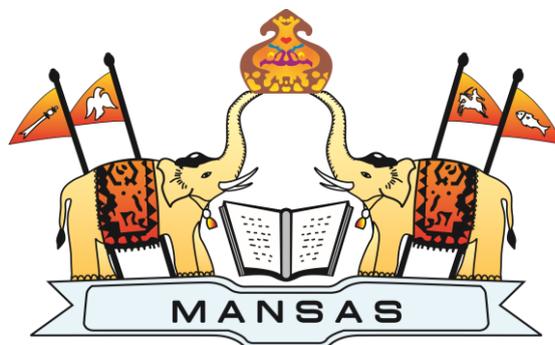


ACADEMIC REGULATIONS & CURRICULUM

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



ELECTRONICS AND COMMUNICATION ENGINEERING B. Tech. Program

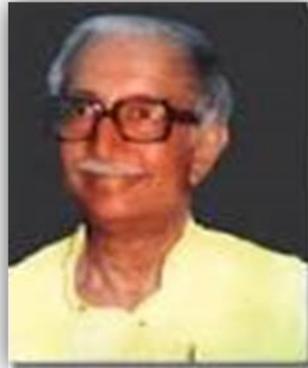


MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING (Autonomous)

(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

Academic Regulations (R24M) for B. Tech (Regular-Full time)

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

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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<p>EOEC-Extended Open Elective Cluster</p> <ul style="list-style-type: none"> 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, <p>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.</p> <ul style="list-style-type: none"> 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:

$$CA = \text{Final PA} + \text{TA}$$

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 arbitrate 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.,

$$SGPA = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

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

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

$$\text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i}$$

where " S_i " is the SGPA of the i^{th} 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 Discipline 1 (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 administered 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 university.

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. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> To keep the CC footage of the act as an evidence.

<p>2.b</p>	<p>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.</p> <p>(i) If the communication is with the person(s) who belongs to our college.</p> <p>(ii) If the communication is with the person(s) outside the campus or people who are not related to our college.</p>	<p>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.</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <ul style="list-style-type: none"> • 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.
<p>3.</p>	<p>If the candidate impersonates any other candidate in connection with the examination.</p>	<p>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.</p>

		<ul style="list-style-type: none"> • 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	<p>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.</p> <p>Also, if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally.</p>	<p>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.</p> <p>In addition to the above punishment, a committee shall be constituted and recommends appropriate punishment for the improper conduct.</p> <ul style="list-style-type: none"> • 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.	<p>Expulsion from the examination hall and cancellation of the performance in that subject only.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p>

		<p>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p> <ul style="list-style-type: none"> • 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.	<p>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.</p> <ul style="list-style-type: none"> • To Obtain a statement from Valuer / Chief Valuer authorized by Spot Coordinator and Controller of Examinations.

* * *

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 or 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 Criminal intimidation	 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 unnatural offence	 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 six consecutive academic years from the year of admission, shall forfeit their seat.

3. Minimum Academic Requirements

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

- i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the mid semester evaluation and end examination taken together.
- ii. A student shall be promoted from 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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R24-MVGR
COURSE STRUCTURE
ELECTRONICS AND COMMUNICATION ENGINEERING
B. TECH. (Regular/Honors) COURSE STRUCTURE
(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	R24MCIVT001	Environmental Studies	2	0	0	2
6	R24MENGT001	Language Proficiency	2	0	0	2
7	R24MSCSL001	Office Tools and Social Media Etiquette	0	0	3	2
8	R24MENGT002	Constitutional Values	2	0	0	2
9	R24MENGT004	Ethics and Human Values	2	0	0	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	R24MECET004	Basic Network Analysis	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	1	0	2	2
Total Credits						20

III Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MECET001	Internet of Things	3	0	0	3
2	R24MECET002	Electronic Devices and Circuits	3	0	0	3
3	R24MECET003	Digital Electronics	3	0	0	3
4	R24MECET005	Signals, Systems and Stochastic Processes	3	0	0	3
5	R24MCSCST001	Data Structures	3	0	0	3
6	R24MSCST011	Operating Systems	3	0	0	3
7	R24MECEL001	Electronic Devices and Circuits Lab	0	0	3	2
8	R24MECEL002	Digital Logic Design Lab	0	0	3	2
9	R24MCSCCL001	Data Structures Lab	0	0	3	2
Total Credits						24

IV Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MECET006	Analog and Digital Communications	3	0	0	3
2	R24MECET007	EM Waves and Transmission Lines	3	0	0	3
3	R24MECET008	Analog Circuits	3	0	0	3
4	R24MECET009	Digital Signal Processing	3	0	0	3
5	R24MCSCST003	Python Programming	3	0	0	3
6	R24MCSCST004	Database Management Systems	3	0	0	3
7	R24MECEL003	Analog and Digital Communications Lab	0	0	3	2
8	R24MECEL004	Digital Signal Processing Lab	0	0	3	2
9	R24MCSCCL002	Python Programming Lab	0	0	3	2
Total Credits						24

V Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MEEET004	Control Systems	3	0	0	3
2	R24MECET010	Microprocessors and Microcontrollers	3	0	0	3
3	R24MECET011	Digital VLSI design	3	0	0	3
4	R24MECET012	Digital Image and Video Processing	3	0	0	3
5	R24MECETXXX	DSC-E1	3	0	0	3
6	R24MCSCCT005	Software Engineering	3	0	0	3
7	R24MECEL005	Microprocessors and Microcontrollers Lab	0	0	3	2
8	R24MCSCCL003	Database Management Systems Lab	0	0	3	2
9	R24MECEP001	Community Project	0	0	2	2
Total Credits						24

VI Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MECET013	Embedded Systems	3	0	0	3
2	R24MECET014	Analog VLSI design	3	0	0	3
3	R24MECET015	Antennas and Microwave Engineering	3	0	0	3
4	R24MCSCCT006	OOP with JAVA	3	0	0	3
5	R24MECETXXX	DSC E2	3	0	0	3
6	R24MECETXXX	DSC E3	3	0	0	3
7	R24MECEL006	VLSI Lab	0	0	3	2
8	R24MCSCCL004	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	R24MECET016	Industry 4.0 and IIOT (Self Study /MOOCS)	3	0	0	3
2	R24MECETXXX	DSC E4 (Self-Study/MOOCS)	3	0	0	3
3	R24MECETXXX	DSC E5 (Self-Study/MOOCS)	3	0	0	3
4	R24MECEP002	Mini Project	0	0	2	2
5	R24MECEL007	PCB Design/ Electromagnetic Simulation/ Digital Design using System Verilog/ Machine Learning and Deep Learning/ Drone Technology/ Embedded Systems	0	0	3	2
						13

VIII Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R24MCSCCT007	Computer Networks	3	0	0	3
	R24MCSCCT008	Artificial Intelligence: Principles and Techniques	3	0	0	
	R24MCSCCT009	OOAD and Design Patterns	3	0	0	
2	R24MECEP003	Major-Dissertation/Academic Project-Major	0	0	5	8
Total Credits						11

B.Tech. (Regular) Total Credits: 160

DEPARTMENT ELECTIVE COURSES

Communication Systems

S. No.	Type of Course	Course Code	Course Title	Credits	Sem
1	DSC-E1	R24MECET020	Optical Communications	3	V
2	DSC-E2	R24MECET021	Cellular and mobile Communications	3	VI
3	DSC-E3	R24MECET022	Radar and Satellite Communication	3	VI
4	DSC-E4	R24MECET023	Wireless Adhoc and Sensor Networks	3	VII
5	DSC-E5	R24MECET024	MIMO Wireless Communications	3	VII

Signal Processing & Instrumentation

S. No.	Type of Course	Course Code	Course Title	Credits	Sem
1	DSC-E1	R24MECET025	Artificial Intelligence and Machine Learning	3	V
2	DSC-E2	R24MECET026	Speech and Audio Processing	3	VI
3	DSC-E3	R24MECET027	Bio Medical Instrumentation	3	VI
4	DSC-E4	R24MECET028	Deep Learning	3	VII
5	DSC-E5	R24MECET029	Biomedical Signal processing	3	VII

VLSI & Embedded Systems

S. No.	Type of Course	Course Code	Course Title	Credits	Sem
1	DSC-E1	R24MECET030	Computer Organization and Architecture	3	V
2	DSC-E2	R24MECET031	System On Chip	3	VI
3	DSC-E3	R24MECET032	VLSI Physical Design	3	VI
4	DSC-E4	R24MECET033	Testing and Testability	3	VII
5	DSC-E5	R24MECET034	VLSI Design Flow: RTL to GDS	3	VII

B. Tech. (Honors) – Electronics and Communication Engineering
 (Applicable from the Academic Year 2024-25 Onwards)
Communication Systems

S.No	Course Code	Course Title	Credits	Sem
1	R24MECEHT01	Information Theory and Coding	3	VI
2	R24MECEHT02	Modern Communication Systems	3	VI
3	R24MECEHT03	RF and Microwave design	3	VII
4	R24MECEHT04	GPS and Navigation systems	3	VII
5	R24MECEHT05	Software Defined Radio	3	VIII
6	R24MECEHT06	Satellite Internet Systems	3	VIII

Signal Processing & Instrumentation

S.No	Course Code	Course Title	Credits	Sem
1	R24MECEHT07	Advanced Digital Signal Processing	3	VI
2	R24MECEHT08	Transform Techniques	3	VI
3	R24MECEHT09	DSP Processors and Architectures	3	VII
4	R24MECEHT10	Soft Computing Techniques	3	VII
5	R24MECEHT11	RADAR Signal Processing	3	VIII
6	R24MECEHT12	Bio Medical Imaging	3	VIII

VLSI & Embedded Systems

S.No	Course Code	Course Title	Credits	Sem
1	R24MECEHT13	Real Time Operating Systems	3	VI
2	R24MECEHT14	Low Power VLSI design	3	VI
3	R24MECEHT15	Complex Programmable Logic Device and Field Programmable Gate Array	3	VII
4	R24MECEHT16	Application Specific Integrated Circuit Design	3	VII
5	R24MECEHT17	Scripting Languages	3	VIII
6	R24MECEHT18	UAV Design	3	VIII

EXTENDED OPEN ELECTIVE CLUSTER

R24

Computer Science Cluster(CSC) (for MEC, ECE, EEE, CIV and CHE) (Not 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	R24MCSCT001	Data Structures	III	EOEC-L1	R24MCSCCL001	Data Structures Lab	III
EOEC-T2	R24MCSCT002	Operating Systems	III	EOEC-L2	R24MCSCCL002	Python Programming Lab	IV
EOEC-T3	R24MCSCT003	Python Programming	IV	EOEC-L3	R24MCSCCL003	Database Management Systems Lab	V
EOEC-T4	R24MCSCT004	Database Management Systems	IV	EOEC-L4	R24MCSCCL004	OOP with JAVA Lab	VI
EOEC-T5	R24MCSCT005	Software Engineering	V				
EOEC-T6	R24MCSCT006	OOP with JAVA	VI				
EOEC-E1 Selfstudy/Moocs	R24MCSCT007	Computer Networks	VIII				
	R24MCSCT008	Artificial Intelligence: Principles and Techniques					
	R24MCSCT009	OOAD and Design Patterns					

**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	R24MBMCT003	Entrepreneurship	V				
EOEC-T6	R24MMECT018	Business Analysis	VI				
EOEC - E1 (Self-Study/MOOCs)	R24MBMCT004	Strategic Management	VIII				
	R24MBMCT005	Digital Marketing					
	R24MMECT017	Logistics and Supply Chain Management					

Interior Design Cluster (IDC)

Type of Course	Course code	Course Title	Sem	Type of Course	Course Code	Course Title	Sem
EOEC-T1	R24MIDCT001	Introduction to Interior Design	III	EOEC-L1	R24MIDCL001	Building planning using AutoCAD	III
EOEC-T2	R24MIDCT002	Building planning	III	EOEC-L2	R24MIDCL002	Free hand Perspective drawing	IV
EOEC-T3	R24MIDCT003	Furniture, Colours and Fittings	IV	EOEC-L3	R24MIDCL003	3D Modelling of interiors	V
EOEC-T4	R24MIDCT004	Materials for Interior Design	IV	EOEC-L4	R24MIDCL004	Design Studio Lab	VI
EOEC-T5	R24MIDCT005	Sustainable Materials and Green Buildings	V				
EOEC-T6	R24MIDCT006	Estimation, Costing and Tendering of Interior designs	VI				
EOEC-E1 (Self-study/ MOOCs)	R24MIDCT007	Contemporary aspects of interior design	VIII				
	R24MIDCT008	Soft furnishings	VIII				
	R24MIDCT009	Floriculture and Landscaping	VIII				

I Semester

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 <ul style="list-style-type: none"> • 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 - Ziegler – 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:		
<ol style="list-style-type: none"> 1. Jain and Jain, <i>Engineering Chemistry</i>, 17th ed. New Delhi, India: Dhanpat Rai Publications, 2015. 2. S.S. Dara, <i>Text Book of Engineering Chemistry</i>, 12th ed. New Delhi, India: S. Chand, 2006. 3. Y. Bharathi Kumari, <i>Text Book of Engineering Chemistry</i>, For JNTU R24 Hyderabad, India: VGS Publications, 2023 		
REFERENCE BOOKS:		
<ol style="list-style-type: none"> 1. T. F. Yen, <i>Chemistry for Engineers</i>, London, U.K.: Imperial College Press, 2008. 2. S. K. Chawla, <i>Engineering Chemistry</i>, 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						
	Total Contact Hours	42 (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 methods. (BL3)						
2	Make use of Linear Algebra techniques to find higher powers and inverse of Matrices. (BL3)						
3	Solve first order differential equations and make use of them to deal with real word problems like law of cooling, growth, and decay. (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 I	LINEAR ALGEBRA-1						8 hr
Rank; Consistency criteria; Non homogeneous systems; Homogeneous systems; Characteristic equation; Eigen values; Eigen vectors; Properties.							
Unit II	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 III	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 IV	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 V	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
C01	BL 3	x				
C02	BL 3		x			
C03	BL 3			x		
C04	BL 3				x	
C05	BL 3					x
C06	BL 6	x	x	x	x	x

R24MMATT002	MULTI VARIABLES AND VECTOR CALCULUS (Common to all branches)						
	Total Contact Hours	42 (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 for maxima and minima for functions of several variables. (BL6)						
2	Evaluate double and triple integrals of functions of several variables in two and three dimensions. (BL5)						
3	Interpret the physical meaning of different operators such as gradient, curl and divergence. (BL5)						
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 I							
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 II							
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 III							
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 IV							
VECTOR INTEGRATION						8 hr	
Line integral; Circulation; Work done; Surface integral; Volume integral; Green's theorem; Gauss divergence theorem; Stokes theorem (without proofs).							
Unit V							
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
C01	BL 6	x				
C02	BL 5		x			
C03	BL 5			x		
C04	BL 6				x	
C05	BL 3					x
C06	BL 6	x	x	x	x	x

R24MCHYL001	CHEMISTRY LAB (Common to All Branches)					
	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						
<ul style="list-style-type: none"> 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

- Determination of HCl using sodium carbonate.
- Determination of Strength of an acid in Pb-Acid battery.
- Determination of Iron (II) using potassium dichromate.
- Determination of Hardness of a groundwater sample.
- Determination of Dissolved oxygen in ground water sample.
- Potentiometric titration of Fe (II) with potassium dichromate.
- Conductometric titration of Strong acid VS Strong base.
- Conductometric titration of Weak acid VS strong base.
- pH metric titration of strong acid and strong base.
- Determination of percentage of Iron in Cement sample by colorimetry.

Additional Experiments

- Preparation of nanomaterials by precipitation method.
- Preparation of Bakelite.
- Determination of Cell constant of a conductivity cell.

Advanced Design Experiments

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

TEXTBOOKS

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

REFERENCE BOOKS:

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

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

REFERENCE BOOKS:
1. R. T. Wright and D. F. Boorse, <i>Environmental Science: Toward a Sustainable Future</i> , 13th ed. Boston, MA: Pearson, 2017.
2. United Nations Development Programme, <i>Climate Box. An interactive learning toolkit on climate change</i> . New York, NY, 2018.
3. J.K. Arora, B.K. Tyagi, K.S. Bath, R. Bal, and S.S. Ladhar, <i>Activity Book on Climate Change</i> . 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

R24MENGT001		LANGUAGE PROFICIENCY					
		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 and speaking, meeting the requirement of the concept of constructive presentation. (BL 3)						
5	Demonstrate understanding of the nuances in group communication. (BL3)						
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 hr
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 hr
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.						5 hr
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.						5 hr
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.						5 hr
REFERENCE BOOKS:							
1	Seely, John. <i>Oxford guide to effective Writing and Speaking</i> . Oxford Press. 2022.						
2.	Atkins, Ros. <i>The art of explanation</i> . 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

R24MSCSL001	OFFICE TOOLS & SOCIAL MEDIA ETIQUETTE						
	Total Contact Hours	42 (P)	L	T	P	C	
	Pre-requisite	-	0	0	3	2	
Course Objective							
<ul style="list-style-type: none"> 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/						

R24MENGT002	CONSTITUTIONAL VALUES						
	Total Contact Hours	28(L)	L	T	P	C	
	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 hr
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 hr
Unit III	Right to freedom of Religion (Articles 25-28); Cultural and educational Rights (Articles 29-30).						5 hr
Unit IV	Right to Life and personal liberty (Article 21); Right to constitutional remedies (Article 32).						5 hr
Unit V	Role of Judiciary and other institutions in the protection of Fundamental Rights; Case Studies.						5 hr
LEARNING RESOURCES							
REFERENCE BOOK:							
1	Durga Das Basu, et al., <i>Introduction to the Constitution of India</i> , 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

R24MENGT004	ETHICS AND HUMAN VALUES					
	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 hr
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 hr
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.						
Unit III	ETHICAL THEORIES					5 hr
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					5 hr
Engineering ethics - Social Experimentation; Safety Responsibility and Rights: Engineers as responsible Experimenters, 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 CONTEXTS					5 hr
Ethics and Global Contexts: Environmental ethics; computer ethics; Business Ethics; Corporate Social responsibility; Code of ethics.						
<u>LEARNING RESOURCES</u>						
TEXTBOOKS:						
1	R R Gaur, R Sangal, G P Bagaria, "A Foundation Course in Human Values					

	<i>and Professional Ethics</i> " Excel Books, New Delhi, 2010.
REFERENCE BOOKS:	
1	A.N. Tripathi, " <i>Human Values</i> ", 2nd Ed, New Age Int. Publishers, 2004.
2	Charles D. Fleddermann, " <i>Engineering Ethics</i> ", 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

II Semester

		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 hr
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 hr
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; Clausius-Mossotti relation in dielectrics;						
Unit III	WAVE OPTICS					8 hr
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- Brewster's law; Double refraction; Quarter and Half wave plates						
Unit IV	PHOTONICS					8 hr
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 hr
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, <i>Engineering Physics</i> , Second edition. Cengage Learning, 2021.	
2	M. N. Avadhanulu, P.G.Kshirsagar and TVS Arun Murthy, <i>A Text book of Engineering Physics</i> , Eleventh edition. S.Chand Publications, 2019.	
REFERENCE BOOKS:		
1	Hitendra K. Malik and A.K. Singh, <i>Engineering Physics</i> , Second edition. Mc. Graw Hill Publishers, 2017.	
2	M.R. Srinivasan, <i>Engineering Physics</i> , Second edition. New Age International Publishers, 2021.	
3	Shatendra Sharma and Jyotsna Sharma, <i>Engineering Physics</i> , 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 I	Unit II	Unit III	Unit IV	Unit V
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	42 (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.							
<u>LEARNING RESOURCES</u>							
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
C01	BL 5	x				
C02	BL 3		x			
C03	BL 3			x		
C04	BL 3				x	
C05	BL 5					x
C06	BL 6	x	x	x	x	x

R24MECET004	BASIC NETWORK ANALYSIS					
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisite	NIL	3	1	0	3
Course Objective						
To equip the students with a comprehensive understanding of electrical circuit analysis, including fundamental circuit elements, advanced network theorems, resonance phenomena, transient analysis, Laplace transforms, and two-port network parameters, enabling them to analyze, design, and optimize complex electrical circuits.						
Course Outcomes						
At the end of this course students will demonstrate the ability to						
1	Apply Kirchhoff's laws, mesh, nodal analysis and circuit reduction techniques to solve basic electrical circuits. (BL3)					
2	Analyze and solve AC, DC circuits to determine various power metrics using mesh, nodal analysis techniques and network theorems. (BL4)					
3	Analyze two-port networks using Z, Y, ABCD, and h parameters, and determine their interrelationships and interconnections. (BL4)					
4	Evaluate coupled and resonance circuits for bandwidth and quality factor, and assess transient responses of R-L, R-C, and R-L-C circuits using Laplace transforms. (BL5)					
5	Evaluate complex AC, DC circuits using network analysis concepts and justify the choice of methods based on circuit requirements. (BL5)					
6	Design and synthesis electrical circuits by integrating basic network analysis concepts, demonstrating the ability to develop complex circuit solutions. (BL6)					
SYLLABUS						
Unit I	BASIC ELECTRICAL CIRCUITS AND AC POWER ANALYSIS					8 hr
CG1: Introduction to circuit elements –Kirchhoff Laws, Mesh Analysis; Nodal Analysis; Super mesh analysis, Super Nodal Analysis; Star-Delta Conversion. CG2: Introduction to AC, Problem Solving using Mesh and Nodal Analysis; AC Power analysis: Instantaneous Power, Average Power, Apparent Power, Power Factor; Duals and duality.						
Unit II	NETWORK THEOREMS					8 hr
CG1: Superposition; Thevenin's theorem; Norton's theorem; Maximum Power Transfer; CG2: Tellegen's theorem; Milliman's theorem; Reciprocity theorem; Compensation and Substitution theorems.						
Unit III	RESONANCE AND COUPLED CIRCUITS					8 hr
CG1: Introduction, Series resonance; Parallel resonance; Bandwidth of series and parallel resonance; Quality factor of series and parallel resonance; CG2: Self-inductance, Mutual inductance; Coefficient of coupling, Dot convention; analysis of coupled circuits; Ideal Transformer; conductively coupled equivalent circuits.						
Unit IV	TRANSIENTS					8 hr
CG1: Steady state and Transient response, DC Response of R-L and R-C circuits; Sinusoidal Response of R-L and R-C circuits; R-L-C with DC excitation; R-L-C elements with AC excitation; CG2: Overview of Laplace Transforms, Circuit elements in S-Domain; R-L, R-C and R-L-C circuits response for DC and AC excitations in Laplace approach.						

Unit V	TWO-PORT NETWORKS	8 hrs
CG1: Introduction to two port networks; Open circuit Impedance (Z) parameters; Short circuit Admittance (Y) parameters; Transmission (ABCD) parameters; Hybrid (h) parameters; CG2: Inter-relationships of different parameters; Inter-connection of two-port networks; T and π Representations;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.	
2	Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020.	
REFERENCE BOOKS:		
1	D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013.	
2	Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017	
3	Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku, McGraw-Hill Education.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.nesoacademy.org/ee/01-network-theory	
2	https://www.electrical4u.com/electrical-engineering-articles/circuit-theory/	
ONLINE COURSES		
1	https://nptel.ac.in/courses/108105159	
2	https://onlinecourses.nptel.ac.in/noc22_ee07/preview	
3	https://nptel.ac.in/courses/106105154	

Bloom's level - Units catchment articulation matrix

CO	BloomsL evel	UnitI	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X	X			
CO2	BL4		X	X	X	
CO3	BL4	X	X	X	X	X
CO4	BL5	X	X	X	X	
CO5	BL5					X
CO6	BL6		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, pseudocode; 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, typecasting.							
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; Unconditional 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 filemodes, Formatted I/O; File handling functions; fopen(), fclose(),fscanf(), fprintf(); Random access file shandling 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, <i>The C programming Language</i> , Second Edition, Pearson, 2015.	
2	Pradip Dey, Manas Ghosh, <i>Programming In C</i> , 2 nd Edition, Oxford Higher Education, 2011.	
REFERENCE BOOKS:		
1	Dr Reema Thareja, <i>Programming in C</i> , Third Edition, Oxford Press, 2023.	
2	Byron Gottfried, <i>Programming with C</i> , Third Edition. Schaums Outlines Series,2017.	
3	Ajay Mittal, <i>Programming in C - A Practical Approach</i> , Pearson, 2010.	
ONLINE COURSES		
1	https://mvqrce.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 & Involutés					
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	Modelling of complex 3D geometries and their conversion to orthographic views					
LEARNING RESOURCES						
TEXT BOOKS:						
1	N. D. Bhatt, <i>Engineering Drawing</i> , Charotar Publishing House, 2016.					
2	Dhananjay Jolhe, <i>Engineering Drawing with an Introduction to AutoCAD</i> , Tata McGraw Hill, 2017					

REFERENCE BOOKS:

- | | |
|---|--|
| 1 | K.L. Narayana and P. Kannaiah, <i>Engineering Drawing</i> , Tata McGraw Hill, Third Edition, 2013. |
| 2 | M.B.Shah and B.C. Rana, <i>Engineering Drawing</i> , Pearson Education Inc.,2009. |

ADDITIONAL REFERENCE MATERIAL

- | | |
|---|---|
| 1 | https://nitc.ac.in/imgserver/uploads/attachments/Ed__5c3343c5-c3f9-468a-b114-8f33556810b4_.pdf |
|---|---|

R24MPHYL001	PHYSICS LAB					
	Total Contact Hours	28(L)	L	T	P	C
	Pre-requisite	Higher Secondary School Physics	0	0	2	1
Course objectives						
<ul style="list-style-type: none"> • 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 reconnoitre 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, <i>A Textbook of Engineering Physics Practical</i> , First edition. Laxmi Publications Pvt. Ltd., 2016.
REFERENCE BOOK:	
1	S. Balasubramanian and M.N. Srinivasan, <i>A Textbook of Practical Physics</i> , First edition. S. Chand Publishers, 2017
ADDITIONAL REFERENCE:	
1	www.vlab.co.in

R24MSCSL002	PROCEDURAL PROGRAMMING LAB					
	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 <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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 Fahrenheit and vice versa 3. Write a C Program to to calculate simple and compound interest 					
3	Week 3: Selection Statements <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 1. Write a C program to print a pyramid patterns using nested loops. 					

	<ol style="list-style-type: none"> 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	<p>Week 6: Arrays</p> <ol style="list-style-type: none"> 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	<p>Week-7: String Handling</p> <ol style="list-style-type: none"> 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	<p>Week-8: Functions</p> <ol style="list-style-type: none"> 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	<p>Week-9: Recursive Functions</p> <ol style="list-style-type: none"> 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	<p>Week-10: Pointers & Dynamic Memory Allocation</p> <ol style="list-style-type: none"> 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	<p>Week-11: Structures & Unions</p> <ol style="list-style-type: none"> 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	<p>Week-12: File Handling</p> <ol style="list-style-type: none"> 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, <i>The C programming Language</i> , Prentice Hall.
2	Pradip Dey, Manas Ghosh, <i>Programming In C</i> , Oxford Higher Education.
REFERENCE BOOKS:	
1	Dr Reema Thareja, <i>Programming in C</i> , Third Edition, Oxford Press
2	Byron Gottfried, <i>Programming with C</i> , Schaums Outlines Series, Third Edition.
3	Ajay Mittal, <i>Programming in C - A Practical Approach</i> , Pearson
ONLINE COURSES	
1	https://www.tutorialspoint.com/learn_c_by_examples

R24MENGT003	HEALTH AND WELLNESS					
	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 hr
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, <i>Yoga The Path to Holistic: The Definitive Step-by-step Guide</i> , DK Publishers, 2021.					
2	C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian, <i>Nutritive value of Indian foods (NVIF)</i> , National Institute of Nutrition, India, 2023.					
3	ICMR-National Institute of Nutrition, <i>Short summary report of nutrient</i>					

	<i>requirements for Indians, 2020.</i>
4	Emily Attached & Marzia Fernandez, <i>Mental Health Workbook, 2021.</i>
REFERENCE BOOKS:	
1	C. Nyambichu & Jeff Lumiri, <i>Lifestyle Diseases: Lifestyle Disease Management, 2018.</i>
2	Nashay Lorick, <i>Mental Health Workbook for Women: Exercises to Transform Negative Thoughts and Improve Well-Being, 2022.</i>
3	Angela Clow & Sarah Edmunds, <i>Physical Activity and Mental Health, 2013.</i>
ADDITIONAL REFERENCE MATERIAL	
1	B.K.S. Iyengar, <i>Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority, 2006.</i>
2	Claude Bouchard, Steven N. Blair, William L. Haskell, <i>Physical Activity and Health, Human Kinetics, 2012.</i>
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	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X

R24MMECW001	ENGINEERING WORKSHOP					
	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, <i>Mechanical workshop practice</i> , second edition, PHI learning, 2010.
2	Bruce J. Black, <i>Workshop Processes, Practices and Materials</i> , Routledge publishers, 5th Edn. 2015.
3	B.S. Raghuwanshi, <i>A Course in Workshop Technology Vol I. & II</i> , , Dhanpath Rai & Co., 2015 & 2017.
REFERENCE BOOKS:	
1	S. K. Hajra Choudhury, Hajra Choudhury, A K, Roy, Nirjhar, Bhattacharya, S C. <i>Elements of Workshop Technology, Vol. I</i> , 14th edition, Media Promoters and Publishers, Mumbai. 2007.
2	H. S. Bawa, <i>Workshop Practice</i> , Tata-McGraw Hill, 2004.
3	Soni P.M. & Upadhyay P.A, <i>Wiring Estimating, Costing and Contracting</i> ; 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/

III Semester

R24MECET001	INTERNET OF THINGS					
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisite	Procedural Programming	3	0	0	3
Course Objectives: The student will be able to						
<ol style="list-style-type: none"> To provide a comprehensive understanding of the fundamental concepts of IoT and to familiarize students with the enabling technologies of IoT. To equip students with detailed knowledge of various IoT communication protocols, and to develop the ability to select appropriate protocols for specific IoT applications. To introduce students to various IoT prototyping boards and to develop skills in programming IoT systems using relevant tools and libraries. To familiarize students with the concepts of various IoT cloud platforms and storage models, enabling students to make decisions regarding cloud services for IoT deployments. To develop students' understanding of data analytics and security services in IoT. 						
Course Outcomes						
After going through this course, the student will be able to						
1	Apply the basic concepts and principles of IoT to identify and describe various IoT components and architectures in practical scenarios.(BL3)					
2	Analyze different IoT communication protocols and use cases to determine the most suitable protocol for specific IoT applications.(BL4)					
3	Examine and differentiate between various IoT prototyping boards and communication modules for IoT project development.(BL4)					
4	Evaluate different IoT cloud platforms and storage models to make decisions on cloud services for IoT deployments.(BL5)					
5	Assess the methods of IoT data analytics and security protocols in IoT cloud platforms and systems.(BL5)					
6	Design and develop an end-to-end IoT solution that integrates knowledge from all units to address a real-world problem or opportunity.(BL6)					
SYLLABUS						
Unit I	INTRODUCTION TO IOT					8 hr
Competency Group1:						
IoT – Definition, advantages and disadvantages, history/evolution; Characteristics of IoT and enabling technologies of IoT; IoT Architecture, Physical Design – Things/modules in IoT and IoT protocol suite; Logic Design of IoT – Functional blocks of IoT, Communication models of IoT; IoT levels and deployment templates, Architecture of IoT – 3 layered and 5 layered architectures.						
Competency Group2:						
Domain Specific application of IoT: Home Automation, Smart cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style. Basics of networking - Internet Principles – Types of networks, IP Addresses, MAC Address; TCP and UDP ports, Application Layer Protocols.						
Unit II	IOT PROTOCOL SUITE					8 hr
Competency Group1:						
M2M – Introduction, network/gateway, characteristics, Differences between IoT and M2M; CoAP - Introduction, key features and architecture, Message types and						

messaging models;MQTT - Introduction, architecture, terminology and structure of control packet.		
Competency Group2:		
AMQP – Introduction, Architecture and types of message exchanges; 6LoWPAN – Introduction, network, working and security; Ethernet – Introduction, standards and frame; Wi-Fi – Introduction, standards, security, advantages and disadvantages; IEEE 802.15.4 LRWPAN – Introduction, key features, node types and network types.		
Unit III	PROTOTYPING AND PROGRAMMING	8 hr
Competency Group1:		
Prototyping boards – Arduino UNO R3, ESP8266 NodeMCU; Raspberry Pi, Communication techniques and modules- UART, SPI, I2C; ESP-01 Wi-Fi module, HC-05 Bluetooth module; Zigbee – Introduction, Types of networks; LoRA – Introduction, LoRA WAN, applications and advantages.		
Competency Group2:		
Programming Internet of Things Systems - Introduction to IDE, Sketch, Basic Functions- Digital and analog I/O; Libraries and Functions – Liquid crystal, Servo, Stepper, Software serial, Wi-Fi, Wire, SPI and other libraries used in IoT; Programming of sensors.		
Unit IV	IOT PHYSICAL SERVERS AND CLOUD PLATFORMS	8 hr
Competency Group1:		
Introduction to Cloud storage models and API – Definition, communication APIs in IoT (REST & WebSocket); Fog & Edge computing and differences between them; Advantages and key features of cloud platforms; Selection criteria and application domain of IoT cloud platforms.		
Competency Group2:		
IoT cloud storage – Introduction, advantages and disadvantages; IoT cloud platforms - ThingSpeak, Thingworx, IBM Watson, Microsoft Azure, Amazon AWS IoT core, Google cloud IoT; Case Study over Cloud Services and Administration; Android IoT Apps - Blynk, ThingSpeak, MQTT.		
Unit V	DATA AND ANALYTICS FOR IOT	8 hrs
Competency Group1:		
Introduction to data analytics for IoT, IoT Data analytics- overview, Challenges; Machine Learning in IoT, Predictive Analysis; Big data analytics tools and technology; Edge streaming Analytics, Distributed Analytics system; Network Analytics.		
Competency Group2:		
IoT Security - Common challenges in OT Security; Phased application security in operational Environments, OT Network Characteristics Impacting Security.		
<u>LEARNING RESOURCES</u>		
TEXTBOOKS:		
1	"Internet of Things: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti.	
2	"Designing the Internet of Things", Adrian McEwen, Hakim Cassimally 1stEdition, John Wiley, 2014	
3	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro.	

REFERENCE BOOKS:	
1	"Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and editors.
2	"Practical IoT Projects with LoRa, NodeMCU and ESP8266" by Agus Kurniawan.
3	"Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini.
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc24_cs115/preview
2	https://onlinecourses.swayam2.ac.in/ntr24_ed44/preview
3	Coursera and edX: Platforms offering courses on IoT, networking, and related topics from universities and institutions worldwide.

Bloom's level – Units catchment articulation matrix						
CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL3	X	X			
CO2	BL4		X	X		
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

R24MECET002	ELECTRONIC DEVICES AND CIRCUITS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Physics	3	0	0	3
Course Objective						
Students will gain understanding of various electronic devices and circuits						
Course Outcomes: The students will be able to						
1	Choose a diode for the specific application. (BL4)					
2	Assess transistors as electronic switches for high power and low power applications. (BL5)					
3	Analyze parameters to solve multi-port systems and transistor circuit analysis using the hybrid model. (BL4)					
4	Design a multistage amplifier with the given specification by using BJT and FET. (BL6)					
5	Select different feedback amplifiers and oscillators based on their application. (BL5)					
6	Design Analog electronic circuits using the concepts of electronic devices and circuits (BL6)					
SYLLABUS						
Unit 1	DIODES AND APPLICATIONS					8 hr
Competency Group1: Formation of PN junction diode, Open circuited PN Junction, Energy Band Diagram of PN Diode; Forward and Reverse Bias, Current components in PN Diode; Diode Equation explanation, V-I Characteristics, Temperature Dependence on V-I characteristics; Diode Resistance (Static and Dynamic), Diode Capacitance.						
Competency Group2: Zener Diode, Avalanche and Zener breakdown, Zener diode as voltage regulator; Half wave rectifier, Full wave rectifier (Center tapped and Bridge); Inductor filter, Capacitor filter; LC filter and π -section filter.						
Unit 2	BIPOLAR JUNCTION TRANSISTOR, BIASING & STABILIZATION					8 hr
Competency Group1: Construction and operation; Transistor as a switch and as an Amplifier; Transistor CB, CE, CC configurations; Transistor load line analysis and Operating point.						
Competency Group2: Biasing and bias stability; Transistor biasing methods; Bias compensation; Thermal runaway and thermal stability.						
Unit 3	SMALL SIGNAL ANALYSIS OF TRANSISTOR AMPLIFIERS					8 hr
Competency Group1: Two port devices and transistor hybrid model; Determination of h-parameters from characteristics, measurement of h-parameters; conversion formulae for the parameters of three transistor configurations; Analysis of a transistor amplifier circuit using h- parameters.						
Competency Group2: Comparison of transistor amplifier configurations; Generalized approximate hybrid model; and analysis of CE, CC amplifiers; hybrid- π model of a BJT.						
Unit 4	INTRODUCTION TO FET & MULTISTAGE AMPLIFIERS					8 hr
Competency Group1: Construction and operation of Junction Field Effect Transistor; JFET volt-ampere characteristics, FET parameters, Expression of saturation drain current; Biasing of FET, small signal Analysis of common source amplifier; Small signal Analysis of						

common gate and common drain amplifier.	
Competency Group2: Different coupling schemes used in amplifiers; General analysis of Two stage RC coupled amplifier using BJT; General analysis of Two stage RC coupled FET amplifiers; CE-CB cascode amplifier.	
Unit 5	FEEDBACK AMPLIFIERS, OSCILLATORS 8 hr
Competency Group1: Feedback concept, transfer gain with feedback, general characteristics of negative feedback amplifiers, Types of negative feedback- voltage series feedback amplifier; voltage shunt feedback amplifier; current series feedback amplifiers; and current shunt feedback amplifier.	
Competency Group2: Condition for oscillations; RC-phase shift oscillator; Wien bridge oscillator, Hartley oscillator; and Colpitts oscillators, Crystal oscillators.	
LEARNING RESOURCES	
TEXT BOOKS:	
1	Integrated Electronics – Jacob Millman, C. Halkias, C.D.Parikh , Tata Mc-Graw Hill, Second Edition, 2011.
2	Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition
3	Adel. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits," 6th Edition, Oxford University Press, 2011
REFERENCE BOOKS:	
1	<i>Electronic Devices and Circuits-</i> S Salivahanan, N Suresh Kumar, Tata Mc-Graw Hill, Third Edition, 2012.
2	<i>Electronic Devices and Circuit Theory-</i> R.L. Boylestad and LouisNashelsky, Pearson Publications, Tenth Edition.
3	K.Lal Kishore, " <i>Electronic Circuit Analysis</i> ", 2 nd Ed, B S Publications, 2008
ADDITIONAL REFERENCE MATERIAL	
1	<u>Electronic Devices and Circuits Lecture Notes and Study Material PDF - BTech Geeks</u>
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc20_ee77/preview
2	https://onlinecourses.nptel.ac.in/noc24_ee127/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	BL5		X			
CO3	BL4			X		
CO4	BL6				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET003	DIGITAL ELECTRONICS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	NIL	3	0	0	3
Course Objective						
To enable students, acquire a comprehensive understanding of digital logic design, encompassing essential areas such as binary arithmetic, the minimization of Boolean algebra expressions, the design of combinational logic circuits, and the intricacies of sequential logic circuit design.						
Course Outcomes						
At the end of this course students will have the ability to						
1	Apply number systems, binary codes, and binary arithmetic to perform conversions and arithmetic operations. (BL3)					
2	Analyze and simplify Boolean functions using Boolean algebra, K-maps and Quine-McCluskey methods for efficient circuit design. (BL4)					
3	Analyze and design combinational circuits and implement switching functions using PROM, PLA, and PAL structures. (BL4)					
4	Appraise and distinguish combinational circuits and sequential circuits. (BL5)					
5	Evaluate the functionality and performance of sequential circuits like flip-flops, registers, counters and state machines. (BL5)					
6	Design and develop advanced digital systems using combinational and sequential circuits. (BL6)					
SYLLABUS						
Unit I	NUMBER SYSTEMS AND BINARY CODES					8 hr
Competency Group 1: Number systems, Conversions: Non-decimal to decimal and Vice-Versa; r's complement and r-1's complement, Signed number and Unsigned number representations; Binary addition/Subtraction, Binary Multiplication.						
Competency Group 2: Binary Codes: Weighted and non-weighted codes, Self complementing/Reflection codes; Floating Point Representation; Error Detection and Correction Codes, Hamming code.						
Unit II	BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES					8 hr
Competency Group 1: Basic Gates, Truth tables; Basic gates realization using Universal Gates; Basic Boolean Functions and properties, Huntington's postulates, Duality and Complement; Standard/ Canonical and Reduced Forms – SOP, POS; Minimization and Realization using Basic Boolean functions						
Competency Group 2: Boolean Function Minimization using Karnaugh - Maps (3,4,5 Variables) given Max terms and Min terms; K-Maps Minimization with don't care condition; Quine-McCluskey or Tabulation method						
Unit III	COMBINATIONAL CIRCUITS					8 hr
Competency Group 1: Design procedures, Adders, Subtractors; Binary parallel adder (Ripple Adders), Binary Adder-Subtractor, Carry Look-Ahead Adder, BCD Adder; Code Converters; Magnitude Comparator;						
Competency Group 2: Decoders, & implementing Boolean functions using decoders, 7-Segment Display Decoder; Encoders & Priority Encoders; Multiplexers, & implementing Boolean functions using multiplexers; De-Multiplexers; Design of Higher Order Circuits with						

lower Order circuits;		
Unit IV	FLIPFLOPS AND REGISTERS	8 hr
Competency Group 1: Definition and classification of sequential circuits; Latches; Difference between Level Triggering and Edge-Triggering, Positive-edge and Negative-edge; Basic flip-flops: SR- flip-flops, D-flip-flop, JK-flip-flops, T-flip-flop, Master-Slave flip-flop, flip-flop characteristic tables, flip-flop excitation tables, Flipflop Conversions.		
Competency Group 2: Registers: Shift registers; Control Buffer Registers; Universal Shift Register		
Unit V	COUNTERS, STATE MACHINES AND PLDS	8 hrs
Competency Group 1: Ripple counters: Up Counter, Down Counter, Up/Down Counter, MOD counter; Synchronous Counters Up Counter, Down Counter, Up/Down Counter, Design of Counters with unused states (MOD counter); Ring Counter & Johnson Counter; State Table, State Diagrams and State Minimization Techniques; Finite State Machines: Mealey and Moore Machines;		
Competency Group 2: PROM, PLA, PAL-basic structures, Realization of switching functions using PROM, PLA and PAL		
<u>LEARNING RESOURCES</u>		
TEXTBOOKS:		
1	Digital Design, 4th Edition, Morris Mano, Michael D. Ciletti, Pearson	
2	Fundamentals of Logic Design, 5 th Edition, Roth, Cengage.	
REFERENCE BOOKS:		
1	Switching and Finite Automata Theory, 3rd Edition, Kohavi, Jha, Cambridge	
2	Switching and Finite Automata Theory, 3rd Edition, Kohavi, Jha, Cambridge	
3	Digital Electronics by G.K. Kharte, Oxford University Press	
4	Switching Theory and Logic Design by A. Anand Kumar, PHI, 2 nd Edition	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/	
2	https://byjus.com/physics/digital-electronics/	
3	https://www.javatpoint.com/digital-electronics	
4	https://www.electrical4u.com/electrical-engineering-articles/digital-electronics/	
5	https://www.tutorialspoint.com/digital_circuits/index.htm	
6.	https://youtube.com/playlist?list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm&si=I9Stu13KZnxZZDmp	
ONLINE COURSES		
1	https://onlinecourses.swayam2.ac.in/nou24_ec07/preview	
2	https://nptel.ac.in/courses/108105132	
3	https://onlinecourses.nptel.ac.in/noc22_ee55/preview	

Bloom's level - Units catchment articulation matrix

CO	BloomsL	UnitI	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X				
CO2	BL4		X	X	X	X
CO3	BL4			X		X
CO4	BL5			X	X	X
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

R24MECET005	SIGNALS , SYSTEMS AND STOCHASTIC PROCESSES					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Mathematics	3	0	0	3
Course Objective						
This course helps the students to grasp the basics of signals, systems and random process which are the basis for understanding all communication courses like analog & digital communications etc. It enables the students to analyse different LTI systems in the presence of noise sources.						
Course Outcomes						
After completing this course, the students will be able to						
1	Apply various operations on signals and analyze various signals using Fourier series and Fourier transform. (BL4)					
2	Choose the right sampling frequency for sampling of signals and explain the properties of LTI systems, concepts of bandwidth, convolution and correlation. (BL5)					
3	Evaluate the spectral density functions and analyse LTI system stability with the help of Laplace transform. (BL5)					
4	Classify random variables, explain different standard distribution and density functions and apply different operations on random variable. (BL3)					
5	Explain the concepts random processes, stationarity, noise temperature and evaluate the performance of linear systems in terms of figure of merit. (BL5)					
6	Adapt the concepts of signals, systems and random processes to analyse LTI systems and to establish proper communication between source and destination. (BL6)					
SYLLABUS						
Unit I	SIGNALS, FOURIER SERIES AND FOURIER TRANSFORM					8 hr
Competency Group 1: Classification of signals, Elementary signals; Basic operations on signals; Signal approximation using orthogonal functions, Fourier series- Trigonometric Fourier series; Exponential Fourier series, Fourier spectrum;						
Competency Group 2: Deriving Fourier transform from Fourier series, F.T of standard signals- Single sided real exponential, impulse signal; Gate pulse, Constant amplitude, Signum & Unit step signal; FT of Sinusoidal signal, periodic signals, properties of Fourier transforms;						
Unit II	SAMPLING THEOREM AND LTI SYSTEMS					8 hr
Competency Group 1: Sampling theorem, graphical and analytical proof for Band Limited Signals, Aliasing effect Types of sampling: impulse sampling, Natural sampling and flat top sampling, Introduction to band pass sampling theorem; Classification of systems, Linear time invariant (LTI) system, Impulse response; Response of an LTI system, Properties of LTI systems- causality, stability;						
Competency Group 2: Transfer function of an LTI system, Causal LTI systems described by differential equations, Distortion less transmission through a system; Ideal and non-ideal filters, Signal bandwidth, System bandwidth; Convolution of signals & Properties of convolution, problems; Cross correlation, Auto correlation of signals and properties.						

Unit III	SPECTRAL DENSITY FUNCTIONS AND LAPLACE TRANSFORM	8 hr
<p>Competency Group 1: Parseval's theorem, Energy density spectrum & Power density spectrum; Relation between auto correlation function and energy density function/power spectral density function, detection of periodic signals in the presence of noise by correlation & auto correlation methods. Definition of Laplace transform, Relation between L.T and F.T. of a signal, problems; Concept of region of convergence (ROC) and properties of ROC.</p> <p>Competency Group 2: Properties of Laplace transform; Inverse Laplace transform, analysis of LTI system using L.T(causality & stability); L.T of commonly used signals;</p>		
Unit IV	RANDOM VARIABLE AND OPERATIONS ON RANDOM VARIABLE	8 hr
<p>Competency Group 1: Definition of a Random Variable, Types of Random variables, Distribution and Density functions and Properties; standard distribution & density functions: Gaussian, Rayleigh, Uniform, Exponential, Binomial, Poisson density functions;</p> <p>Competency Group 2: Mathematical expectation, properties of expectation, Moments; Variance and Skew, properties of variance; Characteristic Function, Moment Generating Function; Joint distribution and density functions.</p>		
Unit V	RANDOM PROCESS AND NOISE	8 hrs
<p>Competency Group 1: Concept of random process, classification of random processes, statistical properties of random process; Concept of Stationary process-first order, second order, Wide Sense Stationarity; power density spectrum of random process and its properties; Cross-Power Density Spectrum and properties.</p> <p>Competency Group 2: Classification of Noise, White Noise, band limited white Noise; Resistor Noise voltage, Noise spectral density, Equivalent Noise temperature; Signal to Noise ratio, equivalent Noise bandwidth, Noise Figure; Noise in cascaded amplifiers, overall noise figure.</p>		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Signals, Systems & Communications - B.P. Lathi, BS Publications, 3rd edition, 2009.	
2	Signals and Systems - A.V. Oppenheim, A.S. Willsky, S.H. Nawab, PHI, 2 nd Ed, 2011.	
3	Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, TMH, 4 th Edition, 2002.	
REFERENCE BOOKS:		
1	Signals & Systems - Simon Haykin and Van Veen, Wiley, 2 nd edition, 2008.	
2	Signals & Systems – P. Ramakrishna Rao, Shankar Prakriya, McGraw Hill Education, 2 nd edition, 2013	
2	Signals & Systems – A. Anand Kumar, PHI, 2nd edition, 2013.	
3	Probability theory and stochastic process, Y. Mallikarjuna Reddy, Universities Press, 4 th edition. 2013.	
4	Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI, 2002	

ADDITIONAL REFERENCE MATERIAL

1	https://nptel.ac.in/courses/117/101/117101055/
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ONLINE COURSES

1	https://nptel.ac.in/courses/108/106/108106163
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2	https://nptel.ac.in/courses/108/104/108104100/
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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	BL5			X		
CO4	BL3				X	
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

R24MCSCCT001	DATA STRUCTURES					
	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.					
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, <i>Data Structures and algorithm analysis in C</i> , Pearson, 2nd Edition.
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, <i>Fundamentals of data structures in C</i> , Silicon Press, 2008.
3	Richard F, Gilberg , Forouzan, Cengage, <i>Data Structures</i> , 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'slevel - Unitscatchmentarticulationmatrix

CO	Blooms Level	UnitI	UnitII	Unit III	Unit IV	UnitV
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

R24MSCST011 (EOEC-T2)	OPERATING SYSTEMS (Common to all Branches)					
	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.		
<u>LEARNING RESOURCES</u>		
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	"LinuxKernelDevelopment"byRobertLove.	
3	"FileSystemForensicAnalysis"byBrianCarrier.	
ONLINE COURSES		

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

R24MECEL001	ELECTRONIC DEVICES AND CIRCUITS LAB					
	Total Contact Hours	42 (P)	L	T	P	C
	Pre-requisite	Physics	0	0	3	2
Course Objective						
The objective of this laboratory is to understand the concepts, working and characteristics of Different BJT and FET Transistors, amplifiers and oscillators.						
Course Outcomes: Students have the ability to						
1	Describe the operation and characteristics of PN diode, Zener Diode, BJT and FET.					
2	Analyze the frequency response of single and multistage amplifiers					
3	Analyze the frequency response of FET amplifier in CS and CD configurations					
4	Analyze the feedback amplifiers					
5	Design RC & LC oscillators					
List of Experiments (Minimum of Ten Experiments have to be performed)						
1	PN junction Diode Characteristics					
2	Zener Diode Characteristics					
3	Half wave Rectifiers (without and with filter)					
4	Full wave Rectifiers (without and with filter)					
5	Transistor CB Characteristics					
6	Transistor CE Characteristics					
7	FET Characteristics					
8	CE Amplifier					
9	CC Amplifier (Voltage series feedback amplifier)					
10	FET -CS Amplifier					
11	FET -CD Amplifier					
12	RC-phase shift Oscillator					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Integrated Electronics – Jacob Millman, C. Halkias, C.D.Parikh , Tata Mc-Graw Hill, Second Edition, 2011.					
2	Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition					
3	Adel. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits," 6th Edition, Oxford University Press, 2011					
REFERENCE BOOKS:						
1	Electronic Devices and Circuits- S Salivahanan, N Suresh Kumar, Tata Mc-Graw Hill, Third Edition, 2012.					
2	Electronic Devices and Circuit Theory-R.L. Boylestad and Louis Nashelsky, Pearson Publications, Tenth Edition.					
3	K.Lal Kishore, "Electronic Circuit Analysis", 2nd Edition, B S Publications, 2008					
ADDITIONAL REFERENCE MATERIAL						
1	Electronic Devices and Circuits Lecture Notes and Study Material PDF - BTech Geeks					
2	https://www.researchgate.net/publication/283073107_Electronics_Lab_Manual					

R24MECEL003	DIGITAL LOGIC DESIGN LAB					
	Total Contact Hours	42 (P)	L	T	P	C
	Pre-requisite	DE	0	0	3	2
Course Objective						
<ul style="list-style-type: none"> Implement the Digital Electronic Concepts both combinational and sequential logic circuits in Verilog HDL. 						
Course Outcomes						
1	Understand the basics of Hardware Description Languages, Program structure and basic language elements of Verilog HDL.					
2	Understand types of modelling, modules, functions of Verilog and simulate and synthesize related Programs					
3	Design, Simulate and synthesize various Verilog HDL descriptions for Combinational circuits.					
4	Design, Simulate and synthesize various Verilog HDL descriptions for Sequential circuits.					
5	Developing test benches to verify the functionality of combinational and sequential Circuits					
6	The students come to terms with the understanding of how to verify the implemented logic with Nexys-4 DDR FPGA hardware module/kit					
List of Experiments (Minimum of Ten Experiments have to be performed)						
1	Realization of Logic Gates					
2	Full Adder					
3	3 to 8 Decoder					
4	Priority Encoder					
5	8X1 Multiplexer and 1X4 De-multiplexer					
6	4 Bit Comparator					
7	D Flip-Flop					
8	Decade Counter					
9	Random Counter					
10	Universal Shift Register					
11	First In & First Out (FIFO)					
12	Synchronous RAM					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Verilog HDL-A guide to Digital Design and Synthesis-Samir Palnitkar-ISBN: 0134516753; Pub: Prentice Hall PTR					
2	Fundamentals of Digital logic with Verilog design-2e, Brown Vranesic, McGrawHill education, ISBN-13:978-0-07-066724-2					
3	Digital Design Principles & Practices by John F. Wakerly, PHI Publications, Third Edition. 2005					
ADDITIONAL REFERENCE MATERIAL						
1	https://www.youtube.com/watch?v=pKgsgyNSGV0&list=PLAC_jmBddcjTPEh1UV_ojRJmsx2D9sQXH					
2	https://www.youtube.com/watch?v=S26TPZm4zzM&list=PL3Soy1ohxIP1TLpcbYXYcVWItRy_XrUk8					

Note: The students are required to design and draw the internal logical structure of the following digital Circuits and to develop Verilog HDL Source code, perform simulation using test bench with relevant simulator then analyze the obtained simulation results

using necessary synthesizer and then validate the implemented logic with different hardware modules/kits (FPGA kits).

All the experiments are required to verify and implement the logical operations on the FPGA Hardware in the Laboratory.

Software requirements:

Vivado Xilinx Design Suite software tool

Hardware requirements:

Nexys-4 DDR FPGA, Computer Systems with required specifications

R24MCSC001 (EOEC-L1)	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) <ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> 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) <ul style="list-style-type: none"> Write a C Program to implement Stack operations using arrays. Write a C Program to implement Stack operations using linked list. 					

	<ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • 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)) <ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • Write a C Program to implement Binary Heap (Min Heap or Max Heap).
12	WEEK 12 (HASHING) <ul style="list-style-type: none"> • 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, <i>Data Structures and algorithm analysis in C</i> , Pearson, 2nd Edition.
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, <i>Fundamentals of data structures in C</i> , Silicon Press, 2008.
3	Richard F, Gilberg , Forouzan, Cengage, <i>Data Structures</i> , 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

IV Semester

R24MECET006		ANALOG & DIGITAL COMMUNICATIONS					
		Total Contact Hours	42 (L)	L	T	P	C
		Pre-requisite	Signals, Systems and Stochastic Processes	3	0	0	3
Course Objective							
<ul style="list-style-type: none"> Familiarize with the fundamentals of analog communication systems, analog modulation and demodulation of signals Distinguish various analog pulse and digital pulse modulation methods. Understand various functional blocks of radio transmitters and receivers. Performance of various digital carrier modulation technics based on probability of bit errors. 							
Course Outcomes							
The students will be able to:							
1	Apply the concepts of amplitude modulation and subsystems. (BL3)						
2	Identify the difference between frequency modulation and amplitude modulation. (BL3)						
3	Analyze the performance of analog modulations based on SNR and distinguish the performance of radio transmitters and receivers. (BL4)						
4	Compare various analog pulse and digital pulse modulations (BL4)						
5	Critically compare and contrast source coding and channel coding techniques (BL5)						
6	Choose the appropriate modulation technique for the required application (BL6)						
SYLLABUS							
Unit 1	LINEAR MODULATION					8 hr	
<p>Competency Group1 : Introduction to communication system, need for modulation, Amplitude Modulation; Time domain and frequency domain description; single-tone modulation, power relations in AM waves; Generation of AM waves; Square law modulator, Detection of AM Waves; Envelope detector;</p> <p>Competency Group2 : DSB-SC Generation of DSBSC Waves, Ring Modulator; Coherent detection of DSB-SC Modulated waves, COSTAS Loop; SSB-SC representation and generation, Coherent detection of SSB; Advantages and applications of VSB. Related problems</p>							
Unit 2	ANGLE MODULATION					8 hr	
<p>Competency Group 1: Basic concepts, Frequency Modulation, Single-tone frequency modulation; Spectrum Analysis of Sinusoidal FM Wave; Narrow band FM, Wide band FM; Constant Average Power, Transmission bandwidth of FM Wave</p> <p>Competency Group 2 : Introduction to Phase modulation; Generation of FM Waves, Direct and Indirect FM; Detection of FM Waves using Phase locked loop; Comparison of FM&AM. Related problems</p>							
Unit 3	RADIO TRANSMITTERS, RECEIVERS & PULSE MODULATION					8 hr	
<p>Competency Group 1: Radio Transmitter - Classification of Transmitter, AM Transmitter, FM Transmitter block diagram; Radio Receiver - Receiver Types & characteristics- TRF receiver, Super heterodyne receiver; - Intermediate frequency, image frequency and its rejection, AGC; FM Receivers, Comparison with AM Receiver.</p> <p>Competency Group 2: Noise in AM&FM System; Pre-emphasis &De-emphasis, Time Division Multiplexing, Frequency Division Multiplexing; Types of Pulse modulation, Generation & demodulation of PAM; PWM, PPM.</p>							
Unit 4	DIGITAL CARRIER MODULATION					8 hr	
Competency Group 1: Elements of digital communication systems, Advantages of							

digital communication systems; Elements of PCM: Sampling, Quantization & Coding; Quantization error, Companding in PCM systems; Differential PCM systems, DPCM. Delta modulation; its drawbacks, slope overloading, adaptive delta modulation, comparison of PCM and DM systems.		
Competency Group 2: Introduction, Generation and detection of ASK, FSK; PSK, DPSK; QPSK; Baseband signal receiver; probability of error, the optimum filter; probability of error using matched filter(qualitative only)		
Unit 5	INFORMATION THEORY & CODING	8 hr
Competency Group 1: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties. Information rate, Mutual information and its properties, Shannon's theorem, Shannon-Fano coding, Huffman coding, efficiency calculations, Gaussian channel capacity (Hartley -Shannon's Law) Channels, bandwidth -S/N trade off.		
Competency Group 2: Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes, Algebraic structure, encoding, syndrome calculation of BCC, characteristics of BCH Codes, Introduction of convolution codes, encoding of convolution codes, time domain approach, transform domain approach. Graphical approach: state, tree and trellis diagram. Decoding using Viterbi algorithm.		
<u>LEARNING RESOURCES</u>		
TEXT BOOKS:		
1	Communication Systems- Simon Haykin, JohnWiley, 2 nd Ed.2005.	
2	Communication Systems - R.P. Singh, SP Sapre, Second Edition TMH, 2007.	
3	Digital and Analog Communication Systems- K.Sam Shanmugam.Wiley, 4 th Ed.2007.	
REFERENCE BOOKS:		
1	Electronics & Communication System - George Kennedy and Bernard Davis, TMH 2004.	
2	Communication Systems- B.P.Lathi, BS Publication, 2006.	
3	Principles of Communication Systems- H Taub & D.Schilling, Gautam Sahe, TMH, 3 RD Edition, 2007.	
4	Analog communication - P. Ramakrishna Rao, 1 st Edition, 2011	
5	Digital Communication - P. Ramakrishna Rao, 1 st Edition, 2017	
ONLINE COURSES		
1	https://nptel.ac.in/courses/117/105/117105144/	
2	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee46	
3	https://nptel.ac.in/courses/117/102/117102059/	

Bloom's level and-Units catchment articulation matrix

CO	Blooms L	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
CO 1	BL 3	X				
CO 2	BL 3		X			
CO 3	BL 4			X		
CO 4	BL 4				X	
CO 5	BL 5					X
CO 6	BL 6	X	X	X	X	X

R24MECET007		EM WAVES AND TRANSMISSION LINES					
		Total Contact Hours	42 (L)	L	T	P	C
		Pre-requisite	Engineering Mathematics, Engineering Physics	3	0	0	3
Course Objective							
<ul style="list-style-type: none"> Analyze electromagnetic wave propagation in lossy media Apply Transmission line fundamentals for high-speed digital circuits and communication systems Explain radiation fundamentals 							
Course Outcomes							
Students will be able to:							
1	Apply basic laws of electrostatics and magnetostatics for determining E and H for different charge, current distributions. (BL3)						
2	Analyze the time varying behavior of EM waves with the help of Maxwell's equations. (BL4)						
3	Analyze the characteristics of propagation between two different types of media with the knowledge of uniform plane wave characteristics. (BL4)						
4	Measure the basic parameters of transmission lines with the help of smith chart. (BL5)						
5	Explain the fundamental parameters of antenna. (BL3)						
6	Design an impedance matching device for microwave communication. (BL6)						
SYLLABUS							
Unit 1	Electrostatics & Magnetostatics						8 hr
Competency Group 1 :							
Introduction to 3D coordinate systems and their transformations, Columb's law, electric field intensity and potential; Gauss law, its applications; Energy Density, Poisson's and Laplace's Equations; Convection and Conduction Currents, Dielectric Constant, Capacitance – Parallel Plate, Coaxial Capacitors;							
Competency Group2:							
Biot-Savart Law, Magnetic Flux Density; Ampere's Circuital Law and Applications, Magnetic Scalar and Vector Potentials; Forces due to Magnetic Fields, Ampere's Force Law; inductance and magnetic energy density;							
Unit 2	Electromagnetic Wave Equations						8 hr
Competency Group 1 :							
Maxwell's equations in differential form, Maxwell's equations in integral form and word statement; Boundary conditions-1: Dielectric-Dielectric and Dielectric-Conductor Interfaces; Boundary conditions-2: Dielectric-Dielectric and Dielectric-Conductor Interfaces;							
Competency Group2:							
Wave equations for conducting; Dielectric and lossless media; Uniform Plane Wave (UPW) and general solution of UPW; Relations between E & H in UPW; Characterization of conductors and dielectrics.							
Unit 3	Electromagnetic Wave Characteristics						8 hr
Competency Group 1 :							
Wave propagation in good conductors and good dielectrics, skin depth; polarization; Poynting Vector and Poynting theorem – applications;							
Competency Group2:							
Introduction, Normal incidence of UPW on perfect conductor and perfect dielectrics; and Oblique incidence of UPW on perfect conductor and perfect dielectrics for parallel polarization; Oblique incidence of UPW on perfect conductor and perfect dielectrics for perpendicular polarization; Brewster angle; critical angle, total internal reflection,							

surface impedance.		
Unit 4	Transmission Lines	8 hr
<p>Competency Group 1 : Definition, Types, Applications, equivalent circuit of two wire parallel transmission lines, Primary constants, Line Equations; Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities; Infinite Line Concept, Lossless and Low Loss Characterization;</p> <p>Competency Group 2: Distortion-Condition for Distortion less and Minimum Attenuation; Input Impedance Relations, SC and OC Lines; Reflection, Reflection Coefficient, VSWR; Smith Chart-Construction and Applications; Impedance matching devices, types, quarter wave matching; Related problems.</p>		
Unit 5	Antenna Fundamentals	8 hr
<p>Competency Group 1 : Definition of antenna, Radiation Mechanism -single wire, two wire, dipoles; Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes; Beam widths, Beam Area, Radiation Intensity;</p> <p>Competency Group 2: Beam Efficiency, Directivity, Gain and Resolution; Aperture Efficiency, Effective Height and length; Friis transmission equation and statements of antenna theorems.</p>		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Elements of Electromagnetics – Matthew N.O. Sadiku, Oxford Univ. Press, 4 th ed., 2007.	
2	Electromagnetic Field Theory Fundamentals- by Bhagat Singh Guru, Hüseyin R. Hiziroglu, Cambridge university press, 3 rd edition.	
3	Antenna Theory - C.A. Balanis, John Wiley & Sons, 2 nd Edition, 2009.	
REFERENCE BOOKS:		
1	Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2 nd Ed, 2000.	
2	Engineering Electromagnetics- William H. Hayt Jr. and John A Buck, TMH, 7 th Ed.	
3	Electromagnetic waves and transmission lines – Y Mallikarjuna Reddy, University press private Ltd, 2 nd edition.	
4	Computational Electromagnetics with MATLAB, Fourth Edition - Matthew N.O. Sadiku, Oxford Univ. Press	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.youtube.com/watch?v=0OwmYAljz4A	
ONLINE COURSES		
1	https://nptel.ac.in/courses/117101056	
2	https://onlinecourses.nptel.ac.in/noc22_ee43/preview	

Bloom's level and-Units catchment articulation matrix

CO	Blooms L	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
CO 1	BL 3	X				
CO 2	BL 4		X			
CO 3	BL 4			X		
CO 4	BL 5				X	
CO 5	BL 3					X
CO 6	BL 6	X	X	X	X	X

R24MECET008	ANALOG CIRCUITS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Electronic Devices and Circuits, Basic Network Analysis	3	0	0	3
Course Objective						
This course aims to help students grasp the various non-linear wave shaping circuits using diodes and transistors, enabling them to analyze various power amplifiers and tuned amplifiers, and understand the operation and characteristics of op-amp, design and analyze applications of IC 741 Operational amplifier and 555 Timer, able to understand Analog to Digital & Digital to Analog converters, Phase Locked Loops and Three-Terminal Voltage Regulators.						
Course Outcomes						
1	Evaluate the nonlinear wave shaping circuits. (BL 5)					
2	Analyze various power amplifiers and tuned amplifiers. (BL 4)					
3	Examine the concepts of Linear ICs and the characteristics of OP-AMP 741. (BL 4)					
4	Appraise the applications of IC 741 Operational amplifier and 555 Timer. (BL 5)					
5	Contrast Analog to Digital & Digital to Analog converters, Phase Locked Loops and Three-Terminal Voltage Regulators. (BL 4)					
6	Design various electronic circuits using active components. (BL 6)					
SYLLABUS						
Unit 1	NON-LINEAR WAVE SHAPING					8 hr
Competency Group 1 : Diode series clippers; Diode shunt clippers; clipping at two independent levels; Transfer characteristics of clippers.						
Competency Group 2 : Transistor clippers, Emitter coupled clipper; Positive clamping operation, Negative clamping operation; clamping circuits using diode with different inputs; Clamping circuit theorem.						
Unit 2	POWER AMPLIFIERS AND TUNED AMPLIFIERS					8 hr
Competency Group 1 : Concept, features of power amplifiers, comparison of voltage and power amplifiers; Classification of power amplifiers; Series fed directly coupled Class A amplifier; Transformer coupled Class A amplifier;						
Competency Group 2 : Distortion in Amplifiers, Push pull class B amplifier; Complementary symmetry Class B amplifier, cross over distortion; Introduction, classification of tuned amplifiers, Q-Factor, requirements of tuned amplifier; Single and double tuned amplifier analysis.						
Unit 3	INTRODUCTION TO OP-AMP					8 hr
Competency Group 1 : Differential Amplifier using BJT, The operational Amplifier, Block diagram representation of a typical Op-Amp; schematic symbol, Classification of IC's, Types of IC's;						
Competency Group 2 : Manufacturers designation for Linear IC's, Package Types and temperature ranges; The Ideal and practical OP-Amp equivalent circuits and transfer curve, Ideal and practical Op-Amp specifications; open-loop Op-Amp configurations, DC and AC characteristics; Compensation techniques.						

Unit 4	APPLICATIONS OF OP-AMPS AND 555 TIMER	8 hr
Competency Group 1 : Inverting and Non-inverting amplifier, Summing, scaling, averaging amplifiers; Peaking amplifier, Instrumentation amplifier; Integrator and differentiator; Comparators, Schmitt Trigger; Butterworth filters– 1st order LPF, HPF filters.		
Competency Group 2 : Band pass, Band reject and All pass filters; Introduction to 555 timer, connection diagram, Block diagram; Monostable and Astable Operations.		
Unit 5	D/A, A/D CONVERTERS & REGULATORS	8 hr
Competency Group 1 : Introduction, basic DAC techniques, weighted resistor DAC; R-2R ladder DAC, inverted R-2R DAC; Different types of ADCs - parallel comparator type ADC, counter type ADC; successive approximation ADC and dual slope ADC;		
Competency Group 2 : DAC and ADC Specifications; PLL - Introduction, Block schematic, principles and description of individual blocks; 566 VCO, 565 PLL; IC Regulators: Three-Terminal Voltage Regulators, 78xx and 79xx Series.		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Electronic Devices and Circuits – J. Millman, C.C. Halkias, SatyabrataJit, Tata Mc-Graw Hill , Second Edition-2007.	
2	Pulse, Digital and Switching Waveforms by J. Millman, H. Taub and MS Prakash Rao, McGraw-Hill, 2007.	
3	Op-Amps & Linear ICs by Ramakanth A. Gayakwad, PHI, 1987.	
REFERENCE BOOKS:		
1	Electronic Devices and Circuits- G.K.Mithal, Khanna Publishers, 2010.	
2	Pulse and Digital Circuits” by A.Anand Kumar, PHI, Second Edition 2012.	
3	Linear Integrated Circuits – D. Roy Chowdhury, New Age International (p) Ltd, 2nd Edition, 2003.	
ADDITIONAL REFERENCE MATERIAL		
1	Mothiki S. Prakash Rao, Pulse Digital & Switching Waveforms, 2nd Edition, TMH.	
2	Taub and Schilling, Digital Integrated Electronics, Mc-Graw Hill, 1977.	
3	Robert F.Coughlin, Frederick F.Driscoll, -Operational Amplifiers and Linear Integrated Circuits, Sixth Edition, PHI, 2001.	
ONLINE COURSES		
1	http://www.digimat.in/nptel/courses/video/117106088/L22.html	
2	http://nptel.ac.in/courses/117106086/	
3	https://onlinecourses.nptel.ac.in/noc24_ee73/unit?unit=20&assessment=26	

Bloom's level - Units catchment articulation matrix

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

		DIGITAL SIGNAL PROCESSING				
		Total Contact Hours	42 (L)	L	T	P
R24MECET009	Pre-requisite	Signals, Systems, and Stochastic Processes, Mathematics	3	0	0	3
	Course Objective: The student will be able to					
<ol style="list-style-type: none"> 1. Analyze the Discrete Time Signals and Systems using Z-Transforms and FFT. 2. Learn the IIR and FIR Filter design procedures and Understand the various implementations of digital filter structures. 3. Know the need of Multirate Processing and learn the concepts of DSP Processors. 						
Course Outcomes						
After going through this course, the student will be able to						
1	Analyze discrete time systems by solving difference equations using Z-transforms (BL4)					
2	Evaluate the performance of DFT and FFT algorithms for discrete time signals. (BL5)					
3	Design IIR Digital filter from the given specifications. (BL6)					
4	Design FIR Digital filter from the given specifications. (BL6)					
5	Apply multirate signal processing concepts in DSP applications and demonstrate various blocks of DSP processors. (BL3)					
6	Construct IIR and FIR filter structures for various DSP applications. (BL6)					
SYLLABUS						
Unit 1	INTRODUCTION TO DISCRETE TIME SYSTEMS					8 hr
Competency Group1: Introduction to digital signal processing, Classification of Discrete time systems; Solution of Linear constant coefficient difference equations- impulse response; Solution of Linear constant coefficient difference equations- output response; introduction to Z-transform and its ROC.						
Competency Group2: Z-transform of basic functions; Properties of Z-transforms; Inverse Z-transforms; solution of difference equations using Z-transforms and System function.						
Unit 2	DISCRETE FOURIER TRANSFORM					8 hr
Competency Group1: Discrete Fourier Series, Properties of discrete Fourier series; Discrete Fourier transforms; Properties of DFT; Inverse Discrete Fourier transform.						
Competency Group2: Convolution using DFT; Fast Fourier transforms (FFT) - Radix-2 decimation in time; Fast Fourier transforms (FFT) - Radix-2 decimation in frequency; Inverse FFT.						
Unit 3	DESIGN OF IIR DIGITAL FILTERS & REALIZATIONS					8 hr
Competency Group1: Introduction to digital filters; Analog filter approximations – Butter worth; Analog filter approximations – Chebyshev; Design of IIR Digital filters from analog filters - Impulse Invariant.						
Competency Group2: Design of IIR Digital filters from analog filters – Bilinear, Analog and Digital frequency transformations Basic structures of IIR systems-Direct form-I; Direct form-II, Cascade; Parallel, Transposed forms.						
Unit 4	DESIGN OF FIR DIGITAL FILTERS & REALIZATIONS					8 hr
Competency Group1: Comparison of IIR & FIR filters, Characteristics of FIR filters with linear phase; Frequency response of linear phase FIR filters; Design of FIR digital filters using Fourier						

series method; Design of FIR digital filters using window techniques – rectangular, frequency response of rectangular window.	
Competency Group2: Design of FIR digital filters using window techniques – triangular, hamming; Design of FIR digital filters using window techniques – hanning, blackman; Kaiser, Comparison of different window techniques; Design of FIR digital filters using Frequency Sampling technique, Basic structures of FIR systems.	
Unit 5	MULTIRATE DIGITAL SIGNAL PROCESSING & DSP PROCESSORS 8 hr
Competency Group1: Introduction to multirate digital signal processing- Decimation, Interpolation; Frequency response of Decimation and Interpolation; Sampling rate conversion, Introduction to Programmable DSPs; Multiplier and Multiplier Accumulator (MAC), Bus Structures and Memory Access schemes in DSPs.	
Competency Group2: Multiple access memory, multiport memory, VLIW Architecture; Pipelining, Special addressing modes; On-Chip Peripherals; TMS320C67XX architecture.	
LEARNING RESOURCES	
TEXT BOOKS:	
1	Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, DimitrisG.Manolakis, Pearson Education / PHI, 2007.
2	Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI.
3	Digital Signal Processors – Architecture, Programming and Applications, B.Venkataramani, M.Bhaskar, TATA McGraw Hill, 2002.
REFERENCE BOOKS:	
1	Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006.
2	DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
3	Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra.
ONLINE COURSES	
1	https://archive.nptel.ac.in/courses/108/101/108101174/
2	https://archive.nptel.ac.in/courses/117/105/117105134/
3	https://archive.nptel.ac.in/courses/108/106/108106136/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL4	X				
CO2	BL5		X			
CO3	BL6			X		
CO4	BL6				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

R24MCSCCT003 (EOEC-T3)	PYTHON PROGRAMMING						
	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 Programsll, 2 nd 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 Editionll, Prentice Hall	
2	John V Guttag. -Introduction to Computation and Programming Using Pythonll, 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

R24MCST004 (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	https://dev.mysql.com/doc/refman/8.0/en/select.html	

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	

R24MECEL003	Analog and Digital Communications Lab					
	Total Contact Hours	42(P)	L	T	P	C
	Pre-requisite	Analog and Digital Communications	0	0	3	2
Course Objective						
This laboratory gives students deep knowledge in different analog and digital communication techniques at the practical level. This lab focuses the fundamental concepts on generation , demodulation of analog and analog pulse modulations, digital modulation techniques,						
Course Outcomes						
After completion of this laboratory, students will be able to						
1	Demonstrate the generation and detection of analog and digital modulation techniques					
2	Explain the difference between sampling , PCM and Delta modulation.					
3	Compare different analog and digital modulation techniques.					
4	Demonstrate various analog pulse modulation method.					
List of Experiments (Minimum of Ten Experiments have to be performed)						
1	Amplitude Modulation and Demodulation.					
2	Frequency Modulation and Demodulation.					
3	AM-DSB-SC Modulation and Demodulation.					
4	Diode Detector.					
5	Pulse Amplitude Modulation and Demodulation.					
6	Pulse Width Modulation and Demodulation.					
7	Pulse Position Modulation and Demodulation.					
8	Pulse Code Modulation and Demodulation.					
9	Delta Modulation and Demodulation					
10	FSK Generation and Detection					
11	PSK modulation and demodulation.					
12	DPSK Generation and Detection.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Communication Systems- Simon Haykin,JohnWiley, 2 nd Ed.2005.					
2	Communication Systems - R.P. Singh, SP Sapre, Second Edition TMH, 2007.					
3	Digital and Analog Communication Systems- K.Sam Shanmugam.Wiley, 4 th Ed.2007.					
REFERENCE BOOKS:						
1	Electronics & Communication System - George Kennedy and Bernard Davis, TMH 2004.					
2	Communication Systems- B.P.Lathi, BS Publication, 2006.					
3	Principles of Communication Systems- H Taub & D.Schilling, GautamSahe, TMH, 3 RD Edition, 2007.					

R24MECEL004	Digital Signal Processing Lab					
	Total Contact Hours	42 (P)	L	T	P	C
	Pre-requisite	Signals, Systems, and Stochastic Processes	0	0	3	2
Course Objective						
<ul style="list-style-type: none"> Analyze the performance of various digital signal processing algorithms 						
Course Outcomes						
1	Estimate the spectra of discrete signals using FFT.					
2	Analyze the magnitude and phase characteristics of digital IIR and FIR filters using Butterworth and Chebyshev designs.					
3	Implement algorithms on TMS 320C6713, Digital Signal Processor.					
List of Experiments (Minimum of Ten Experiments have to be performed)						
1	To verify Linear convolution of DT sequences.					
2	To verify circular convolution of DT sequences					
3	To verify N-point DFT of a sequence. Also perform IDFT on the result obtained to verify the result.					
4	To compute Power Density Spectrum of a sequence using DFT					
5	To verify circular convolution and correlation using DFT.					
6	To verify FFT of a sequence using the following methods. (a) Decimation in time (b) Decimation in frequency.					
7	To obtain Impulse and Step response of a LTI system.					
8	Design IIR filter (LP/HP) using Butterworth and Chebyshev techniques.					
9	Design FIR filter (LP/HP) using windowing techniques.					
10	To compute the Decimation and Interpolation of the given signal.					
11	Implement IIR filter (LP/HP) on DSP Processor, TMS320C6713.					
12	Implement FIR filter (LP/HP) on DSP Processor, TMS320C6713.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Digital Signal processing(II-Edition): S.K. Mitra, TMH					
2	Digital Signal Processors – Architecture, Programming and Applications, B.Venkataramani, M.Bhaskar, TATA McGraw Hill, 2002.					
3	Algorithms in Digital Signal Processing -A Practical Approach- Prof .C.B.Deshpande,Dhanpat rai &Co,(Pvt.) Ltd,2007					
ADDITIONAL REFERENCE MATERIAL						
1	http://vlabs.iitkgp.ac.in/dsp/#					
2	https://www.mathworks.com/matlabcentral/fileexchange/58879-digital-signal-processing-lab-exercises/					
3	https://www.ti.com/lit/an/spra921/spra921.pdf?ts=1706541783250&ref_url=https%253A%252F%252Fwww.google.com%252F					

R24MCSC002	PYTHON PROGRAMMING LAB					
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisite	-	0	0	3	2
Course Objective						
Students will learn about basic programming constructs which are used to develop both desktop and web applications using python programming.						
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 the various widgets to design and develop Graphical User Interface (GUI) applications.					
List of Experiments						
1	Week – 1: <ol style="list-style-type: none"> Write a python script to illustrate at a types (int,char,float,string). Write a python program to perform the following expressions using operator precedence <ol style="list-style-type: none"> $5+3*2$ $2*3**2$ $2**3**2$ $(2**3)**2$ Write a python program to illustrate type conversion functions Write a python program to illustrate pi,sqrt,cos,sin functions of math module 					
2	Week – 2: <ol style="list-style-type: none"> Write a program to calculate simple interest Write a python program to calculate compound interest Write a python program to print ASCII value of a character Write a python program to find the area of a circle Write a program whether the given number is prime or not. Write a python program to find the area of a triangle Write a program to perform string concatenation 					
3	Week – 3: Illustrate Numpy operations. <ol style="list-style-type: none"> Program to read, process and display data Program to access data using various numpy functions on 1D arrays. Illustrate other built-in functions of Numpy on 2D arrays. 					
4	Week – 4: <ol style="list-style-type: none"> Write a python program to display minimum and maximum among three numbers. Write a python program to count the number of even and odd numbers from a series of numbers. Write a python program to display Fibonacci series using iteration and recursion. Write a python program to find the factorial of a number with and without recursion. 					

5	<p>Week – 5:</p> <ol style="list-style-type: none"> 1. Write a python program to finds umofelements in a listre cursively 2. Write a python program to determine number of times agiven letter occursin a string using recursion 3. Write a python program to find if a number is prime or not a prime using recursion 4. Write a python program to find the product of two numbers using recursion. 5. Write a python program find the power of a number using recursion.
6	<p>Week – 6:</p> <ol style="list-style-type: none"> 1. Write a python program to find the largest and smallest number in a list. 2. Write a python program to merge two lists and sortit. 3. Write a python program to removetheduplicateitemsfrom alist. 4. Writeapythonprogramtocheckif astringisapalindromeornot. 5. Write aprogram toreplace all the occurrencesof a with x ina string.
7	<p>Week – 7:</p> <ol style="list-style-type: none"> 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 number. 2. Write a python program that takes the list of tuples and sorts the list of tuplesin increasing order bythe last element ineach tuple. 3. Write a python program to add a key value pair to adictionary and update the dictionary based on the key.
8	<p>Week – 8:</p> <ol style="list-style-type: none"> 1. Illustrate in operator and write a python program to count number of lowercase characters in a string. 2. Illustrate the following functions of list 1) len 2) extend 3)sort 4) append 5)insert 6)remove 3. Program to pass list as an argument to function illustrate with example 4. Illustrate the following methods of dictionary with examples 5. 1) keys() 2) values() 3)items() 4) pop() 5)delete() 6. Write a Program to do a reverse dictionary lookup in python.
9	<p>Week – 9:</p> <ol style="list-style-type: none"> 1. Write a program to generate 20 random numbers in the range of 1 to100 and write to a file 2. Program to Illustrate seek (), tell () and flush () methods with different arguments. 3. Program to Illustrateread, read line and read line smethods.
10	<p>Week – 10:</p> <ol style="list-style-type: none"> 1. Program to illustrate how to import data from CSV to Data Frameusing Pandas. 2. Program to illustrate how to Inspect datain Data Frame using head (),tail()and describe() functions. 3. Program to perform sorting and slicing operations.
11	<p>Week – 11:</p>

	<ol style="list-style-type: none"> 1. Program to design an application to display-HelloWorld. 2. Program to design an application using Label, Entry and Button widgets. 3. Program to design an application using Tkinter Geometry method pack (),grid (),place () methods. 4. Program to design an application using Check Button and Radio button widgets.
12	<p>Week – 12:</p> <ol style="list-style-type: none"> 1. Program to design an application using Menu and Menu button widgets. 2. Program to design an application using List box and Scroll bar widgets. 3. Program to design an application using Message box and File Dialog widget
Demonstration experiments	
1	Demonstration of Python IDLE to implement solutions.
2	Demonstration on Colab note book to read, access and display data from google drive.
3	Demonstration on jupyter note book to link and access data.
LEARNING RESOURCES	
TEXTBOOKS:	
1	Kenneth A.Lambert. -Fundamentals of Python:First Programs II, 2 nd Edition, Publisher:Cengage Learning
2	R.Nageswara Rao, -Core Python Programming.
REFERENCE BOOKS:	
1	Wesley J.Chun.-Core Python Programming-Second Edition II, Prentice Hall
2	John V.Guttag.-Introduction to Computation and Programming Using Python II, Prentice Hall of India.
3	Python Practice Book Release 2014, Anand Chitipothu.
ADDITIONAL REFERENCE MATERIAL	
1	https://www.tutorialspoint.com/python/
2	https://docs.python.org/3/tutorial/
3	https://www.python-course.eu/python3_course.php
4	https://www.w3schools.com/python/pandas/default.asp
5	https://www.geeksforgeeks.org/python-programming-language/
6	https://www.programiz.com/python-programming

V Semester

R24MEEET004		CONTROL SYSTEMS					
		Total Contact Hours	42 (L)	L	T	P	C
		Pre-requisite	Electrical circuits, differential equations, Laplace transforms.	3	0	0	3
Course Objective							
<ul style="list-style-type: none"> • 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 analyse 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 to develop and design a closed loop control system with good transient and Steady state performance. (BL6)						
SYLLABUS							
Unit1	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;							
Unit2	TimeResponseAnalysis					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; Servo motors;							
Unit3	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;							
Unit4	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;

Unit5

StateVariableAnalysis

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	
TEXTBOOKS:	
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.Nagoorkani, 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-Unit 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

R24MECET010	MICROPROCESSORS AND MICROCONTROLLERS					
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisite	DE, ANC	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 I/O, memory , interrupts and serial communication to do projects.						
Course Outcomes						
After completing this course, the students will be able to						
1	Demonstrate functional blocks and features of 8086 microprocessor and execute programs. (BL3)					
2	Examine and differentiate interfacing modules like 8255PPI, 8259 PIC.(BL4)					
3	Distinguish between microprocessor and microcontroller hardware architectures and functional blocks.(BL4)					
4	Explicate programming with an assembler.(BL5)					
5	Appraise timer/counter, interrupts and serial communication functional blocks of AVR microcontroller.(BL5)					
6	Design and develop various electronic products by applying full complement of architectural features and programming concepts of microprocessors and microcontrollers.(BL6)					
SYLLABUS						
Unit I	Introduction to 8086 Microprocessor					8 hr
Competency Group1: 1: Architecture of 8086; 2: Register Organization; 3: Pin configuration and Signal Description of 8086; 4: Physical Memory Organization, General Bus Operation;						
Competency Group2: 5: I/O Addressing Capability, Special Processor Activities; 6: Timings of Signals in Minimum and Maximum Mode of 8086 System; 7&8: Addressing Modes of 8086;						
Unit II	8086 Microprocessor Features, Programming and Interfacing					8 hr
Competency Group1: 1&2:Instruction Set of 8086, 3:Assembler Directives & Operators, Stack Structure of 8086, 4:Interrupts and interrupt Handling;						
Competency Group2: 5: Procedures and Macros;6:Machine Language Instruction Formats, Machine Level Programs, 7:Assembly Language Programming tools, Programming with an Assembler;8:Illustrative Assembly Level Language Programs.						
Unit III	Interfacing of Peripherals with 8086 & Introduction to AVR Microcontroller					8 hr
Competency Group1: 1:Architecture of 8255 PIO (Programmable input Output Port);2: Modes of Operation of 8255,ADC 0808 & DAC 0800 interfacing; 3:Architecture of Programmable Interrupt Controller 8259A, 4:Architecture of programmable communication interface 8251 USART,						
Competency Group2: 5:Introduction to Microcontrollers, Atmel AVR Architecture Overview - Introduction, Families;6:Registers of AVR, Nonvolatile and Data Memories;7:Port						

System Features, Peripheral Features-Internal Subsystems; 8:AVR AT mega128/328 - Overview;		
Unit IV	Timers/Counters, Interrupts and Serial Communication programming of AVR Microcontroller	8 hr
Competency Group1: 1: Assembly Programming AVR microcontroller- Introduction, The AVR Instruction Set, 2&3:Assembler Directives, Addressing Modes of AVR; 4: AVR Programming in C, AVR Programming tools – WinAVR, AVR STUDIO/ARDUINO IDE usage.		
Competency Group2: 5:Serial Communication Subsystem - UART, 6:Analog-to-Digital Conversion;7: Interrupt Subsystem, Timing Sub system;8: PWM - Wave Generation in AVR.		
Unit V	INTERFACING WITH AVR Controller	8 hrs
Competency Group1: 1&2:Programming - I/O Ports, Input Devices - Switches, Keypads, Sensors;3: Output Devices- LED, Seven-Segment LED Displays, 4:Dot Matrix Display, LCD, BUZZER,		
Competency Group2: 5Hardware and Software Interfacing with the AVR - RS 232(UART), 6:USB, EEPROM;7: SPI, I2C; 8:DS1307 RTC programming with AVR.		
<u>LEARNING RESOURCES</u>		
TEXTBOOKS:		
1	Advanced Microprocessors and Peripherals by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2 nd edition, 2009.	
2	Atmel AVR Microcontroller Primer: Programming and Interfacing, Steven F. Barrett, Morgan & Claypool,2008	
3	The AVR Microcontroller And Embedded Systems Using Assembly And 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=PLnZLfHvLkNN2ttBIgZvo6lGFprOoanEl	
2	https://www.youtube.com/watch?v=_qxueXKHg04&list=PLDe416Soc eX2lUjvXKaeAfnq04WqH91Bk	

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	BL4		X	X		
CO4	BL3				X	
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

R24MECET011	DIGITAL VLSI DESIGN					
	TotalContactHours	42(L)	L	T	P	C
	Pre-requisite	EDC, DE	3	0	0	3
Course Objective						
Students shall gain the knowledge and skills required to design and implement digital circuits Like combinational, sequential, and memory at the chip level.						
Course Outcomes						
1	Explain the effect of scaling on MOS devices.(BL4)					
2	Design an inverter with the required specifications.(BL6)					
3	Choose a preferred logic designstyle for designing a complex circuit.(BL5)					
4	Adapta VLSI design methodology for a complex design.(BL6)					
5	Construct a Memory cell with the required size and specifications.(BL6)					
6	Design to accommodate the entire complement of Digital ICs and their implementation Methodologies for various electrical products.(BL6)					
SYLLABUS						
Unit 1	MOS DESIGN					8hr
Basic steps in Fabrication process NMOS, PMOS; N-well CMOS fabrication process; MOSFET structure under external bias; Structure and Operation of MOS Transistor (MOSFET); MOSFET Current-Voltage Characteristics; MOSFET Scaling; Small-Geometry Effects; MOSFET Capacitances.						
Unit 2	MOS INVERTERS: STATIC CHARACTERISTICS					8hr
Voltage transfer characteristic (VTC) of the ideal and practical inverter-Noise Immunity and Noise Margins; Resistive load inverter; Inverters with n-type MOSFET load; CMOS inverter; Delay time definitions-calculation of T_{PLH} ; calculation of T_{PHL} ; Estimation of interconnect parasitic; Switching Power Dissipation of CMOS Inverters.						
Unit 3	COMBINATIONAL AND DYNAMIC LOGIC CIRCUITS					8hr
Stick diagram and layout design rules; CMOS NOR2 (Two-Input NOR) Gate, CMOS NAND2 (Two-Input NAND) Gate; Realization of Complex logic gate using Conventional CMOS; CMOS full adder;The basic principle of Pass transistor circuits, CMOS Transmission gates; Dynamic CMOS Logic (Precharge-Evaluate Logic); Domino CMOS Logic, and Cascaded domino CMOS logic gates, NP-Domino Logic; AOI and OAI gates, Pseudo-NMOS Gates.						
Unit 4	SEQUENTIAL CIRCUITS & VLSI DESIGN METHODOLOGIES					8hr
SR Latch circuit, CMOS SR latch, clocked SR flip-flop; JK latch circuit, Master-Slave Flip- Flop; clocked latch and flip-flop circuits; CMOS D-latch and Edge triggered flip-flop; VLSI Design Flow, VLSI Design Styles: Full custom, standard cell; Programmable Logic Devices (PLDs); Complex PLD; Field Programmable Gate Arrays (FPGAs).						
Unit 5	SEMICONDUCTOR MEMORY DESIGN					8hr
Read-only memory (ROM) Circuits; A 4-bit x 4-bit NOR-based ROM array; A 4-bit x 4-bit NAND-based ROM array; Design of Row and Column Decoders;Typical random-access memory array organization; Static Read-Write Memory (SRAM) Circuits, Various configurations of SRAM cell, SRAM Operation Principles; Full CMOS SRAM cell; Dynamic Read-Write Memory (DRAM) Circuits.						
<u>LEARNINGRESOURCES</u>						
TEXT BOOKS:						
1	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, TMH,					

	3 rd Ed. 2011
2	Digital Integrated Circuits, A Design Perspective, Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic.
REFERENCEBOOKS:	
1	Digital Integrated Circuit Design, Ken Martin,Oxford University Press, 2011.
2	Analysis and Design of Digital Integrated Circuits,Third Edition, David A.Hodges, Horace G. Jackson and Resve A.Saleh, McGraw-Hill, 2004.
ADDITIONALREFERENCE MATERIAL	
1	https://www.ele.uri.edu/courses/ele447/Slides/EE560_CombLog02.pdf
2	http://www.facweb.iitkgp.ac.in/~isg/CAD/SLIDES/06-VLSI-design-styles.pdf
3	http://eng.staff.alexu.edu.eg/~mmorsy/Courses/Undergraduate/EE431_Digital_Integrated_Circuits/PDFs/Lectures/Ch10_Semiconductor_Memories.pdf
ONLINE COURSES	
1	https://nptel.ac.in/courses/108/107/108107129/

Bloom's level - Units catchment articulation matrix

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

R24MECET012	Digital Image and Video Processing					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	SSSP, Digital Signal Processing	3	0	0	3
Course Objective						
<ol style="list-style-type: none"> 1. To grasp the comprehensive understanding of the fundamental techniques and methodologies used in processing digital images and videos, 2. To learn the principles of digital image and video representation, including acquisition, sampling, quantization, and storage. 3. To apply various enhancement, restoration, compression, segmentation, and motion estimation techniques to solve real-world problems in areas such as multimedia, computer vision, medical imaging, and video analytics. 						
Course Outcomes						
After completing this course, the students will be able to						
1	Apply intensity transformation techniques, various spatial filters and frequency domain filters to enhance image quality. (BL3)					
2	Analyse the effectiveness of various spatial filters in restoring images affected by specific noise types. (BL4)					
3	Analyse the strengths and limitations of various edge detection techniques. (BL4)					
4	Compare and contrast color models (RGB, HSI, and CMY) and pseudo-color processing methods for enhancing and compressing color images. (BL5)					
5	Evaluate compression standards and advanced methods for image and video compression. (BL5)					
6	Design and implement innovative techniques for the tasks such as motion tracking, segmentation and video compression, and critically evaluate their performance to address real-world challenges in areas like surveillance, multimedia, and autonomous systems. (BL6)					
SYLLABUS						
Unit I	Fundamentals of Image processing, Image Transforms and Intensity Transformations					8 hr
Basic steps of Image processing system, Components of Image processing system; Image sampling and quantization, Resolution; Basic relationships between pixels ; Image transforms: 2-D Discrete Fourier Transform, Properties; Discrete cosine Transform; some basic grey level transformations; Piecewise Linear Transformation Functions; Histogram processing and Histogram Equalization..						
Unit II	Image Enhancement and Image Restoration					8 hr
Spatial Domain Filtering: Smoothing Linear and Nonlinear Filters: Mean and Median Filters; Sharpening: First order and Second order derivative Filters; Frequency Domain Filtering: Low-pass (Smoothing): Ideal, Butterworth and Gaussian Filtering; High-Pass (Sharpening): Ideal, Butterworth and Gaussian Filtering; Image Degradation function and Noise Models; Restoration in the presence of noise only- Spatial Filtering; Periodic Noise Reduction, Estimating Degradation function; Inverse Filtering & Wiener Filtering.						
Unit III	Image Compression					8 hr
Introduction, Need for image compression, Types of redundancies; Classification of image Compression models: Lossy and Lossless; JPEG standards; Compression techniques-Huffman coding, run length coding; bit plane coding, arithmetic coding; Predictive coding; Block transform coding; Wavelet-based image						

compression		
Unit IV	Image Segmentation and Color Image Processing	8 hr
Point, Line, edge detection and edge models; Advanced techniques for edge detection; Edge linking and boundary description - local and global processing using Hough transform; Thresholding -basic, global, multiple; region based segmentation; Color Fundamentals, Color models–RGB, HSI,CMY; Pseudo color image processing, Basics of full-color image processing; Color Transformations, Noise in color images, Color image compression and segmentation.		
Unit V	Basic Steps of Video Processing and 2D Motion Estimation	8 hrs
Analog Video and Digital Video; Time varying image formation models: Three dimensional motion models-Rigid motion in Cartesian and homogeneous Coordinate systems; Sampling of Video signals, Filtering operations, Optical flow and General Methodologies, Motion Estimation- Pixel Based, Block based; Mesh based, Global and Region based; video compression: block transform coding and Predictive coding; Application of motion estimation in video coding and Video Compression Standards.		
<u>LEARNING RESOURCES</u>		
TEXTBOOKS:		
1	R.C. Gonzalez and R.E. Woods, "Digital Image Processing", Second Edition, Pearson Education, 2008	
2	S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image processing", Tata McGraw Hill.	
3	Digital Video Processing– Murat Tekalp, 1st Ed., PH Int.	
REFERENCE BOOKS:		
1	Anil Kumar Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2nd edition 2004.	
2	Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication", 1st edition , PHI	
ADDITIONAL REFERENCE MATERIAL		
1	https://nptel.ac.in/courses/117/104/117104020	
2	https://nptel.ac.in/courses/117/105/117105135	
3	https://nptel.ac.in/courses/108/106/108106168/	
ONLINE COURSES		
1	https://onlinecourses.nptel.ac.in/noc22_ee116/preview	

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	BL4				X	
CO4	BL5			X	X	
CO5	BL5			X		X
CO6	BL6	X	X	X	X	X

R24MECET020	OPTICAL COMMUNICATIONS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Optics, EM waves and Transmission Lines	3	0	0	3
Course Objective						
Students will gain understanding of basic parameters of Optical Fibers, characteristics of different Fiber Cables, Connectors, Couplers and Characteristics of Optical wave propagation and measurement techniques for Optical parameters.						
Course Outcomes						
1	Analyze fundamental concepts of Optical Fibers and its characteristics for fiber optic systems (BL4)					
2	Analyze the impact of different fiber loss mechanisms and dispersion types on optical signal transmission. Compare splicing techniques, fiber alignment methods for optimizing optical communication systems. (BL 4)					
3	Assess the performance characteristics of Optical Sources and Detectors (BL 5)					
4	Compare the performance characteristics of Optical receivers design (BL 4)					
5	Evaluate optical switch technologies in the evolution of Optical Wireless Communication. (BL 5)					
6	Design optical fibers, sources, switches, and optical networks in Optical communication system. (BL6)					
SYLLABUS						
Unit 1	OPTICAL FIBERS					8hr
OVERVIEW OF OPTICAL FIBERS						
General Optical Communication System, Advantages of Optical fibers; Ray Theory: total internal reflection, acceptance angle; Numerical aperture, Skew rays; Different types of Optical fibers, Graded index fiber; Cylindrical fibers- modes, V number, mode coupling; Electromagnetic Mode Theory: Phase Velocity, Group Velocity;						
UNIT II	DISPERSION					8hr
Attenuation and Scattering Losses; Material absorption losses; Bending Loss, core and cladding loss, Dispersion mechanisms; Splicing techniques, splicing single mode fibers; Fiber alignment and joint loss multimode fiber joints, single mode fiber joints; Optical fiber connectors: connector types, single mode fiber connectors, connector return loss; Fiber materials: Glass, halide, active glass, chalcogenide glass, plastic optical fibers.						
UNIT III	OPTICAL SOURCES AND DETECTORS					8hr
OPTICAL SOURCES: Light Emitting Diode (LED), Structures; Quantum efficiency and LED power, Modulation Bandwidth of LED; LASER Diode- Laser diode modes and threshold conditions, Laser diode rate equations; External Quantum efficiency, Modulation of LASER diodes. PHOTO DETECTORS: Photodetectors – PIN Photodetector; Avalanche Photodiode; detector response time, temperature effect on avalanche gain; comparison of Photodetectors.						
UNIT IV	POWER COUPLING & OPTICAL RECEIVER DESIGN					8hr
Source to fiber power launching- output patterns, power coupling, power launching, equilibrium numerical aperture, laser diode to fiber coupling; Fundamental Receiver operation; Digital Receiver Performance-Probability of error, Quantum limit; BER Comparisons; Point-to-point links- system considerations, link power budget with examples; Error control; Analog Links-Carrier to Noise Ratio; Multichannel Transmission techniques.						

UNIT V	OPTICAL SWITCHES & WDM	8hr
Large Optical switches, Optical switch technologies; Optoelectronic approach, Optical Gating; SONET, Optical Add/Drop Multiplexing; Operational principles of WDM; WDM Network Elements-Optical Line Terminals, Optical Line Amplifiers; Optical Add/Drop Multiplexers (OADM) Architectures; A Brief History of OWC.		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Gerd Keiser, <i>Optical Fiber Communications</i> , 5 th Edition, Tata McGraw-Hill India, 2013.	
2	Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki, <i>Optical Networks- A Practical Perspective</i> , 3rd Edition, Morgan Kaufmann Publishers, 2009	
REFERENCE BOOKS:		
1	John M Senior, <i>Optical Fiber Communications-Principles and Practice</i> , 3 rd Edition, Pearson Education Ltd., 2010.	
2	Z.Ghassemlooy W.Popoola S.Rajbhandar, <i>Optical Wireless Communications System and Channel Modelling with MATLAB</i> , 2nd edition, CRC Press, 2019.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.elprocus.com/basic-elements-of-fiber-optic-communication-system-and-its-working/	
ONLINE COURSES		
1	https://onlinecourses.nptel.ac.in/noc19_ee67/announcements?force=true	
2	https://onlinecourses.nptel.ac.in/noc19_ee57/course?user_email=profmsn26@gmail.com	
3	https://onlinecourses.nptel.ac.in/noc20_ph08/announcements?force=true	

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL4	X			X	
CO2	BL4	X			X	X
CO3	BL5		X			
CO4	BL4			X		
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET025	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	SSSP	3	0	0	3
Course Objectives						
<ol style="list-style-type: none"> 1. Students will get exposure to describe the fundamentals of AI and its applications. 2. Students will be able to apply machine learning algorithms to solve problems of moderate complexity. 						
Course Outcomes: Students will be able to						
1	Apply foundational concepts and search algorithms artificial intelligence to solve practical problems in different domains.(BL3)					
2	Analyze the role of knowledge-based agents and logic in AI systems for effective reasoning and decision-making.(BL4)					
3	Analyze the working of Perceptron, Single Layer, and Multi-Layer Perceptron models.(BL4)					
4	Analyze the significance of machine learning algorithms (supervised learning algorithms) in diverse applications.(BL4)					
5	Evaluate the impact of dimensionality reduction on preserving the information content of the original data using unsupervised learning algorithms.(BL5)					
6	Develop and Implement end-to-end Neural Network and Machine Learning models to solve real-world problems, optimizing them for performance, interpretability, and scalability.(BL6)					
SYLLABUS						
Unit 1	FUNDAMENTALS OF AI AND SEARCH TECHNIQUES					8 hr
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: (Depth First Search, Breadth First Search, Depth Limited, Iterative Deepening, Bidirectional search); Informed (Best First Search and A* Algorithm); Hill Climbing Algorithms in Artificial Intelligence (Simple and Steepest Ascent); Constraint satisfaction problems: Constraint Processing: CSPs, Consistency Based Diagnosis; Algorithm Backtracking, Arc Consistency, Algorithm Forward Checking); Adversarial Search.						
Unit 2	KNOWLEDGE REPRESENTATION AND REASONING					8 hr
Knowledge-Based Agent, Logic; Propositional Logic, A simple knowledge base; First-order Logic; Inference In First-Order Logic; Knowledge Representation; Quantifying Uncertainty; Probabilistic Reasoning; Making Simple Decisions						
Unit 3	ARTIFICIAL NEURAL NETWORKS					8 hr
Introduction, Machine learning basics, Neuron Model, Neural Network Architecture, Learning Rules, Perceptron, Single Layer Perceptron, Multilayer Perceptron, Feed forward propagation, Back propagation Networks, Kohonen's self-organizing networks, Hopfield network, Applications of NN.						

Unit 4	MACHINE LEARNING I	8 hr
Supervised Learning: Introduction to machine learning, Bayes Theorem, Regression, Regression with Maximum Likelihood Estimation, classification with k-Nearest Neighbour (KNN), Support Vector Machines, Decision Trees, Random Forest, Naive Bayes classifier, Bagging, Boosting improving classification using Bagging, Boosting.		
Unit 5	MACHINE LEARNING II	8 hr
Unsupervised Learning: Basics of Clustering, types of clustering, K-Means clustering, Association analysis, Dimensionality reduction: Feature extraction - Principal component analysis, Singular value decomposition. Feature selection – feature ranking and subset selection, filter, wrapper and embedded methods.		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson Publications, 2020.	
2	E. Alpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, 2020.	
3	B. Yegnanarayana, "Artificial Neural Networks", PHI, 2009.	
4	Christopher. M. Bishop, Pattern recognition and Machine Learning, Springer, 2006.	
REFERENCE BOOKS:		
1	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill	
2	Tom M. Mitchell, Machine Learning, MGH	
3	S. O. Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Education (India), 2016.	
ONLINE COURSES		
1	https://keras.io/	
2	https://github.com/keras-team	
3	https://cedar.buffalo.edu/~srihari/CSE574/	
4	https://onlinecourses.nptel.ac.in/noc23_cs18/preview	
5	https://onlinecourses.nptel.ac.in/noc25_cs50/preview	
6	https://onlinecourses.nptel.ac.in/noc24_ee146/preview	
7	https://onlinecourses.nptel.ac.in/noc23_cs87/preview	

Bloom's level – Unit 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	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET030	COMPUTER ORGANIZATION AND ARCHITECTURE					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	DE	3	0	0	3
Course Objective						
The objective of this course is to provide foundational knowledge of computer architecture, including functional units, data representation, memory organization, and control unit design. It aims to develop analytical skills in understanding CPU organization, instruction cycles, and advanced processing techniques like pipelining and multiprocessors. Students will gain the ability to apply these concepts to design efficient computing systems for real-world applications.						
Course Outcomes						
After completing this course, the students will be able to						
1	Apply knowledge of basic computer types, functional units, data representation techniques, and error detection codes to solve computational problems(BL3)					
2	Analyze register transfer operations, micro-operations, and instruction cycles to understand the working of computer components(BL4)					
3	Examine the organization of central processing units, addressing modes, and control unit design to understand processor functionality. (BL4)					
4	Evaluate memory systems and input-output organization, including cache, virtual memory, and DMA, to optimize system performance. (BL5)					
5	Assess advanced processing techniques like pipelining, vector processing, and multiprocessor systems for performance improvement. (BL5)					
6	Create integrated solutions using concepts of computer architecture, memory organization, and processing techniques for real-world applications. (BL6)					
SYLLABUS						
Unit I	BASIC STRUCTURE OF COMPUTERS & COMPUTER ARITHMETIC					8 hr
Computer Types, Functional units; Basic operational concepts Bus structures; Software, Performance, multiprocessors and multi computers; Data types, Complements, Data Representation; Fixed Point Representation. Floating – Point Representation; Error Detection codes; Addition and subtraction Algorithms; multiplication Algorithms, Division Algorithms;						
Unit II	REGISTER TRANSFER LANGUAGE & MICRO-OPERATIONS					8 hr
RTL- Registers, Register transfers; Bus and memory transfers; Micro operations: Arithmetic, Logic; and shift micro operations, Arithmetic logic shift unit; Computer Registers, Computer instructions; Instruction cycle. Instruction codes, Timing and Control unit; Types of Instructions: Memory Reference Instructions, Register reference; Input – Output and Interrupt;						
Unit III	CENTRAL PROCESSING UNIT ORGANIZATION & MICRO PROGRAMMED CONTROL					8 hr
Central Processing Unit organization: General Register Organization, Stack organization; Instruction formats; Addressing modes, Data Transfer and Manipulation; Program Control, CISC and RISC processors; Control unit design: Design approaches, Control memory; Address sequencing; micro program example, design of CU; Micro Programmed Control;						
Unit IV	MEMORY & INPUT-OUTPUT ORGANIZATION					8 hr
Memory Hierarchy, Main memory; Auxiliary memory, Cache memory; Associative						

memory; Virtual memory, Memory management hardware; Peripheral Devices, Input-Output Interface; Asynchronous data transfer Modes of Transfer; Priority Interrupt, Direct memory Access; Input -Output Processor (IOP), Serial communication;	
Unit V	PIPELINE AND VECTOR PROCESSING 8 hrs
Parallel Processing, Pipelining; Arithmetic Pipeline, Instruction Pipeline; RISC Pipeline Vector Processing, Array Processors; Multi processors: Characteristics of Multiprocessors; Interconnection Structures; Interprocessor Arbitration; Interprocessor Communication and Synchronization; Cache Coherence;	
<u>LEARNING RESOURCES</u>	
TEXTBOOKS:	
1	Computer System Architecture – M.Moris Mano, IIIrd Edition, PHI / Pearson, 2006.
2	Computer Organization – Car Hamacher, ZvonksVranesic, SafwatZaky, V Edition, McGraw Hill, 2002.
REFERENCE BOOKS:	
1	Computer Organization and Architecture – William Stallings Seventh Edition, PHI/Pearson, 2006.
2	Computer Architecture and Organization – John P. Hayes, Mc Graw Hill International editions, 1998.
ADDITIONAL REFERENCE MATERIAL	
1	“Computer Organization and Architecture: Designing for Performance”, 10th Edition by William Stallings, Pearson Education.
2	Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,
ONLINE COURSES	
1	<u>NPTEL :Computer science - Introduction to computer architecture(npTEL.ac.in)</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			
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MCSCT005	SOFTWARE ENGINEERING (Common to all Branches)						
	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-IP, 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	
2		
ADDITIONAL REFERENCE MATERIAL		
1	https://ocw.mit.edu/courses/16-355j-software-engineering-concepts-fall-2005/pages/lecture-notes/	
2		
ONLINE COURSES		
1	https://nptel.ac.in/courses/106101061	
2		

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

R24MECEL005	MICROPROCESSORS AND MICROCONTROLLERS LAB					
	Total Contact Hours	42 (P)	L	T	P	C
	Pre-requisite	STLD,MPMC	0	0	3	2
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	Serial Communication using UART in AT Mega Microcontroller (Transmitting a Character) with WinAVR/IDE/Simulator					
9	Generating a PWM Signal using the Timer/Counter of AT Mega Microcontroller with WinAVR/IDE/Simulator					
10	Interfacing Switches and LEDs with AT Mega Microcontroller: I/O Port Programming.					
11	Analog to Digital Conversion using AT Mega Microcontroller: Potentiometer as Analog Input.					
12	Interfacing 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	Advanced Microprocessors and Peripherals by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2 nd 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	Microprocessor and Interfacing by Douglas V.Hall, 2nd Edition, TMH, 2006.

REFERENCE BOOKS:

1	Programming 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	http://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

R24MCSC003	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, INTERSECT, MINUS/EXCEPT) and GROUP BY, 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 (updateable views and non-updateable 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, rollback and savepoint.					
Demonstration experiments						
1	Case study- Library Management system					
2	Case study- E-commerce store management					
3	Case Study- Hospital management					
LEARNING RESOURCES						
TEXTBOOKS:						
1	Database System Concepts, Silberschatz, Korth, McGrawhill, Sixth Edition. McGrawHill.					
2	Database Management Systems, Raghurama Krishnan, Johannes Gehrke					

3	LearningSQL,AlanBeaulieu,O'ReillyMedia,Inc.,3 rd 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

VI Semester

R24MECET013	Embedded Systems					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	MPMC	3	0	0	3
Course Objective						
Students will <ul style="list-style-type: none"> • Gain a foundational understanding of embedded systems and comprehend the design process, challenges, and metrics associated with embedded systems. • Develop proficiency in working with both hardware and software platforms used in embedded systems and understand the principles of hardware-software interfacing. • Master the skills required for embedded C programming and apply these programming skills in practical scenarios through project examples. • Delve into the architecture and programming of ARM-based microcontrollers 						
Course Outcomes						
1	Identify the key components involved in Embedded systems and select suitable hardware and software components (BL3)					
2	Analyze the features and functions of various peripheral devices and interfaces and the challenges associated with embedded system design (BL4)					
3	Evaluate different hardware and software platforms used in embedded systems, considering their advantages and disadvantages. (BL5)					
4	Analyze and integrate advanced concepts and skills in embedded C programming to design, develop, and debug complex applications. (BL4)					
5	Critically evaluate and justify the selection of specific ARM-based microcontroller architectures for diverse applications by comparing their features, addressing modes, and programming paradigms. (BL5)					
6	Create efficient solutions for real-world problems using embedded systems. (BL6)					
SYLLABUS						
Unit 1	Introduction to Embedded Systems					8 hr
Competency Group1: Definition, characteristics, and examples of embedded systems, Embedded system components: processors, memory, Embedded system components: peripherals, sensors, actuators, etc., Embedded system design process: requirements, specifications, modeling,						
Competency Group2: Embedded system design process: simulation, implementation, Embedded system design process: testing, debugging, etc.Embedded system design challenges: performance, power, reliability, security, etc., Embedded system design metrics: cost, quality, time, etc.						
Unit 2	Embedded Hardware and Software Platforms					8 hr
Competency Group1: Embedded hardware platforms: microcontrollers, microprocessors, Embedded hardware platforms: DSPs, FPGAs, SoCs. Embedded software platforms: operating systems, middleware, drivers, libraries, Embedded hardware, and software interfacing: buses, protocols, standards.						
Competency Group2: Embedded Firmware design approaches. EmbeddedFirmware development languages, Programmed I/O, ISR concept.Embedded Software development processand tools. The integrated development environment (IDE)-cross-compilers, compilers, assemblers, linkers, debuggers, emulators, simulators.						

Unit 3	Embedded Systems Programming	8 hr
Competency Group1: Embedded C programming: syntax, data types, operators, Embedded C programming: control structures, functions, Embedded C programming: pointers, arrays, strings. Embedded C programming: input/output, interrupts, timers		
Competency Group2: Serial communication, bit manipulation, memory management, data structures.Embedded C programming 1: interfacing LED, LCD display, Embedded C programming 1: interfacing keypad		
Unit 4	ARM-based Microcontrollers - I	8 hr
Competency Group1: Introduction to LPC 2148 ARM Processors: features; Memory Organization in ARM Processor, ARM instruction set: data processing, data transfer, ARM instruction set: control flow		
Competency Group2: ARM addressing modes: register, immediate, shifted register, etc.Basics of ARM programming: Assembly and C programming;Arithmetic operations, Logic operations		
Unit 5	ARM-based Microcontrollers - II	8hr
Competency Group1: LPC 2148 ARM Processor Peripherals: GPIO, LPC 2148 ARM Processor Peripherals: ADC, DAC, LPC 2148 ARM Processor Peripherals: PWM.LPC 2148 ARM Processor Peripherals: Timers		
Competency Group2: LPC 2148 ARM Processor Peripherals: UART, LPC 2148 ARM Processor Peripherals: SPI, I2C. LPC 2148 ARM Processor Interfacing: LCD, LPC 2148 ARM Processor Interfacing: RTC		
LEARNING RESOURCES		
TEXT BOOKS:		
1	"Embedded Systems: Introduction to ARM Cortex-M Microcontrollers" by Jonathan Valvano	
2	"Embedded Systems" by Rajkamal, TMH, 2017	
3	"The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors" by Joseph Yiu	
REFERENCE BOOKS:		
1	"Embedded System Design: A Unified Hardware/Software Introduction", By F. Vahid and T. Givargis, Wiley India Pvt. Ltd., 2002.	
2	"ARM System Developer's Guide: Design and Optimizing System Software", A.N. Sloss, D. Symes and C. Wright, by Morgan Kaufman Publishers, 2004.	
3	"ARM System Developer's Guide: Designing and Optimizing System Software" by Andrew Sloss, Dominic Symes, and Chris Wright	
4	"Programming Embedded Systems: With C and GNU Development Tools" by Michael Barr and Anthony Massa	
ADDITIONAL REFERENCE MATERIAL		
1	"RTOS for Arm Cortex-M Microcontrollers" by Jonathan Valvano	
ONLINE COURSES		
1	https://nptel.ac.in/courses/108102045	
2	https://onlinecourses.nptel.ac.in/noc20_cs14/preview	
3	https://onlinecourses.nptel.ac.in/noc20_ee98/	
4	https://archive.nptel.ac.in/courses/106/105/106105193/	

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				X
CO3	BL5		X			
CO4	BL4			X		
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

		Analog VLSI Design				
R24MECET014	Total Contact Hours	40 (L) +2 (Orientation)	L	T	P	C
	Pre-requisite	EDC, ANC, Digital VLSI Design	3	0	0	3
Course Objective						
To enable learners to analyze, evaluate, and design CMOS analog circuits covering transistor models, gain stages, frequency response, feedback, and biasing.						
Course Outcomes: Students will able to						
1	Critically evaluate the electrical characteristics of MOS transistors and justify the choice of NMOS/PMOS current mirror configurations (BL5)					
2	Evaluate and compare different small-signal models and justify their suitability in analyzing amplifiers and current mirror circuits derived from large-signal schematics. (BL5)					
3	Evaluate various MOSFET amplifier configurations and justify the selection of appropriate topologies. (BL5)					
4	Assess the frequency behavior of MOSFET amplifier stages and appraise different operational amplifier topologies. (BL5)					
5	Critique feedback amplifier structures and biasing/reference circuits, and justify the choice of appropriate topologies. (BL5)					
6	Design and integrate advanced CMOS amplifiers and feedback circuits to create efficient, reliable analog systems. (BL6)					
SYLLABUS						
Unit 1	MOSFET Device Characteristics and Current Mirror Design					8 hr
Competency Group1: CMOS Technology; Analog circuit design; Physical characteristics of MOS Transistor; Electrical characteristics of MOS transistor.						
Competency Group2: PMOS Transistor; Diode connected NMOS Transistors; NMOS Current mirror; PMOS Current mirror.						
Unit 2	Small signal models					8 hr
Competency Group1: The low frequency small-signal model for an NMOS Transistor; The small-signal model for a PMOS Transistor; A high-frequency small-signal model; Inverting Amplifier.						
Competency Group2: Deriving a small-signal equivalent circuit from a large signal schematic; The small-signal model for a NMOS current mirror; The small-signal model for a PMOS current mirror; Advanced transistor models.						
Unit 3	Basic Gain Stages					8 hr
Competency Group1: The common-source stage at low frequencies; The common-source amplifier with an active load; The common-drain stage at low frequencies; The common-gate stage at low frequencies.						
Competency Group2: The cascode stage at low frequencies; The differential pair at low frequencies; Small-signal equivalent circuit for the differential pair; NMOS differential pair with an active load.						

Unit 4	Frequency response and Multistage Amplifiers	8 hr
Competency Group1: Frequency response of the common-source stage; Frequency response of the common-drain stage; Frequency response of the common-gate stage; Frequency response of the differential pair.		
Competency Group2: Noninverting amplifier circuit using an operational amplifier; Cascode operational amplifiers; Two-stage operational amplifier; Two-stage operational amplifier with feedback.		
Unit 5	Feedback Amplifier and Bias Circuit	8 hr
Competency Group1: The basic feedback structure; Advantages of feedback; Feedback Topologies-Feedback amplifier with voltage sensing and current mixing; Feedback Topologies-Feedback amplifier with current sensing and current mixing, voltage mixing.		
Competency Group2: Bias current circuits with NMOS transistors; Bias current circuits with cascading; Band gap voltage references; Voltage regulators.		
LEARNING RESOURCES		
TEXT BOOKS:		
1	CMOS Analog IC Design :Fundamentals- Erik Bruun,3 rd Edition, Bookboon Learning	
2	Design of Analog CMOS Integrated Circuits-Behzad Razavi, TMH Education.	
3	Microelectronics: Circuit Analysis and Design- Donald A. Neamen, Fourth Edition, McGraw Hill	
REFERENCE BOOKS:		
1	Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.	
2	P.E.Allen & D.R.Holberg, "CMOS Analog Circuit Design",3 rd Edition, Oxford University Press,2011.	
3	T.C.Carusone, D.A.Johns & K.Martin, "Analog Integrated Circuit Design", 2 nd Edition, Wiley, 2012.	
ADDITIONAL REFERENCE MATERIAL		
1	http://www.ee.iitm.ac.in/~ani/2013/ee5390/lectures.html	
2	https://www.youtube.com/playlist?list=PLYrySVqmyVPzvVIPW-TTzHhNWg1J_0LU	
ONLINE COURSES		
1	https://nptel.ac.in/courses/117/106/117106030/	
2	https://onlinecourses.nptel.ac.in/noc25_ee06/preview	

Bloom's level – Units catchment articulation matrix

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

		ANTENNAS AND MICROWAVE ENGINEERING				
R24MECET015	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Integrations, Electromagnetic Waves & Transmission lines	3	0	0	3
Course Objective						
To equip students with comprehensive knowledge of antennas and microwave devices, enabling them to analyze, design, and evaluate different communication antennas, waveguides, microwave components, and solid-state devices, with a focus on their applications in modern communication systems.						
Course Outcomes						
1	Evaluate the performance characteristics of different wire antennas, including dipole antennas, monopole antenna, loop antennas, and helical antennas, to determine their suitability for specific applications.(BL-5)					
2	Evaluate the design characteristics and performance parameters of microwave antennas, including Yagi-Uda antenna, reflectors, horn antennas, microstrip patch antennas and array antennas to recommend optimal solutions for specific communication requirements.(BL-5)					
3	Evaluate the performance of rectangular waveguides and microwave components (attenuators, tees, directional couplers), and their selection for specific microwave communication applications.(BL-5)					
4	Evaluate the operational principles, efficiency, and applications of different microwave tubes along with solid-state devices, to recommend them for specific microwave applications.(BL-5)					
5	Analyze different antenna and microwave measurement techniques to assess antenna and microwave system performance.(BL-4).					
6	Design various antennas, waveguides, and microwave components to meet specific communication and application requirements effectively. (BL-6)					
SYLLABUS						
Unit 1	WIRE ANTENNAS					8hr
Antenna fundamentals, relation between current sources and potential A; Calculation of field components, radiation resistance and Directivity of infinitesimal dipole; Characteristics of Half wave dipole; Characteristics of Quarter wave monopole antenna; Loop antenna characteristics; Helical antennas normal and axial modes, Applications of wire antennas;						
Unit 2	MICROWAVE ANTENNAS AND ARRAYS					8hr
Yagi-Uda antenna Characteristics; Reflector antennas-types, parabolic reflector characteristics, types of feeds; Horn Antennas–Types, Design Characteristics of Pyramidal Horn antenna; Micro-strip Antennas: types, advantages & limitations, feeding methods; Design of Rectangular patch antennas; Introduction to antenna arrays, types of arrays, N-element uniform linear array; N element Broad side array and their characteristics; N element End-fire array and their characteristics;						

Unit 3	WAVE GUIDES AND COMPONENTS	8hr
Introduction, Microwave Spectrum and Bands, Applications of Microwaves; Rectangular Waveguides - Solution of Wave Equations in Rectangular Coordinates; TE/TM mode analysis, Expressions for Fields; Rectangular Waveguide parameters, Waveguide Attenuators; Scattering Matrix–Significance, Formulation and Properties; Microwave Tee Junctions: (E plane, H-plane); Magic Tee, directional Coupler characteristics;		
Unit 4	MICROWAVE TUBES AND SOLID STATE DEVICES	8hr
Limitations of conventional tubes at microwave frequencies; Two-cavity klystrons - Velocity-modulation and Applegate Diagram, Bunching process; Reflex klystrons - velocity modulation and Applegate Diagram, Bunching process; Power output and efficiency of two-cavity klystron and reflex klystron; Slow Wave Structures, Helix TWT-Amplification process; Multicavity Cylindrical Magnetrons; TEDs-Gunn Diode, Principle, Ridley-Watkins-Hilsum Theory - Characteristics; Avalanche Transit Time Devices - IMPATT Diode -Principle of operation and Characteristics.		
Unit 5	ANTENNA AND MICROWAVE MEASUREMENTS	8 hr
Antenna Impedance measurement; Antenna Gain measurement; Measurement of radiation pattern and radiation resistance; Description of Microwave Bench–Different Blocks and their Features; Microwave Power Measurement–Bolometer Method; Measurement of Attenuation, Frequency; Low and high VSWR measurement; Impedance Measurement;		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Balanis Constantine A., Antenna Theory Analysis and design (John Wiley & Sons, 3rd Edition, 2005).	
2	J.D. Kraus, Antennas, McGraw Hill, 2001.	
3	D.M. Pozar, <i>Microwave engineering</i> , 4 th edition, Wiley, 2012	
4	Samuel Y. Liao, <i>Microwave Devices and Circuits</i> , 3 rd Edition, PHI, 2004.	
REFERENCE BOOKS:		
1	Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.	
2	M. Kulkarni, Microwave and Radar Engineering, Fifth Edition, Umesh Publications, 2010	
ADDITIONAL REFERENCE MATERIAL		
1	Antenna and Wave Propagation, G.S.N Raju, Pearson Education India, 3 rd Edition 2009.	
2	I.J. Bahland P. Bhartia, Micro Strip Antennas, Artech House, 1980.	
ONLINE COURSES		
1	https://archive.nptel.ac.in/courses/108/101/108101092/	
2	https://archive.nptel.ac.in/courses/108/103/108103141/	
3	https://archive.nptel.ac.in/courses/108/101/108101112/	

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL5	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL5				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MCST006	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						
Students will have the ability to understand, 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" 9 th Edition, Oracle Press	
2	Paul Deitel and Harvey Deitel, "Java How to Program", 11 th Edition, Pearson.	
REFERENCE BOOKS:		
1	Herbert Schildt, "Java: A Beginner's Guide", 9 th Edition, McGraw Hill, 2022	
2	Bruce Eckel, "Thinking in Java", 9 th 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

R24MECET021	CELLULAR AND MOBILE COMMUNICATIONS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Analog Communications & Digital communications	3	0	0	3
Course Objective						
Students will						
1. Gain understanding of generations of mobile communications and basic operation of mobile cellular system						
2. Gain understanding of types of interferences present and methods to reduce interference.						
3. Gain understanding of frequency management and channel assignment in mobile cellular communications.						
4. Gain understanding of wireless mobile communication systems.						
Course Outcomes						
1	Identify the limitations of conventional communication system and to understand different generations of cellular system (BL3)					
2	Analyse the basic elements of cellular systems and the effects of interference on cellular system performance (BL4)					
3	Analyse different types of interference present in cellular systems and methods to reduce interferences (BL4)					
4	Examine the frequency management and channel assignment that is carried out in cellular communication system (BL5)					
5	Contrast the various multiple access techniques used in the cellular mobile generations (BL4)					
6	Create wireless communication networking between mobiles (BL6)					
SYLLABUS						
Unit 1	INTRODUCTION TO CELLULAR MOBILE SYSTEMS:					8 hr
Evolution of mobile radio communications; Generations of mobile wireless systems (1G, 2G, 2.5G, 3G & 4G); limitations of conventional telephone systems; basic cellular; system performance criteria; uniqueness of mobile radio environment; operation of cellular systems; cellular geometry and hexagonal shaped cells, analog & digital cellular system.						
Unit 2	ELEMENTS OF CELLULAR MOBILE RADIO SYSTEMS					8 hr
General description of the problem; maximum number of frequency channel per cell; consideration of the components of Cellular system; concept of frequency reuse channels; Co-channel Interference Reduction Factor; desired C/I from a normal case in a Omni directional Antenna system; cell splitting,						
Unit 3	INTERFERENCE					8 hr
Interference and its types, introduction to Co-Channel Interference; co-channel interference areas in a system, design of Omni directional in a worst case; design of a directional antenna system; Reduction of co-channel interference: tilting of antenna, umbrella pattern of antenna; effect of height of the antenna; Adjacent channel interference; Introduction, refraction, reflection, diffraction, scattering and Log normal shadow in; Small scale fading, factors and its effects influencing fading; a general formula to mobile radio propagation						
Unit 4	FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT					8 hr
Numbering and grouping; setup channels: access and paging channels channel assignments to cell sites and mobile units; Fixed channel assignment and Non-fixed channel assignment; to operate with additional spectrum; hand off, Types of hands off.						

Unit 5	MODERN WIRELESS COMMUNICATION SYSTEM	8hr
GSM radio subsystem, GSM channel types; Frame structure for GSM; multiple access schemes: FDMA, TDMA, CDMA and SDMA; Signal processing in GSM: GPRS and EDGE ;Wireless Networks Overview of Wi-Fi, Wi MAX and Bluetooth technology (Basic features and physical specifications).		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Mobile Cellular Telecommunications - W.C.Y. Lee, Tata McGrawHill, 2 nd Edition,2006.	
2	Wireless Communications, Principles and Practice Rappaport, T.S., 2 nd Edition, Prentice Hall, NJ, 2002	
3	Mobile communication- G K Behera, SCIETECH PUBLICATIONS PVT LTD,2008.	
REFERENCE BOOKS:		
1	Wireless Communications-AndreaGoldsmith, 2005 Cambridge University Press.	
2	Principles of Mobile Communications -Gordon L.Stuber, Springer International 2 nd Edition,2007.	
3	Wireless and Mobile Communications-LeeMcGraw Hills, 3 rd Edition,2006.	
ADDITIONAL REFERENCE MATERIAL		
1	Mobile Cellular Communication - Gottapu Sasibhushana Rao, Pearson International, 2013.	
ONLINE COURSES		
1	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee48/ "Introduction to Wireless and Cellular Communications".	
2	https://nptel.ac.in/courses/117/104/117104099/# "Advanced 3G and 4G Wireless Mobile Communications".	
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/index.html "MIT Course Principles of Wireless Communications"	

Bloom's level - Unit catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL3	X				
CO2	BL4		X			
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET022	RADAR & SATELLITE COMMUNICATION					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	EMWTL, ADC	3	0	0	3
Course Objective						
1. To acquire fundamentals of various Radar and Satellite systems concepts. 2. Comprehend the satellite subsystems, Link design and earth station technology. 3. Design VSAT networks and advanced radar and satellite systems for communication applications.						
Course Outcomes						
After completing this course, the students will be able to						
1	Analyze radar systems by evaluating key parameters such as radar range equation, transmitter power, and system losses, and assess the effects of Doppler shifts in CW radar. (BL 4)					
2	Analyze MTI, Pulse Doppler, and tracking techniques, and assess their role in accurate target detection and tracking. (BL 4)					
3	Evaluate orbital mechanics and orbital effects on satellite communication performance. (BL 5)					
4	Evaluate satellite subsystems and analyze satellite link design parameters (BL 5)					
5	Evaluate earth station technologies and design VSAT networks for optimal performance (BL 5)					
6	Design advanced radar and satellite systems for communication and tracking applications. (BL 6)					
SYLLABUS						
Unit I	RADAR FUNDAMENTALS AND CW RADAR					8 hr
Radar Block diagram and operation; Radar Range equation; Minimum Detectable Signal, Integration of Radar pulses; Radar Cross-section, Transmitter Power; PRF and Range ambiguities; System losses; Doppler Effect, CW radar - block diagram; Non zero IF receiver; FM CW radar- block diagram.						
Unit II	MTI, PULSE DOPPLER AND TRACKING RADAR					8 hr
MTI & Pulse Doppler Radar-Block diagram and principle; Delay-line cancellers, Blind speeds; Range gated Doppler filters, MTI delay lines, limitations; Sequential lobing, Conical scan; Mono-pulse tracking radar; Target reflection characteristics and angular accuracy; Scanning Patterns in acquisition radar; Tracking in range, Comparison of trackers.						
Unit III	ORBITAL MECHANICS AND LAUNCHERS					8 hr
Overview of Satellite communications; Kepler's laws, Orbital equation; Orbital elements; look angle determination; Orbital perturbations, Orbit determination; Launches and launch vehicles, Launch vehicle selection factors; Satellite positioning into geostationary orbit; Orbital effects in communication systems performance.						
Unit IV	SATELLITE SUB-SYSTEMS AND LINK DESIGN					8 hr
Attitude and Orbit control systems; Telemetry, Tracking and command control system; Power supply system; Communication subsystem; Spacecraft antennas, Basic transmission theory; system noise temperature, G/T ratio; design of down link and uplink; design of satellite links for specified C/N.						
Unit V	EARTH STATION TECHNOLOGY AND VSAT SYSTEMS					8 hr

Introduction, Transmitters, Receivers; Antennas, Tracking systems; Terrestrial interface, Primary power test methods; Very Small Aperture Terminal (VSAT) systems-Network architectures; Access control protocol, Delay considerations; Multiple Access methods; VSAT earth station engineering; Calculation of link margins for VSAT network, System design procedure.

LEARNING RESOURCES

TEXTBOOKS:

1	Merrill I. Skolnik, <i>Introduction to Radar Systems</i> , 3rd edition, McGraw-Hill, 2017.
2	Timothy Pratt, Charles Bostian and Jeremy Allnutt, <i>Satellite Communications</i> , 2nd Edition, WSE, Wiley Publications, 2003.

REFERENCE BOOKS:

1	Peyton Z. Peebles, <i>Radar Principles</i> , John Wiley & Sons Edition, 2007.
2	Dr.D.C.Agarwal, <i>Satellite Communications: Covering latest digital satellite technologies and systems</i> , 2nd edition, Khanna Publishers, 2007.
3	Madhavendra Richharia, <i>Mobile Satellite Communications: Principles and Trends</i> , 2nd edition, John Wiley and Sons, United Kingdom, 2014.

ADDITIONAL REFERENCE MATERIAL

1	http://ocw.mit.edu
2	http://advancedengineering.umd.edu

ONLINE COURSES

1	https://archive.nptel.ac.in/courses/108/105/108105154/
2	https://archive.nptel.ac.in/courses/117/105/117105131/

Bloom’s level - Units catchment articulation matrix

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

R24MECET026	SPEECH AND AUDIO PROCESSING					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	SSSP, Digital Signal Processing	3	0	0	3
Course Objective						
This course will enable students: <ol style="list-style-type: none"> 1. To understand multirate structures, sampling rate converters. 2. To understand multirate filter banks such as two channel QMF banks. 3. To understand different parametric and non-parametric techniques for power spectral estimation. 4. To have an in-depth knowledge of use of digital systems in real time applications. 						
Course Outcomes						
After completing this course, the students will be able to						
1	Analyse the principles of Multirate Digital Signal Processing, including decimation, interpolation, and sampling rate conversion, and implement these techniques in real-world signal processing applications. (BL4)					
2	Examine the performance of filter banks, polyphase structures, and spectral estimation techniques (BL4)					
3	Implement and evaluate adaptive filtering algorithms, such as Least Mean Squares (LMS), Recursive Least Squares (RLS), and Kalman filters, for applications like noise cancellation, equalization, and real-time signal processing. (BL5)					
4	Analyze and implement parametric spectral estimation techniques using Auto-Regressive (AR), Moving Average (MA), and ARMA models, and apply high-resolution spectral estimation algorithms such as MUSIC and ESPRIT for advanced signal processing applications. (BL4)					
5	Evaluate the performance of parametric and non-parametric methods for power spectrum estimation of a signal while considering the suitability of the signal for wavelet transform analysis (BL5)					
6	Develop and implement DSP algorithms using various computational techniques, ensuring efficient real-time processing and application in modern communication and multimedia systems. (BL6)					
SYLLABUS						
Unit I						8 hr
Fundamentals of Digital Speech Processing: Introduction, Review of Digital Signal Processing Concepts, Anatomy & Physiology of Speech Organs, articulatory Phonetics, Acoustic Phonetics, Acoustic Theory of Speech Production, lossless tube models Digital models for speech signals.						
Unit II						8 hr
Time Domain Models for Speech Processing: Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech Vs Silence discrimination using energy and zero crossings, Pitch period estimation using a parallel processing approach, The short time autocorrelation function, Pitch period estimation using autocorrelation function, Median smoothing and speech processing.						
Unit III						8 hr
Speech Enhancement and Automatic Speech Recognition: Nature of interfering sounds, Speech enhancement techniques-spectral subtraction, Multi microphone Approach, Basic pattern recognition approaches, Evaluating the similarity of speech						

patterns, Isolated digit Recognition System, Continuous digit Recognition System, Large vocabulary word recognition system	
Unit IV	8 hr
Voice response systems and Speaker Recognition: General considerations in the design of voice response systems. Multiple output digital voice response systems, typical applications of computer voice response systems, Recognition techniques, Features that distinguish speakers, Speaker recognition by humans, Speaker Verification System, Speaker Identification System,	
Unit V	8 hrs
Homomorphic Speech Processing and Linear Predictive Coding (LPC) Analysis: Homomorphic Systems for Convolution, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation. The Autocorrelation Method, The Covariance Method, Pitch Detection using LPC Parameters, LPC vocoder-quantization considerations.	
<u>LEARNING RESOURCES</u>	
TEXTBOOKS:	
1	Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2	Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., Wiley India, 2000.
REFERENCE BOOKS:	
1	SPEECH CODING ALGORITHMS, Foundation and Evolution of Standardized Coders - WAI C. CHU, A JOHN WILEY & SONS, INC., PUBLICATION

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL4	X				
CO2	BL4		X			
CO3	BL5			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET027		BIOMEDICAL INSTRUMENTATION						
		Total Contact Hours	40 (L) +2 (Orientation)		L	T	P	C
		Pre-requisite	Electronics Circuits and Devices		3	0	0	3
Course Objectives								
1. To introduce fundamentals of transducers as applicable to physiology 2. To explore human body parameter measurement setups 3. To describe the medical imaging systems 4. To explain the principle of therapeutic devices								
Course Outcomes:								
Students will be able to								
1	Apply understanding of the general configurations and functional descriptions of various sensors. (BL3)							
2	Identify the characteristics of the biosignals, cardiovascular system, and their importance in diagnosis (BL3)							
3	Identify a particular cardiovascular measurement system for obtaining specific diagnostic information(BL3)							
4	Distinguish various respiratory system measurements and differentiate the suitability of a specific device for simple therapeutic applications (BL4)							
5	Select an appropriate imaging technique for acquiring physiological parameters (BL5)							
6	Choose a specific measurement system to obtain certain physiological parameters (BL6)							
SYLLABUS								
Unit 1		INTRODUCTION					8 hr	
General configuration and functional description of measuring instruments, Classification of measuring instruments; Static and Dynamic Characteristics of Instrumentation System; Error in the measurement and Error in the Instrumentation Systems, Statistical analysis; Active and Passive Transducers, Classification of Transducers; Physiological transducers, Displacement, Position and Motion Transducers; Pressure Transducers, Transducers for Body Temperature Measurement; Photoelectric Transducers, Optical Fiber Sensors; Biosensors, Smart Sensors, MEMS systems.								
Unit 2		BIO POTENTIALS AND CARDIOVASCULAR SYSTEM					8 hr	
Physiological systems of the body; Introduction to bio-medical signals, Man-Instrument System; The Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potentials; Electrodes: Electrode theory, Bio Potential Electrodes; The Cardiovascular System,The Heart; Blood Pressure, Characteristics of Blood Flow;Heart Sounds, Cardiovascular Measurements-Electrocardiography, ECG recorders.								
Unit 3		CARDIOVASCULAR MEASUREMENTS					8 hr	
Measurement of Blood Pressure, direct and indirect methods; Measurement of Heart Sounds; Measurement of blood flow; Electromagnetic Blood Flowmeter, Ultrasonic Blood flowmeter; Plethysmography; Cardiac output measurement, Phonocardiograph, Measurement of heart rate; Measurement of pulse rate, arrhythmia measurement, QRS detection; Oximetry, Pulse Oximeter								
Unit 4		RESPIRATORY SYSTEM MEASUREMENTS AND THERAPEUTIC DEVICES					8 hr	

The physiology of respiratory system; Pulmonary function measurements, (Lung volumes and capacities); spirometry, Pneumotachometers, Volume measurement; Cardiac pacemakers; Cardiac defibrillators; Diathermy, Respiratory Therapy equipment: Ventilators, Humidifiers, Nebulizers, and Aspirators; Haemodialysis Machines, Lithotripsy		
Unit 5	Modern Imaging systems	8 hr
Generation of Ionizing radiation, instrumentation for diagnostic X-rays; special techniques, instrumentation for the medical use of radioisotopes, Digital Radiography, Computed Tomography (CT), system components, Radio-isotopes in medical diagnosis, Emission Computed Tomography (ECT), PET, SPECT; Magnetic Resonance Imaging System, Ultrasonic Imaging System, Echocardiogram, Medical Thermography		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Hand Book of Bio-Medical Instrumentation– R.S. Khandpur, TMH, 3 rd Edition, 2014.	
2	Biomedical Instrumentation and Measurements–C. Cromwell, F.J.Weibell, E.A. Pfeiffer – Pearson education 2 nd Edition.	
3	A course in Electrical and Electronics Measurements and Instrumentation, by A.K.Sawhney, Dhanpat Rai & Co. 3 rd edition Delhi, 2010.	
REFERENCE BOOKS:		
1	Introduction to Bio-Medical Engineering – Michael M. Domach, Pearson, 2 nd Edition.	
2	Introduction to Biomedical Equipment Technology by Joseph J.Carr, John M.Brown, Prentice Hall 4 th Edition.	
3	Biomedical signal analysis– Rangaraj, M. Rangayyan– Wiley Inter science– John willey&Sons Inc 2 nd Edition.	
ONLINE COURSES		
1	https://onlinecourses.swayam2.ac.in/nou25_bt02/preview	
2	https://onlinecourses.nptel.ac.in/noc25_ee09/preview	

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET031		SYSTEM ON CHIP					
DSC-E2		Total Contact Hours	42(L)	L	T	P	C
		Pre-requisite	DVLSID, AVLSID	3	0	0	3
Course Objective							
Students will gain the knowledge and skills needed to design memory, analogue cores, logic cores, and to validate and test the SOC.							
Course Outcomes: Students will be able to							
1	Illustrate SoC design and methodologies.(BL3)						
2	Analyze memory and Analog core design. (BL4)						
3	Implement core and SoC testing strategies. (BL3)						
4	Apply testing techniques for embedded and Analog cores. (BL3)						
5	Evaluate production and IDDQ testing techniques. (BL5)						
6	Comprehend and apply advanced methodologies for designing, validating, and testing logic core, memory, analog, and mixed-signal cores in modern System-on-Chip (SoC) architectures, ensuring efficient integration, performance optimization, and reliable manufacturing.(BL6)						
SYLLABUS							
Unit 1	INTRODUCTION, DESIGN METHODOLOGY FOR LOGIC CORES						8 hr
Architecture of the Present-Day SoC; Design Issues of SoC; Hardware-Software Co-design; SoC Design Flow; General Guidelines for Design Reuse; Design Process for Soft and Firm Cores; Design Process for Hard Cores; Sign-Off Checklist and Deliverables, System Integration.							
Unit 2	DESIGN METHODOLOGY FOR MEMORY AND ANALOG CORES, DESIGN VALIDATION						8 hr
Design Methodology for Embedded Memories; Memory Compiler; Specifications of Analog Circuits; High-Speed Circuits; Core-Level Validation, Core Validation Plan; Testbenches, Core-Level Timing Verification; Core Interface Verification; SoC Design Validation.							
Unit 3	CORE AND SOC DESIGN EXAMPLES, TESTING OF DIGITAL LOGIC CORES						8 hr
Microprocessor Cores; V830R/AV Superscaler RISC Core, PowerPC 603e G2 Core; Core Integration and On-Chip Bus, Examples of SoC; SoC Test Issues, Access, Control, and Isolation; IEEE P1500 Effort; Core Test and IP Protection; Test Methodology for Design Reuse; Testing of Microprocessor Cores;							
Unit 4	TESTING OF EMBEDDED MEMORIES, ANALOG AND MIXED-SIGNAL CORES						8 hr
Memory Fault Models and Test Algorithms; Test Methods for Embedded Memories; Memory Built-in Self-Test; Testing by On-Chip Microprocessor. Analog Parameters and Characterization; Design-for-Test and Built-in Self-Test Methods for Analog Cores; LogicVision's Analog BIST; IEEE P1149.4.							
Unit 5	IDDQ TESTING & PRODUCTION TESTING						8 hr
Physical Defects; Iddq Testing Difficulties in SoC; Design-for-Iddq-Testing; Design Rules for Iddq Testing;Iddq Test Vector Generation;Production Test Flow; At-Speed Testing;Production Throughput and Material Handling.							

LEARNING RESOURCES	
TEXT BOOKS:	
1	Rochit Rajsunah, System-on-a-chip: Design and Test, Artech House, 2007.
2	Prakash Raslinkar, Peter Paterson & Leena Singh, System-on-a-chip verification: Methodology and Techniques, Kluwer Academic Publishers, 2000.
REFERENCE BOOKS:	
1	M. Keating, D. Flynn, R. Aitken, A. Gibbons Shi, Low Power Methodology Manual for System-on-Chip Design Series: Integrated Circuits and Systems, Springer, 2007.
2	A. Manzone, P. Bernardi, M. Grosso, M. Rebaudengo, E. Sanchez, M. SReorda, Centro Ricerche Fiat, Integrating BIST techniques for on-line SoC testing, IEEE Symposium on On-Line testing, 2000
ADDITIONAL REFERENCE MATERIAL	
1	https://www.engrclasses.pitt.edu/electrical/faculty-staff/akjones/ECE2140/Home_files/soc-overview-pitt-11.pdf
2	https://www.sciencedirect.com/topics/engineering/system-on-chip
3	https://link.springer.com/referenceworkentry/10.1007/978-981-99-2836-1_42
ONLINE COURSES	
1	https://www.udemy.com/topic/soc/?srsltid=AfmBOorxXTJ2__b30TVT809teggOdJvz2EDdzNOdDWW6rRFoji_vzjDM
2	https://www.arm.com/resources/education/online-courses/introduction-to-soc
3	https://inskill.in/soc-design-verification.php
4	https://www.vlsiguru.com/soc-design-verification/

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	BL3		X	X		
CO4	BL3			X	X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET032	VLSI Physical Design					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	DVLSID, DE	3	0	0	3
Course Objective Student will gain the knowledge of the Libraries for VLSI physical design. Create partitioning, floorplanning, placement, routing, and physical synthesis for integrated circuit (IC) chip.						
Course Outcomes						
1	Evaluate VLSI design flow and styles using EDA tools, layout, rules, cells, sizing, pads, and libraries.(BL5)					
2	Assess and validate physical design methodologies including partitioning, planning, placement, and constraints for efficient VLSI circuit implementation.(BL5)					
3	Critically analyze and appraise placement techniques, clock synthesis, RC modeling, and power analysis to ensure optimized VLSI physical design.(BL5)					
4	Evaluate and validate routing strategies using graphs, constraints, and extraction techniques to achieve efficient and reliable VLSI interconnect design.(BL5)					
5	Appraise packaging technologies, interconnections, and reliability factors considering design constraints and technology drivers for advanced electronic systems.(BL5)					
6	Design an optimized VLSI layout by adhering to design rules and evolving trends in Electronic Design Automation (EDA).(BL6)					
SYLLABUS						
Unit 1	Libraries					8 hr
Electronic Design Automation (EDA);VLSI Design Flow , VLSI Design Styles ; Layout Layers ; Design Rules; Standard Cells ; Transistor Sizing; Input-Output Pads; Library Characterization;						
Unit 2	PARTITIONING & FLOORPLANNING					8 hr
Netlist partitioning in VLSI physical design; Kernighan-Lin mincut partitioning Algorithm; Technology File, Circuit Description; Design Constraints; Design Planning; Pad Placement, Power Planning; Macro Placement, Clock Planning; Pin Assignment;						
Unit 3	PLACEMENT					8 hr
Global Placement; Min-Cut Placement; Analytic Placement; Detail Placement; Timberwolf algorithm; Clock Tree Synthesis; Distributed RC Network; Power Analysis;						
Unit 4	ROUTING					8 hr
Grid Routing; Terminology & Single-Net Routing; Full-Netlist Routing; Modern Global Routing; Horizontal and Vertical Constraint Graphs; Special Routing; Detail Routing; Extraction;						
Unit 5	Packaging					8 hr
Packaged Electronics, Packaging Functions and Hierarchy; Evolving Trends; Technology Drivers: Wireability , Number of Terminals, and Rent's Rule; Electrical Design Considerations; Packaging Technologies; Chip-Level Interconnections,First-level Packages1; Package Wiring And Terminals; Package Reliability;						

LEARNING RESOURCES	
TEXT BOOKS:	
1	Physical Design essentials, An ASIC Design Implementation Perspective, Khosrow Golshan.
2	Sait, Sadiq M., and Habib Youssef. VLSI Physical Design Automation: Theory and Practice. Vol. 6. World Scientific, 1999. ISBN-10: 9788175967342, ISBN-13: 9788175967342. Weblink
3	Eugene J. Rymaszewski, Rao R. Tummala, Toshihiko Watari (auth.), Rao R. Tummala, Eugene J. Ry "Microelectronics Packaging, Technology Drivers".
REFERENCE BOOKS:	
1	Kahng, Andrew B., et al. VLSI Physical Design: from Graph partitioning to Timing closure. Springer Science & Business Media, 2011. ISBN-10: 9400790201, ISBN-13: 978-9400790209. Weblink
2	Hill & Peterson, Computer Aided Logical Design with Emphasis on VLSI, John Wiley, 1993.
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc25_cs73

Bloom's level - Units catchment articulation matrix

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

R24MECEL006	VLSI LAB					
	Total Contact Hours	42 (P)	L	T	P	C
	Pre-requisite	DE, DVLSID, AVLSID	0	0	3	2
Course Objective: The objective of this lab is						
To design and simulate various digital and analog circuits using LTspice.						
Course Outcomes: Students have the ability to						
1	Understand the MOSFET behavior and its impact on circuit performance.					
2	Design combinational and sequential circuits using various logic styles.					
3	Design and analyze different amplifiers and current mirrors.					
4	Evaluate performance parameters such as power consumption, delay, gain, CMRR, and slew rate through schematic simulations.					
5	Use schematic design and circuit simulation tools.					
List of Experiments: (Minimum of Ten Experiments have to be performed)						
1	Design and simulate a CMOS inverter					
2	Design CMOS NOR2 gate and NAND2 gate and verify the output state.					
3	Design and verify full adder using CMOS logic.					
4	Design and verify a 2:1 multiplexer with the help of TG.					
5	Design and verify $Y = \overline{AB} + C$ using CMOS and Pseudo NMOS logic.					
6	Design and verify $Y = \overline{AB} + C$ using different dynamic CMOS logic.					
7	Design and verify D & T flip flops.					
8	Design and verify 3-bit synchronous counter using D flip flop.					
9	Verify the MOSFET (NMOS & PMOS) Characteristics					
10	Design and Simulate basic Common Source and Common Gate Amplifiers. Validate different amplifier parameters.					
11	Design and analyze various Current Mirrors					
12	Design and simulate differential amplifier. Analyze Gain, Slew rate and CMRR by performing Schematic Simulations.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, TMH, 3 rd Ed. 2011					
2	CMOS Analog IC Design: Fundamentals, Third Edition, Erik Bruun, 2022					
REFERENCE BOOKS:						
1	Digital Integrated Circuits, A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic.					
ADDITIONAL REFERENCE MATERIAL						
1	https://www.youtube.com/watch?v=JRcyHuyb1V0					
2	https://www.youtube.com/watch?v=CyKh7xpvfqI					

R24MCSC004	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.					
List of Experiments						
1	Week 1: Introduction to Java and Structured Programming <ol style="list-style-type: none"> Write a simple Java program that prints "Hello, World!" to the console. Write a Java program that takes user input using the Scanner class. Write a Java program to demonstrate all primitive data types. Implement a Java program that converts a floating-point number to an integer. Create a Java program that uses the final keyword to define constants. 					
2	Week 2: Operators, Control Statements - Selection <ol style="list-style-type: none"> Implement a Java program that uses arithmetic, relational, and logical operators. Write a Java program to find the largest of three numbers using if-else statements. Use the ternary operator to implement a simple conditional check. 					
3	Week 3: Control Statements - Iteration <ol style="list-style-type: none"> Write a Java program that prints all even numbers between 1 and 100 using a for loop. Create a Java program that calculates the factorial of a given number using a while loop. Write a JAVA program to display the Fibonacci sequence. Implement a menu-driven program using a do-while loop. 					
4	Week 4: Arrays <ol style="list-style-type: none"> Write a Java program to reverse a one-dimensional array of integers. Write a Java program to search for an element in an array. Implement a Java program to find matrix multiplication using two-dimensional arrays. 					
5	Week 5: Classes and Methods					

	<ol style="list-style-type: none"> 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	<p>Week 6: Constructors, this Keyword, and Garbage Collection</p> <ol style="list-style-type: none"> 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	<p>Week 7: Inheritance and Polymorphism</p> <ol style="list-style-type: none"> 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	<p>Week 8: Abstract Classes and Interfaces</p> <ol style="list-style-type: none"> 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	<p>Week 9: Exception Handling</p> <ol style="list-style-type: none"> 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	<p>Week 10: Multithreading</p> <ol style="list-style-type: none"> 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	<p>Week 11: Event Handling, AWT</p> <ol style="list-style-type: none"> 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	<p>Week 12: Swings</p> <ol style="list-style-type: none"> 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" 9 th Edition, Oracle Press |
| 2 | Paul Deitel and Harvey Deitel, "Java How to Program", 11 th Edition, Pearson. |

REFERENCEBOOKS:

- | | |
|---|---|
| 1 | Herbert Schildt, "Java: A Beginner's Guide", 9 th Edition, McGraw Hill, 2022 |
| 2 | Bruce Eckel, "Thinking in Java", 9 th 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	30 (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					6 hr
Number System; LCM & HCF; Ratio & Proportion; Percentages; Profit & Loss; Mixture and Allegation.						
Unit II	ALGEBRAIC ANALYSIS					6 hr
Quadratic & Linear eq's; Set theory; Inequalities; Speed, Time and Distance; Time and Work; Simple Interest & Compound Interest.						
Unit III	ADVANCED MATHS					6 hr
Circles, lines & angles; Triangles, quadrilaterals & polygons; Co-ordinate geometry; Areas & perimeter-2D; Surface area & volumes-3D; Trigonometry.						
Unit IV	MODERN MATHS					6 hr
Probability; Permutation and Combination; Surds & Indices; Functions; Logarithms.						
Unit V	DATA INTERPRETATION & ELEMENTARY STATISTICS					6 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 (<u>Arun Sharma (Author)</u>) https://amzn.in/d/3OTZ5uI
3	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (<u>Adda247 Publications (Author)</u>) https://amzn.in/d/4aMMHvg
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 (<u>Disha Experts (Author)</u>)
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 (<u>Arun Sharma (Author)</u>) 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 (<u>Arun Sharma (Author)</u>) https://amzn.in/d/9OQM QBX
7	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (<u>Adda247 Publications (Author)</u>) https://amzn.in/d/4aMMHvg

VII Semester

R24MECET016	Industry 4.0 and IIOT					
	Total Contact Hours	40 (L) +2 (Orientation)	L	T	P	C
	Prerequisite	Basic Electronics, IOT	3	0	0	3
Course Objectives						
1. To introduce fundamentals of Industrial IOT and Industry 4.0. 2. To explore Artificial intelligence, Big data analysis and cyber security. 3. To describe Business Model and Reference Architecture of IIOT. 4. To explain Big Data Analytics, Software Defined Networks and Security.						
Course Outcomes:						
Students will be able to						
1	Understand the fundamentals of Industrial IOT and Industry 4.0 and to Evaluate the Principles of the Fourth Industrial Revolution and Their Applications (BL3)					
2	Design and Integrate Cyber-Physical Systems in Industry 4.0 and apply Augmented Reality (AR) and Virtual Reality (VR) for Industrial Training and Maintenance (BL4)					
3	Examine different Business Model and Reference Architecture of IIOT (BL4)					
4	Integrate and Evaluate Software Defined Networks (SDN) in IIoT Systems (BL5)					
5	Appraise about the security and Fog computing (BL5)					
6	Apply Augmented Reality (AR) and Virtual Reality (VR) for Safety and Maintenance in Industrial Environments and to create IIoT Solutions for Various Industry Applications (Healthcare, Manufacturing, Energy, etc.) (BL6)					
SYLLABUS						
Unit 1	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL IOT					8 hr
Evolution of Industrial Automation- Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Overview of Industrial IoT-1: Components of IIOT -Sensors, Interface, Overview of Industrial IoT-2 : Networks, People & Process Introduction to Industry 4.0: Enabling Technologies – AI, Robotics, IOT, Enabling Technologies Cyber-Physical Systems, Smart Factories, Supporting systems for Industry 4.0 Comparison of Industry 3.0 vs 4.0						
Unit 2	ARCHITECTURES of IIOT					8 hr
Overview of IOT components ;Various Architectures of IOT and IIOT, Advantages &disadvantages, Industrial Internet - Reference Architecture; IIOT System components:Sensors, Gateways, Routers, Modem, Cloud brokers, Servers and its integration, Introduction to WSN, WSN Architecture WSN network design for IOT						
Unit 3	ARTIFICIAL INTELLIGENCE, BIG DATA ANALYSIS AND CYBER SECURITY OF INDUSTRY 4.0					8 hr
Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis,Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Industrial ProcessesPart II, Industrial Sensing & Actuation, Industrial Internet Systems.						
Unit 4	INDUSTRIAL IOT: BIG DATA ANALYTICS ,SOFTWARE DEFINED NETWORKS,SECURITY AND FOG COMPUTING					8 hr
Industrial IoT: Big Data Analytics,Software Defined Networks and SDN in IIoT,Edge Computing in IIoT ,Fog Computing in IIoT ,Security in IIoT						

Unit 5	INDUSTRIAL IOT: APPLICATION DOMAINS	8 hr
Industrial IoT Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Automotive, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications)		
LEARNING RESOURCES		
TEXT BOOKS:		
1	S. Misra, A. Mukherjee, and A. Roy, 2020. <i>Introduction to IoT</i> . Cambridge University Press	
2	S. Misra, C. Roy, and A. Mukherjee, 2020. <i>Introduction to Industrial Internet of Things and Industry 4.0</i> . CRC Press.	
REFERENCE BOOKS:		
1	Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress)	
2	Industrial Internet of Things: Cybermanufacturing Systems” by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)	
ONLINE COURSES		
1	https://onlinecourses.nptel.ac.in/noc24_cs95/announcements?force=true	

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		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET023	WIRELESS ADHOC AND SENSOR NETWORKS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	ADC	3	0	0	3
Course Objective						
1.To make students understand the basics of Wireless Sensor Networks. 2.To familiarize with learning of the Architecture of WSN. 3. To understand the concepts of Networking and Networking in WSN. 4. To make students to understand network management and security in WSN.						
Course Outcomes						
On successful completion of the course students will be able to						
1	Analyze the hardware components in wireless sensor networks. (BL4)					
2	Apply the design principles of WSN architectures and operating systems for simulating environment situations.(BL3)					
3	Apply various concepts for assignment of MAC addresses.(BL3)					
4	Explain the node and network management in wireless sensor networks.(BL5)					
5	Analyze Challenges of Security in Wireless Sensor Networks.(BL4)					
6	Evaluate different network architectures, nodes, management, security and MACs, in Wireless Sensor Networks.(BL)					
SYLLABUS						
Unit 1	OVERVIEW OF WIRELESS AD HOC NETWORKS					8 hr
Competency Group1: Wireless Ad Hoc networks part I , Wireless Ad Hoc networks part II; self-organizing behavior of wireless sensor networks; cooperation in mobile adhoc networks part I, cooperation in mobile adhoc networks part II; Operation states with different power consumption, Microcontroller energy consumption, Memory, Radio transceivers; Competency Group2: Operating systems and execution Environments- Embedded operating systems; Programming paradigms and application programming interfaces; Structure of operating system and protocol stack; Dynamic energy and power management.						
Unit 2	NETWORK ARCHITECTURE.					8hr
Competency Group1: Sensor network scenarios -Types of sources and sinks, Single-hop versus multihop networks; Multiple sinks and sources Three types of mobility. Optimization goals and figures of merit - Quality of service, Energy efficiency; Scalability, Robustness, Design principles for WSNs- Distributed organization; In-network processing, Adaptive fidelity and accuracy, Data centrality, Exploit location information; Exploit activity patterns, Exploit heterogeneity, Component-based protocol stacks and cross-layer optimization; Competency Group2: Service interfaces of WSNs-Structuring application/protocol stack interfaces; Expressibility requirements for WSN service interfaces; Discussion. Gateway concepts-The need for gateways; WSN to Internet communication, Internet to WSN communication, WSN tunneling						
Unit 3	MEDIUM ACCESS CONTROL					8hr
Competency Group1: MAC protocols in MANETS-Part-I, MAC protocols in MANETS-part-II, Routing in MANETS -Part-I, Routing in MANETS -Part-II, Routing in MANETS -Part-III, Multicasting in MANETs, Mobility model for MANETs. Competency Group2: Contention-Based MAC Protocols, Power Aware Multi-Access with Signaling, Sensor MAC; Timeout MAC, Pattern MAC, Routing-Enhanced MAC ;Data-Gathering MAC, Preamble Sampling and Wise MAC; Receiver-Initiated MAC, Hybrid MAC Protocols , Zebra MAC , Mobility Adaptive						

Hybrid MACL.		
Unit 4	NODE AND NETWORK MANAGEMENT	8 hr
<p>Competency Group1: Power Management -Local Power Management Aspects; Dynamic Power Management Conceptual Architecture; Time Synchronization-Clocks and the Synchronization Problem; Time Synchronization in Wireless Sensor Networks</p> <p>Competency Group2: Basics of Time Synchronization; Time Synchronization Protocols, Localization- Overview; Ranging Techniques, Range-Based Localization; Range-Free Localization, Event-Driven Localization.</p>		
Unit 5	NETWORK SECURITY	8hr
<p>Competency Group1: Fundamentals of Network Security - Challenges of Security in Wireless Sensor Networks ; Security Attacks in Sensor Networks , Denial-of-Service; Attacks on Routing ,Attacks on Transport Layer, Attacks on Data Aggregation ; Privacy Attacks, Protocols and Mechanisms for Security ,Symmetric and Public Key Cryptography</p> <p>Competency Group2: Key Management , Defenses Against DoS Attacks; Defenses Against Aggregation Attacks , Defenses Against Routing Attacks; Security Protocols for Sensor Networks, TinySec ,Localized Encryption; and Authentication Protocol ,IEEE 802.15.4 and ZigBee Security.</p>		
LEARNING RESOURCES		
TEXT BOOKS:		
1	Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.	
2	Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2007	
3	Waltenegus Dargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks - Theory And Practice", John Wiley & Sons Publications, 2011	
REFERENCE BOOKS:		
1	KazemSohraby, Daniel Minoli, & TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.	
2	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003	
ONLINE COURSES		
1	https://nptel.ac.in/courses/106/105/106105160/	
2	https://onlinecourses.swayam2.ac.in/arp19_ap52/preview	
3	https://cse.iitkgp.ac.in/~smisra/course/wasn.html	

Bloom's level - Unit catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL4	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MECET024	MIMO WIRELESS COMMUNICATIONS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	ADC, AME	3	0	0	3
Course Objective						
This course aims to help the students to understand introduction to MIMO, space-time block codes and orthogonal space-time block codes, MIMO channel models, antenna selection for MIMO system and suboptimal multi user MIMO techniques						
Course Outcomes						
After completing this course, the students will be able to						
1	Understand basic concepts of MIMO system , its capacity and information rate.(BL3)					
2	Apply the concepts of diversity in antennas, types of transmission schemes and performance analysis of Space-Time Block Codes(BL3)					
3	Compare different MIMO channels (BL4)					
4	Appraise design of different antenna selection for MIMO systems (BL5)					
5	Explain the concepts of Suboptimal techniques for Multiple Access Channel for broad casting and receiving (BL5)					
6	Design an antenna for a specific application in a MIMO system (BL6)					
SYLLABUS						
Unit I	INTRODUCTION TO MIMO					8hr
Need for MIMO systems, Multiple antennas in wireless communication systems, Capacity and Information rates in MIMO channels: Capacity and Information rates in AWGN and fading channels, Capacity of MIMO channels						
Unit II	SPACE-TIME BLOCK CODES and ORTHOGONAL SPACE-TIME BLOCK CODES					8hr
Transmit Diversity with Two Antennas: The Alamouti Scheme Transmission Scheme, Optimal Receiver for the Alamouti Scheme, Performance Analysis of the Alamouti Scheme. Linear Orthogonal Designs, Decoding of Linear Orthogonal Designs, Performance Analysis of Space-Time Block Codes, Quasi-Orthogonal Space-Time Block Codes, Linear Dispersion Codes						
Unit III	MIMO CHANNEL MODELS					8hr
Single user MIMO Capacity, Single user capacity metrics, Multi-user capacity metrics, Transceiver techniques: Linear receivers, MMSE-SIC, V-BLAST, D-BLAST, Closed loop MIMO, Space time coding, Codebook pre-coding.						
Unit IV	ANTENNA SELECTION FOR MIMO SYSTEM					8hr
MIMO System Model, Spatial Multiplexing, SIMO Systems, Implementing antenna selection: Criteria and Algorithms, Performance with Non-Idealities, Antenna selection with spatial correlation.						
Unit V	SUBOPTIMAL MULTI USER MIMO TECHNIQUES					8hr
Suboptimal techniques for Multiple Access Channel, Suboptimal techniques for Broadcast channel, MAC-BC duality for linear transceivers.						
<u>LEARNING RESOURCES</u>						
TEXTBOOKS:						
1	"Coding for MIMO Communication Systems" by Tolga M. Duman, Ali Ghayeb – John Wiley & Sons, 2007					
2	"MIMO Communication for Cellular Networks" by Howard Huang, Constantinos B. Papadias, SivaramaVenkatesan – Springer,2011.					
REFERENCE BOOKS:						
1	"MIMO System Technology for Wireless Communications" Edited by George Tsoulos – Taylor & Francis					

2	"MIMO Wireless Communications" by EzioBiglieri - Cambridge University Press
ADDITIONAL REFERENCE MATERIAL	
1	"Space-time processing for MIMO communications",by A.B. Gershman and N.D. Sidiropoulos, Wiley, Hoboken, NJ, USA, 2005
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc23_ee70/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	BL3		X			
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R24MECET028 DSC-E4	DEEP LEARNING					
	Total Contact Hours	42 (L)	L	T	P	C
	Prerequisite	AIML	3	0	0	3
Course Objective						
<ul style="list-style-type: none"> To equip students with a deep understanding of neural network architectures, optimization techniques, and regularization methods, enabling them to analyze, evaluate, and develop advanced deep learning models for solving complex real-world problems. 						
Course Outcomes						
After completing this course, the students will be able to						
1	Apply the working principles of perceptrons, multilayer perceptrons (MLPs), and sigmoid neurons to analyze their roles in deep learning architectures. (BL-3)					
2	Apply different optimization strategies to evaluate their impact on neural network training efficiency, stability, and generalization.(BL-3)					
3	Analyze and compare different regularization techniques, such as dropout, L2 regularization, and early stopping, to determine their effectiveness in reducing overfitting and improving model generalization.(BL-4)					
4	Compare the performance of different CNN models in terms of accuracy, computational efficiency, and suitability for various image processing applications. (BL-5)					
5	Examine the vanishing and exploding gradient problems in RNNs and explore the role of LSTMs and GRUs in addressing these issues. (BL-4)					
6	Design and develop deep learning models by integrating optimization techniques, dimensionality reduction, regularization methods, convolutional architectures, to solve real-world problems in image processing. (BL-6)					
SYLLABUS						
Unit I	Introduction to Deep Learning and Perceptrons					8 hr
History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.						
Unit II	Optimization Techniques in Neural Networks					8 hr
Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, FeedForward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.						
Unit III	Dimensionality Reduction and Regularization					8 hr
Eigenvalues and eigenvectors, Eigenvalue Decomposition, Principal Component Analysis and its interpretations, Singular Value Decomposition, Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing, Ensemble methods, Dropout, Better activation functions, Batch Normalization.						
Unit IV	Convolutional Neural Networks (CNNs)					8 hr
Convolutional Neural Networks and its layers, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art.						

Unit V	Recurrent Neural Networks (RNNs)	8 hr
Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images.		
<u>LEARNING RESOURCES</u>		
TEXTBOOKS:		
1	Deep Learning- Ian Goodfellow, YoshuaBenjio, Aaron Courville, The MIT Press, 2016	
2	Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc. 2007	
REFERENCE BOOKS:		
1	Deep Learning A Practitioners Approach by J. Patterson, A. Gibson, O'Reilly Media, Inc,2017	
2	Deep learning with python by Jason brownlee., edition1.7, 2016	
ADDITIONAL REFERENCE MATERIAL		
ONLINE COURSES		
1	http://www.deeplearningbook.org	
2	https://onlinecourses.nptel.ac.in/noc25_cs106/preview	
3	https://onlinecourses.nptel.ac.in/noc25_ee181/preview	
4	https://onlinecourses.nptel.ac.in/noc25_cs93/preview	

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 5				X	
CO5	BL 4					X
CO6	BL 6	X	X	X	X	X

R24MECET029		BIOMEDICAL SIGNAL PROCESSING					
		Total Contact Hours	42(L)	L	T	P	C
		Pre-requisite	DSP,SSSP	3	0	0	3
Course Objectives							
To provide students with a comprehensive understanding of biomedical signal analysis techniques, enabling them to process, interpret, and analyze signals from various biomedical sources for diagnostic and therapeutic applications.							
Course Outcomes							
The students will be able to							
1	Apply biomedical signal analysis techniques to interpret signals such as EMG, ECG, EEG, and speech signals, and use computer-aided diagnosis for addressing challenges in biomedical signal processing. (BL3)						
2	Apply various filtering techniques, including time-domain, frequency-domain, and adaptive filtering methods, to address noise issues in biomedical signals and improve signal quality through practical case studies. (BL3)						
3	Analyze biomedical signal processing techniques, including QRS detection, ECG and EEG rhythm analysis, and PSD estimation, to identify patterns and diagnose abnormalities through practical case studies. (BL4)						
4	Evaluate the motor unit firing patterns, cardiac rhythms, and speech signals using point processes and parametric system modeling techniques, and apply spectral modeling for practical biomedical applications (BL5)						
5	Analyze time-variant systems and adaptive segmentation techniques for signal processing, including applications in EEG signal segmentation and HRV analysis (BL4)						
6	Design and develop advanced biomedical signal processing systems, incorporating techniques such as adaptive filtering, time-varying analysis, and spectral modeling for applications in health diagnostics and treatment monitoring.. (BL6)						
SYLLABUS							
Unit I	Introduction to Biomedical Signals					8 hr	
Nature of biomedical signals, examples- EMG, ECG, EEG, speech signal, objectives of biomedical signal analysis, difficulties, computer -aided diagnosis.							
Unit II	Filtering for Removal of Artifacts					8 hr	
Random structured and physiological Noise, illustration of the problem with case studies, Fundamental concepts of filtering, Time domain filtering -Synchronized Averaging, Moving Average, Derivative-based operators to remove low frequency artifacts, Frequency Domain Filtering-Butterworth low and highpass filters, Optimal Filtering-The Weiner Filter, Adaptive Filtering.							
Unit III	Event Detection and Waveform Analysis					8 hr	
Illustration of problem with case studies, Derivative based Approaches for QRS Detection, Pan Tompkins Algorithm for QRS Detection, correlation analysis of EEG Rhythms, ECG Rhythm Analysis, Morphological Analysis of ECG, Envelope extraction and analysis, Estimation of the PSD.							
Unit IV	Modeling of Biomedical Systems					8 hr	
Illustration of the problems -Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech; Point process, Parametric system modeling, Autoregressive model, polo-zero modeling, electromechanical models of signal generation Applications- Heart rate variability, Spectral modeling and analysis of PCG signals.							
Unit V	Analysis of Non stationary Signals					8 hrs	

Illustration of the problem with case studies- articular cartilage damage and knee- joint vibrations, time variant systems, fixed segmentation, adaptive segmentation- spectral error measure, ACF distance, use of adaptive filters for segmentation, applications- adaptive segmentation of EEG signals, Time varying analysis of HRV.

LEARNING RESOURCES

TEXTBOOKS:

1	R M Rangayyan "Biomedical Signal Analysis: A case Based Approach", IEEE Press, John Wiley & Sons. Inc, 2002
2	Willis J. Tompkins " Biomedical Digital Signal Processing", EEE, PHI, 2004

REFERENCE BOOKS:

1	D C Reddy "Biomedical Signal Processing: Principles and Techniques", Tata McGraw-Hill Publishing Co. Ltd, 2005
2	AV Oppenheim and RW Shafer "Discrete-time Signal Processing", Prentice Hall, Englewood Cliffs, NJ, 1989

ADDITIONAL REFERENCE MATERIAL

1	http://people.ucalgary.ca/~ranga/ene1563
2	https://nptel.ac.in/courses/108/105/108105101/
3	https://www.journals.elsevier.com/biomedical-signal-processing-and-control

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc20_ee41/
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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	BL5				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MECET033		TESTING AND TESTABILITY					
		Total Contact Hours	42 (L)	L	T	P	C
		Pre-requisite	DVLSI, AVLSI, DE	3	0	0	3
Course Objective: The objective of this course is to deal with the study of VLSI design flow, Functional verification, verification flow, need of electronic testing, fault modeling, test generation for combinational circuits, test generation for sequential circuits, fault simulation, Built-In Self-Test (BIST), Design for Testability (DFT).							
Course Outcomes							
1	Describe the Testability of Combinational Circuits						
2	Explain the Testability of Sequential Circuits						
3	Illustrate the concepts of Built in Self-Test						
4	Demonstrate the design for Testability of Memory Circuits						
5	Illustrate Self Checking Circuits using various techniques						
6	Understand the Process of Formal Verification						
SYLLABUS							
Unit 1	Introduction to VLSI Testing					8 hr	
Introduction, Testing During VLSI Life Cycle, Test Generation, Fault Models, Levels of Abstraction, Overview of Test Technology Design Verification, Test Generation, Fault Models, Overview of VLSI Test Technology							
Unit 2	Design For Testability					8 hr	
Testability Analysis, Scan design: Muxed-D Scan Cell, Clocked-Scan Cell, LSSD Scan Cell, Scan Architectures: Full-Scan Design, Partial-Scan Design, Random-Access Scan Design, Scan Design Rules							
Unit 3	Logic and Fault Simulation					8 hr	
Simulation models, Logic simulation, Gatelevel Network, Fault simulation, Hazards, Timing Models, Fault Detection. Comparison of Fault Simulation Techniques,							
Unit 4	Test Generation					8 hr	
Random Test Generation, Weighted Random Test Generation, Probability of Fault Detection, Exhaustive Test Generation, Boolean Difference, Deterministic ATPG, D Algorithm: D-Frontier, J Frontier							
Unit 5	Formal Verification					8 hr	
Introduction to Formal Verification, Advantage of FV, Models for FV, Design flow FV, Challenges In Implementing FV, Basic Formal Verification Algorithm, Formalizing Operation Definitions, BDDs.							
LEARNING RESOURCES							
TEXT BOOKS:							
1	Michael. L. Bushnell, and Vishwani. D. Agrawal, "Essentials of Electronic Testing For Digital, Memory And Mixed Signal VLSI Circuits" Kluwer Academic Publishers, Third Edition, 2004.						
2	B. Wile, John C. Goss and W. Rosner " Comprehensive Functional Verification" Morgan Kaufmann, 2005						
3	VLSI Testing digital and Mixed analogue/digital techniques-Stanley L. Hurst, IEE Circuits, Devices and Systems series 9, 1998.						
REFERENCE BOOKS:							

1	Esstentials of Electronic Testing-Bushnell and Vishwani D.Agarwal, Springers.
2	Digital Systems Testing and Testable Design-Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books
3	Hill & Peterson, Computer Aided Logical Design with Emphasis on VLSI , John Wiley, 1993.
4	Formal Verification, An Essential Toolkit for Modern VLSI Design, Erik Seligman, Tom Schubert, M V Achutha Kiran Kumar Second Edition.
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc25_ee25

Bloom's level – Unit 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

R24MECET034	VLSI DESIGN FLOW: RTL TO GDS					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	DE, DVLSI	3	0	0	3
Course Objective						
Students will gain the knowledge and skills needed to understand the VLSI design flow, from high-level system modelling and hardware-software partitioning to RTL design, logic optimization, physical implementation, verification, and post-GDS processes, enabling students to develop and optimize integrated circuits with a focus on performance, power, and area efficiency.						
Course Outcomes: Students will be able to						
1	Understand the integrated circuit design, fabrication, and the VLSI design flow, from pre-RTL methodologies to post-GDS processes. (BL3)					
2	Evaluate and optimize hardware modeling, functional verification, and logic synthesis techniques to enhance the efficiency, reliability, and performance of digital designs using Verilog and formal verification methods. (BL5)					
3	Analyze timing constraints, delay calculations, and power optimizations to ensure accurate static timing analysis and performance optimization in VLSI circuits. (BL4)					
4	Understand formal verification techniques, design-for-test (DFT) methodologies and physical design fundamentals. (BL3)					
5	Evaluate and optimize chip planning, placement, clock tree synthesis, and routing strategies to enhance performance, power efficiency, and manufacturability in VLSI physical design. (BL5)					
6	Develop the VLSI design flow, from pre-RTL methodologies to post-GDS processes, including hardware modelling, logic and timing optimization, formal verification, physical design, and verification techniques. (BL6)					
SYLLABUS						
Unit 1	Introduction to VLSI Design and Implementation Flow					8 hrs
Basic Concepts of Integrated Circuit: Structure, Fabrication, Types, Design Styles, Designing vs. Fabrication, Economics, Figures of Merit, Overview of VLSI Design Flow: Design Flows and Abstraction; Pre-RTL Methodologies: Hardware-software Partitioning, SoC Design, Intellectual Property (IP) Assembly, Behavioral Synthesis, RTL to GDS Implementation: Logic Synthesis, Physical Design; Verification and Testing; Post-GDS Processes.						
Unit 2	Hardware Modeling and RTL Synthesis and Logic Optimization					8 hrs
Hardware Modeling: Introduction to Verilog Functional verification using simulation: testbench, coverage, mechanism of simulation in Verilog, RTL Synthesis: Verilog Constructs to Hardware Logic Optimization: Definitions, Two-level logic optimization, Logic Optimization: Multi-level logic optimization, FSM Optimization Formal Verification: Introduction, Formal Engines.						
Unit 3	Static Timing Analysis and Power Optimization					8 hrs
Static Timing Analysis: Synchronous Behavior, Timing Requirements, Timing Graph, Mechanism, Delay Calculation, Constraints: Clock, I/O, Timing Exceptions, Technology Mapping, Timing-driven Optimizations, Power Analysis, Power-driven Optimizations.						
Unit 4	Formal Verification, DFT and Physical Design Fundamentals					8 hrs
Formal Verification: Model Checking, Combinational Equivalence Checking Technology Library: Delay models of Combinational and Sequential Cells, Design for Test: Basics and Fault Models, Scan Design Methodology, ATPG, BIST, Basic						

Concepts for Physical Design: IC Fabrication, FEOL, BEOL, Interconnects and Parasitics, Signal Integrity, Antenna Effect, LEF files.	
Unit 5	Chip Planning, Placement and Physical Verification 8 hrs
Chip Planning: Partitioning, Floorplanning, Power Planning Placement: Global Placement, Wirelength Estimates, Legalization, Detailed Placement, Timing-driven Placement, Clock Tree Synthesis: Terminologies, Clock Distribution Networks, Clock Network Architectures, Useful Skews Routing: Global and Detailed, Optimizations Physical Verification: Extraction, LVS, ERC, DRC, ECO and Sign-off.	
<u>LEARNINGRESOURCES</u>	
TEXT BOOKS:	
1	L. Lavagno, I. L. Markov, G. Martin, and L. K. Scheffer (Editors), "Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology", CRC Press, 2016.
2	S. Palnitkar, "Verilog HDL: a guide to digital design and synthesis", Pearson Education India, 2003.
REFERENCEBOOKS:	
1	D. Micheli, "synthesis and optimization of digital circuits", mcgraw-hill higher education, 1994.
2	Bushnell and v. Agrawal, "essentials of electronic testing for digital, memory and mixed-signal vlsi circuits", springer science & business media, 2004.
ADDITIONALREFERENCE MATERIAL	
1	https://www.cambridge.org/highereducation/books/introduction-to-vlsi-design-flow/93E6832E63FE6B795181D6D67B552333#overview .
2	M.J.S. Smith, "Application-specific integrated circuits", Addison-Wesley, 1997.
3	J. Bhasker and R. Chadha, "Static timing analysis for nanometer designs: A practical approach", Springer Science Business Media, 2009.
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc23_ee137/preview

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	UnitV
CO1	BL3	X				
CO2	BL5		X			
CO3	BL4			X		
CO4	BL3				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

Skill Enhancement Courses

R24MECELO 07	PCB DESIGN					
	Total Contact Hours	30	L	T	P	C
	Pre-requisite	EDC	0	0	2	2
Course Objective						
This is a basic course for designing of PCB using software. PCB (Printed Circuit Board) designing is an integral part of each electronics products and this program is designed to make students capable to design their own projects PCB up to industrial grade.						
Course Outcomes						
1	Determine appropriate components to make circuits.					
2	Design of a Power Supply Module					
3	Design of types of Rectifiers					
4	Analyze the Design of a Security System					
5	Design of an electronic printed circuit board for a specific application using standard software					
List of Experiments						
1	Introduction to PCB DESIGN and EDA Tool Software					
2	Parameter setting or PCB Design.					
3	Design of a $\pm 5V$ Power supply.					
4	Schematic Creation and simulation of an electronic circuit					
5	Design and Simulate ON/OFF Switches Circuits					
6	Design and simulation of a Half and Full Wave Rectifier					
7	Design of a PCB layout of Lowpass filter					
8	Design of a PCB layout of CE Amplifier					
9	Design and Simulate Simple 7 Segment Circuits					
10	Design of an IR Proximity Sensor – Touchless Door Bell using Zero PCB					
11	Design of a Laser Light Security Alarm.					
12	Design of a Mobile Phone Detector Circuit.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Simon Monk, "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards (Electronics)" 2017					
2	S. Yogesh, "OSCAD: An Open Source EDA Tool for Circuit Design, Simulation, Analysis and PCB Design", Shroff Publishers & Distributors Pvt. Ltd, 2013.					
REFERENCES:						
1	https://www.udemy.com/course/circuit-design-simulation-and-pcb-manufacturing-bundle					
2	https://www.allaboutcircuits.com/technical-articles/pcb-thermal-management-techniques					

R24MECEL007	ELECTROMAGNETIC SIMULATION					
	Total Contact Hours	30	L	T	P	C
	Pre-requisite	EMWTL, AME	0	0	3	2
Course Objective						
<ul style="list-style-type: none"> To equip the students with a skill of designing microwave antennas and components for different frequency specifications and simulate them through an EM simulation tool. 						
Course Outcomes						
1	Will be able to apply the fundamental concepts of antenna, microwave transmission line theory in the design of antennas for communication system(BL-3).					
2	Will be able to design planar microstrip antennas with different feeding techniques for different frequency bands (BL-6).					
3	Will be able to design wire antennas, wave guide structures and also able to apply optometric technique for design of antennas (BL-6).					
4	Will be able to design planar microstrip array antennas and microstrip filters (BL-6).					
5	Will be able to design reconfigurable antennas, antennas with UWB, DGS and fractal techniques(BL-6).					
6	Will be able design a MIMO/DRA antennas, learn antenna parameter measurement through network analyzer(BL-6).					
Week wise Syllabus						
Minimum of 10 structures should be designed from the given list.						
Weeks 1-2	<ul style="list-style-type: none"> Introduction to fundamentals of Antennas and parameters. Fundamentals of Microwave and transmission line theory. Hands on available EM simulation tool basics. 					
Weeks 3-4	<ul style="list-style-type: none"> Simulation of Rectangular Microstrip Edge feed Antenna. Simulation of Rectangular Microstrip Inset feed Antenna. Simulation of Co-axial feed Antenna.. 					
Weeks 5-6	<ul style="list-style-type: none"> Learning Optometric analysis of an antenna. Simulation of dipole antenna. Simulation of Circular Polarized Antenna. 					
Weeks 7-8	<ul style="list-style-type: none"> Simulation of Rectangular wave guide. Simulation of Array antenna. 					
Weeks 9-10	<ul style="list-style-type: none"> Simulation of Micro strip line filter. Simulation of Reconfigurable antenna. 					
Weeks 11-12	<ul style="list-style-type: none"> Simulation of Antennas using (UWB, DGS, Fractal techniques) Simulation of MIMO/DRA antennas. 					
Weeks 13-14	<ul style="list-style-type: none"> Practical measurements through Vector Network Analyzer. Implementing an IEEE paper/Student own project using so far learnt concepts. 					
Week 15	<ul style="list-style-type: none"> End Exam 					
LEARNING RESOURCES						
TEXTBOOKS/ REFERENCE BOOKS:						
1	Balanis Constantine A., <i>Antenna Theory Analysis and design</i> (John Wiley & Sons, 3rd Edition, 2005).					
2	Microwave Engineering by David M. Pozar, 4 th edition, Wiley, 2011.					
3	Warren L.Stutzman, Gary A.Thiele, <i>Antenna Theory and Design</i> (John Wiley & Sons, 3rd Edition, 2013).					

4	RF and Microwave Integrated Circuits, Passive Components and Control Devices by Leo G. Maloratsky, Newnes publisher.
5	Microstrip Antenna design hand book by Ramesh Garg et.al., Artech House publishers.
6	MIMO Antennas for Wireless Communication: Theory and Design 1st Edition, Kindle Edition

R24MECEL 007		DIGITAL DESIGN USING SYSTEM VERILOG					
		Total Contact Hours	30	L	T	P	C
		Pre-requisite	Digital Electronics	0		3	2
Course Objectives							
To understand programming with System Verilog and UVM							
Course Outcomes							
1	To enable design and simulation of digital circuits before physical implementation.						
2	To create highly modular, reusable, and scalable test benches for verifying digital designs						
List of Experiments							
1	Develop an SV Module to demonstrate the declaration of variables.						
2	Develop a system Verilog code to demonstrate the declaration and application of packed and unpacked arrays.						
3	Develop an SV Module to demonstrate the application of Ques and simulate						
4	Develop a system Verilog program to create two dynamic arrays, insert an element and display the size.						
5	Develop a system Verilog code to demonstrate immediate assertions.						
6	Develop a system Verilog testbench to demonstrate concurrent assertions.						
7	Develop a system Verilog testbench to differentiate the calling of a task and a function.						
8	Develop a system Verilog testbench to demonstrate the passing of arguments by value and reference to function.						
9	Develop an SV module to demonstrate the declaration of objects and classes.						
10	Write a system Verilog code to demonstrate the derived class to refer to members of the parent class.						
11	Write an SV module to demonstrate the inheritance.						
12	Develop an SV module to demonstrate the shallow copy to generate the different instances of a class						
13	Write a system Verilog program to demonstrate interface						
14	Develop a test bench in SV to test a sequence detector and simulate.						
15	Develop an SV module to demonstrate the verification of a simple adder using layered testbench						
LEARNING RESOURCES							
TEXT BOOKS:							
1	Chirs Spear, "System Verilog for Verification: A Guide to learning the test bench Language Features", Springer-Verlag New York, INC.Secaucus, NJ, USA, 2006						
2	Donald Thomas, "Logic Design and Verification Using System Veriog", Create Space Independent Publishing Platform, 2014.						
REFERENCES:							
1	https://www.chipverify.com/tutorials/systemverilog						
2.	https://verificationguide.com/systemverilog/systemverilog-tutorial/						
3.	https://vlsiverify.com/systemverilog/						
4.	https://www.systemverilog.in/p/systemverilog-tutorial.html						

R24MECEL007	MACHINE LEARNING AND DEEP LEARNING					
	Total Contact Hours	30 (P)	L	T	P	C
	Pre-requisite	Basic Programming	0	0	3	2
Course Objective						
This course will enable students to make use of Data sets in implementing the machine learning and computer vision applications.						
Course Outcomes: Student will be able to						
1	Apply various data pre-processing techniques to prepare data for machine learning applications. (BL 3)					
2	Analyze datasets to determine model performance metrics such as accuracy, precision, recall, F1 score, and confusion matrix for various classifiers. (BL 4)					
3	Evaluate the use of pre-trained models like VGGNet and ResNet for image classification tasks, discussing their advantages and limitations. (BL 5)					
4	Design and implement end-to-end machine learning and Deep Learning pipelines, integrating advanced data preprocessing, model training, evaluation, and deployment techniques to solve real-world problems. (BL 6)					
LIST OF EXPERIMENTS						
1	Demonstrate various data pre-processing techniques for a given dataset. Write a python program to compute a) Reshaping the data, b) Filtering the data, c) Merging the data d) Handling the missing values in datasets e) Feature Normalization: Min-max normalization f) statistical parameters					
2	Implement an algorithm to demonstrate Back Propagation in NN					
3	Implement linear regression					
4	Implement K-Means_Clustering					
5	Implement the following models on given dataset and determine the values of accuracy, precision, recall, f1 score and confusion matrix for the test data. a. Logistic Regression b. Random Forest Classifier					
6	Implement the following models on given dataset and determine the values of accuracy, precision, recall, f1 score and confusion matrix for the test data. a. k-nearest neighbours Classifier b. Naive Bayesian Classifier					
7	Implement Support Vector Machine model for given dataset					
8	Image classification using CNN for given dataset					
9	Image classification using pre-trained deep learning model VggNet for given dataset					
10	Image classification using pre-trained deep learning model ResNet for given dataset					
11	Basic image operations using OpenCV					
12	Face detection using OpenCV					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Deep learning with python by Jason brownlee, edition 1.7, 2016.					
2	Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien					

	Géron, O'Reilly Media, Inc, 2019.
ADDITIONAL REFERENCE MATERIAL	
1	http://www.deeplearningbook.org
2	https://deepakdvallur.weebly.com/machine-learning-laboratory.html

R24MECEL007	DRONE TECHNOLOGY			L	T	P	C
	Total Contact Hours: 30						
	Prerequisite: Mathematics, Physics, Procedural Programming			0	0	3	2
COURSE OUTCOMES							
Students shall							
1.	Apply knowledge of aerodynamics and flight mechanics to the design process. (BL3)						
2.	Examine the components of UAV navigation systems and their interrelationships. (BL4)						
3.	Evaluate the integration of UAVs in various fields. (BL4)						
4.	Integrate knowledge of basic aerodynamics and flight mechanics with UAV applications. (BL5)						
5.	Develop a comprehensive understanding of UAV regulations and guidelines. (BL5)						
6.	Assess current trends and developments in the UAV industry. (BL6)						
1 Introduction to UAVs							
Basics of aerodynamics and flight mechanics concepts							
Introduction to UAVs and their applications							
Types of UAVs and their characteristics							
UAV components and their functions							
UAV subsystems and their interactions							
2 UAV Design and Construction							
UAV design process and requirements							
UAV sizing and performance analysis							
UAV materials and manufacturing techniques							
UAV structural design and analysis							
UAV propulsion systems and their selection							
3 UAV Navigation and Control							
UAV navigation systems and their components							
UAV control systems and their components							
UAV guidance and control laws							
UAV stability and control analysis							
UAV simulation and testing							
4 UAV Applications							
UAV applications in various fields							
UAV payloads and sensors							
UAV data acquisition and processing							
UAV mission planning and execution							
UAV safety and reliability							
5 UAV Regulations and Ethics							
UAV regulations and guidelines							
UAV ethical considerations							
UAV privacy and security issues							
UAV environmental impact							

Textbooks and References:

1. Introduction to Flight by John D. Anderson
2. Performance, Stability, Dynamics, and Control of Airplanes by Bandu N. Pamadi
3. Aircraft Performance and Design by John D. Anderson
4. Unmanned Aircraft Design: A Review of Fundamentals by Mohammad H. Sadraey
5. Designing Unmanned Aircraft Systems: A Comprehensive Approach by Jay Gundlach
6. Aircraft Design: A Conceptual Approach by Daniel P. Raymer
7. Unmanned Aircraft Systems: UAVs Design Development and Deployment by Reg Austin
8. Small Unmanned Fixed-wing Aircraft Design: A Practical Approach by Andrew J. Keane and James P. Scanlan

Other Materials:

- UAV Design - Part II - Course - NPTEL.
https://onlinecourses.nptel.ac.in/noc20_ae04/preview.
- UAV Design - Part II - Course - NPTEL.
https://onlinecourses.nptel.ac.in/noc21_ae14/preview.
- Open-Source Drone Programming Course for Distance Engineering ... - MDPI. <https://www.mdpi.com/2079-9292/9/12/2163>.
- Introduction to Drones - Amrita Vishwa Vidyapeetham.
<https://www.amrita.edu/course/introduction-to-drones/>.
- 16 Top Drone Programs at Universities and Colleges - Dronethusiast.
<https://www.dronethusiast.com/top-universities-unmanned-aerial-system-programs/>.
- Robotics: Aerial Robotics | Coursera.
<https://www.coursera.org/learn/robotics-flight>.
- NPTEL :: Aerospace Engineering - NOC:UAV Design - Part II.
<https://archive.nptel.ac.in/courses/101/104/101104083/>.

R24MECEL007	EMBEDDED SYSTEMS					
	Total Contact Hours	30 (P)	L	T	P	C
	Pre-requisite	MPMC,ES	0	0	2	2
Course Objective						
<ul style="list-style-type: none"> Students will gain understanding of hardware architecture and functional blocks of ARM32 LPC2148 microcontroller. Students will get exposure to the programming of Raspberry Pi Board. 						
Course Outcomes: The students will be able to						
1	Write and execute programs using Keil UVision.					
2	Perform Interfacing of I/O devices to LPC2148					
3	Perform python programming on Raspberry Pi Hardware Kit.					
List of Experiments						
1	Programming - I/O Ports, Buzzer, LED's, Switches on LPC2148 Hardware Kit.					
2	Programming - LCD on LPC2148 Hardware Kit.					
3	Programming - UART in poll mode on LPC2148 Hardware Kit.					
4	Programming - ADC in poll mode on LPC2148 Hardware Kit.					
5	Programming - Timer/Counter in poll mode on LPC2148 Hardware Kit.					
6	Programming - External Hardware Interrupts on LPC2148 Hardware Kit.					
7	Programming - UART,ADC, Timer/Counter in interrupt mode on LPC2148 Hardware Kit.					
8	Programming - EEPROM on LPC2148 Hardware Kit.					
9	Programming - SPI, I2C, RTC on LPC2148 Hardware Kit.					
10	Perform Read and write from a terminal using Raspberry Pi board					
11	Programming using RPi-GPIO library of Raspberry Pi board.					
12	Programming Raspberry Pi board for Read and write with Node-RED.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Real-Time Operating Systems for ARM Cortex-M.					
2	Joseph Yiu (Auth.) - The Definitive Guide to Arm® Cortex®-M3 and Cortex®-M4 Processors-Newnes (2014)					

VIII Semester

R24MCSCT007	COMPUTER NETWORKS (Common to all Branches)					
	Total Contact Hours	42(L)	L	T	P	C
	Pre-requisites	DE,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 analyse 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. (BL3)					
2	Students will be able to describe, demonstrate, and analyse 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 & 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 ,4thEdition,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	BL3	X				
CO2	BL4		X			
CO3	BL3			X		
CO4	BL5				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MCST008	ARTIFICIAL INTELLIGENCE: PRINCIPLES AND TECHNIQUES					
	Total Contact Hours	42 (L)	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 approaches 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, 3 rd 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

R24MCSCCT009	OOAD AND DESIGN PATTERNS (Common to all Branches)					
	Total Contact Hours	42(L)	L	T	P	C
	Prerequisite	Object Oriented Programming	3	0	0	3
Course Objectives						
1. Understand the importance and basic concepts of object oriented modeling, 2. Specify, analyze and design the requirements for a system and model the state of the set of objects and their implementation specifications. 3. Identify, Analyze 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 behavioural 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 Modeling: Classes ; Relationships; Common Mechanisms; Diagrams; Advanced Structural Modeling: 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 hrs
Composite; FlyWeight; Case study on Structural Patterns; Behavioral Patterns: Chain of Responsibility; Iterator; Memento ; Observer ; Case study on Behavioral 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.oodeesign.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