help students conversant with the theoretical concepts and algorithm a
pproaches that can be applied to the design of AI applications and students will gain insights into foundational principles, algorithms, and theoretical frameworks underlying Machine Learning.

Course Outcomes

After completing this course, the students will be able to

1	Apply AI Search Algorithms and Backtracking Techniques to Solve Constraint Satisfaction Problems. (**BL3**)
2	Analyze and Compare the Applications and Limitations of Propositional Logic and First-Order Logic in Knowledge Representation and Reasoning. (**BL4**)
3	Apply Machine Learning Techniques and Neural Network Models to Solve Real-World Problems Across Various Domains. (**BL3**)
4	Analyze and Compare the Effectiveness of the Find-S and Candidate Elimination Algorithms in Designing a Learning System, Focusing on Version Spaces and Their Applications. (**BL4**)
5	Evaluate the Effectiveness and Applicability of Decision Tree Learning and Single and Multi-Layer Perceptrons in Solving Classification Problems Across Various Domains. (**BL5**)
6	Design and Develop an Integrated Intelligent System that Utilizes AI Search Algorithms, Knowledge Representation, and Machine Learning Techniques, Including Decision Trees and Neural Networks, to Solve Complex Real-World Problems. (**BL6**)

SYLLABUS

Unit I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	8 hrs

Introduction to Artificial Intelligence (AI), machine learning, deep learning, Types of AI, Advantages and Applications of AI; Agents in Artificial Intelligence, Types of agents; State Space Search: Uninformed search: (Iterative Deepening, Bidirectional search); Informed search: Best First Search; A* Algorithm; Hill Climbing Algorithms in Artificial Intelligence (Simple and Steepest Ascent); Constraint satisfaction problems (Constraint propagation: Arc Consistency), Backtracking Algorithm for CSP's; Knowledge-Based Agent (KBA): Architecture and Various level of KBA;

Unit II	KNOWLEDGE REPRESENTATION AND REASONING	8 hrs

Knowledge representation (KR), Approaches to KR, Techniques of KR; Propositional Logic, Logical Connective and Equivalence; Rules of Inference; PEAS description of Wumpus world; First Order Logic in AI, Inference in First-Order Logic; Knowledge Engineering in First-order logic; Forward Chaining and backward chaining in AI; Reasoning in Artificial intelligence;

Unit III	BASICS AND TYPES OF MACHINE LEARNING	8 hrs

Conceptual introduction to Machine Learning and Neural Networks: Biological Neural Networks and Artificial Neural Networks; Supervised Learning: (Linear and Non-Linear regression); Logistic Regression; Classification: Decision Tree and Support Vector Machines; Unsupervised Learning (clustering approach); Association; Semi-Supervised Learning; Reinforcement Learning;

Unit IV	MACHINE LEARNING TRAINING EXAMPLES	8

		hrs
Well Posed Learning Problems, Designing A Learning System, Perspectives and Issues in Machine Learning; Introduction to Concept Learning: A Concept Learning as a Task; Concept Learning as Search; Find-S: Finding a Maximally Specific Hypothesis; Version Spaces Representation: The List-Then-Eliminate Algorithm, Compact Representation for Version Spaces; Candidate Elimination Algorithm and Example; Remarks on Version Spaces and Candidate-Elimination: Converge, Order of Training Examples, Usage of Partially Learned Concepts; Inductive Bias;		
Unit V	**DECISION TREE LEARNING AND SINGLE AND MULTI-LAYER PERCEPTRON**	**8 hrs**
Introduction, Decision Tree Representation and Appropriate Problems for Decision Tree Learning;ID3 Algorithm: An Illustrative Example; Hypothesis Space Search and Inductive Bias in Decision Tree Learning; Neural Network Representation, Appropriate Problems for Neural Network Learning; Perceptrons - Representational Power of Perceptrons, The Perceptron Training Rule; Gradient Descent and The Delta Rule, Stochastic Approximation to Gradient Descent; Multilayer Networks and The Back Propagation Algorithm - A Differentiable Threshold Unit; The Back Propagation Algorithm;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Tom M. Mitchell *"Machine Learning"*, Indian Edition.	
2	Stuart J. Russell and Peter Norvig, *"Artificial Intelligence A Modern Approach"*, Third Edition.	
3	Kevin Knight, Elaine Rich, B. Nair, *"Artificial Intelligence"*, Tata McGraw-Hill Education, 3rd Edition, 2010.	
REFERENCE BOOKS:		
1	Christopher M. Bishop, *"Pattern recognition and machine learning"*, Springer,2007.	
2	Ethem Alpaydin, *"Introduction to Machine Learning"*, PHI, Third edition, 2015.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.javatpoint.com/artificial-intelligence-ai/	
2	https://www.geeksforgeeks.org/machine-learning/	

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

	OOAD AND DESIGN PATTERNS					
R24MCSCT009	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Data Structures	**3**	**0**	**0**	**3**

Course Objective

1. Understand the importance and basic concepts of object-oriented modelling,
2. Specify, analyse and design the requirements for a system and model the state of the set of objects and their implementation specifications.
3. Identify, Analyse the subsystems, various components and collaborate them interchangeably.
4. Describe the design patterns that are common in software applications
5. Design a module structure to solve a problem, and evaluate alternatives

Course Outcomes: On the successful completion of this course, Students will be able to

1	Examine the Object-Oriented Models required for Software development through use case driven approach (**BL4**)
2	Categorize and model the structural and behavioral concepts of the software system. (**BL4**)
3	Develop and explore the transformation of conceptual models into various scenarios and real time applications. (**BL4**)
4	Construct a design consisting of a collection of modules using creational and structural design patterns. (**BL5**)
5	Identify appropriate behavioral patterns to demonstrate the dynamic aspects of a given software model during execution. (**BL5**)
6	Design a Small-Scale Application with Unified Models and Integrated Design Patterns. (**BL6**)

SYLLABUS

Unit I	**INTRODUCTION TO UNIFIED MODELING LANGUAGE**	**8 hr**

Introduction to UML, Importance of Modeling; Principles of Modeling; Object oriented modeling; Conceptual model of UML: Basic building blocks; Conceptual model of UML: Rules; Conceptual model of UML: Common Mechanisms; Architecture; Software Development life cycle

Unit II	**STRUCTURAL MODELING**	**8 hr**

Basic Structural Modelling: Classes; Relationships; Common Mechanisms; Diagrams; Advanced Structural Modelling: Advanced classes; Advanced Relationships; Interfaces, Types and Roles**;** Packages & Instances;

Unit III	**ARCHITECTURAL MODELING & UML 2.0**	**8 hr**

Usecase Diagrams; Interactions: Sequence & Collaboration Diagrams; Activity Diagrams; State Diagrams; Component Diagrams; Deployment Diagrams; Updations in UML 2.0: Interaction overview diagram and Timing diagrams; Unified Process Models in Software Engineering;

Unit IV	**DESIGN PATTERNS-1**	**8 hr**

Introduction to Design patterns; Creational Design Patterns: Factory Method & Abstract Factory; Builder; Prototype; Singleton; Case study on Creational Design Patterns; Structural Patterns: Adapter; Bridge;

Unit V	**DESIGN PATTERNS-2**	**8 hr**

Composite; Fly-Weight; Case study on Structural Patterns; Behavioural Patterns: Chain of Responsibility; Iterator; Memento; Observer; Case study on Behavioural Patterns;

	LEARNING RESOURCES
TEXTBOOKS:	
1	Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.
2	Design Patterns By Erich Gamma, Pearson Education.
3	Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: UML 2 Toolkit, WILEY-Dreamtech India Pvt. Ltd.
REFERENCE BOOKS:	
1	https://www.ibm.com/developerworks/rational/library/769.html
2	https://www.visual-paradigm.com/tutorials/uml-class-diagram-in-diff-programming-languages.jsp
3	https://www.uml-diagrams.org/index-examples.html
4	https://www.tutorialspoint.com/design_pattern/
5	http://www.oodesign.com/
6	https://praveenthomasln.wordpress.com/2012/03/03/interfaces-types-and-roles-s8-cs/
7	https://www.uml-diagrams.org/uml-25-diagrams.html
8	https://www.tutorialspoint.com/uml/uml_2_overview.htm#:~:text=UML%202.0%20offers%20four%20interaction,of%20interactions%20as%20interaction%20occurrences.
ONLINE COURSES	
1	NPTEL :: Computer Science and Engineering - NOC:Object-Oriented Analysis and Design
2	https://onlinecourses.nptel.ac.in/noc22_cs99/preview

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL4		X			
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X