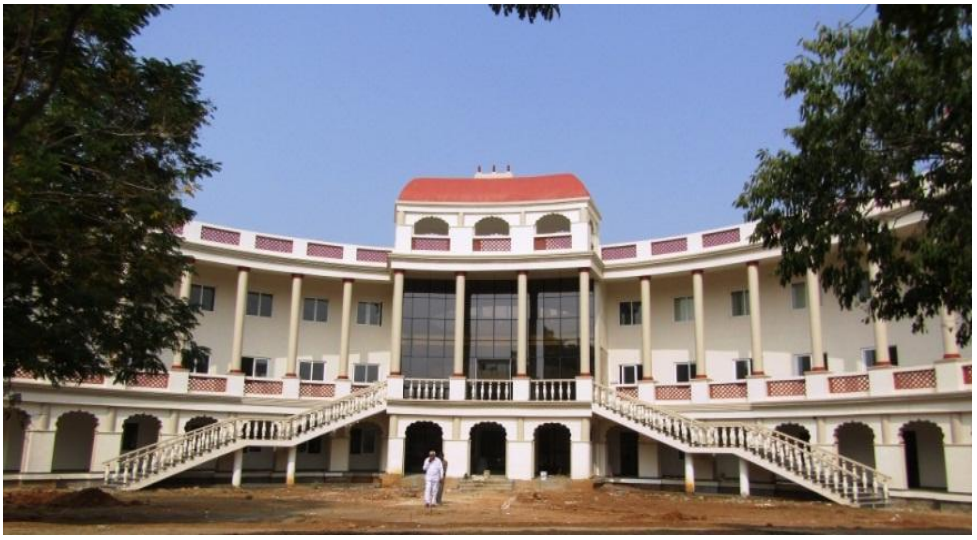
ACADEMIC REGULATIONS & CURRICULUM

Applicable to the students admitted from the Academic Year 2023-2024



ELECTRONICS AND COMMUNICATION ENGINEERING
(B.Tech. Programme)

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

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

1. Award of the Degree

(a) **Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfills the following:**

(i) Pursues a course of study for not less than four academic years and not more than eight academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Eight years).

(ii) Registers for 160 credits and secures all 160 credits.

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

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

(i) Student secures additional 18 credits fulfilling all the requisites of B.Tech. program i.e., 160 credits.
(ii) Registering for Honors is optional.
(iii) Honors is to be completed simultaneously with B.Tech. programme.

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

2. Admissions

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

3. Program related terms

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

Credit definition:

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

4. Semester/Credits:

i. A semester comprises 90 working days and an academic year is divided into two semesters.
ii. The summer term is for eight weeks during summer vacation. Internship/ apprenticeship / work-based vocational education and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study.
iii. Regular courses may also be offered during the summer on a fast-track mode to enable students to do additional courses or complete backlogs in coursework.
iv. The Universities/HEIs can decide on the courses to be offered in the summer term depending on the availability of faculty and the number of students.

5. Structure of the Undergraduate Programme

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

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

6. Course Classification:

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

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

7. Programme Pattern

i. Total duration of the B. Tech (Regular) Programme is four academic years.
ii. Each academic year of study is divided into two semesters.
iii. Minimum number of instruction days in each semester is 90 days.
iv. There shall be mandatory student induction program for fresher's, with three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., are included as per the guidelines issued by AICTE.
v. Health/wellness/yoga/sports and NSS /NSS /Scouts & Guides / Community service activities are made mandatory as credit courses for all the undergraduate students.
vi. Courses like Environmental Studies, Ethics and Human values are offered as non-credit mandatory courses for all the undergraduate students.
vii. Increased flexibility for students through an increase in the elective component of the curriculum, with 05 Professional Elective courses and 08 Open Elective courses.
viii. Professional Elective Courses, include the elective courses relevant to the chosen specialization/branch. Proper choice of professional elective courses can lead to students specializing in emerging areas within the chosen field of study.
ix. A total of 29 credits are offered in the curriculum as Extended Open Elective Cluster (EOEC). A student can complete the requirement for B.Tech. Degree with a Minor within the 160 credits by opting for the

courses offered through various verticals/tracks under Extended Open Elective Cluster (EOEC).

x. While choosing the electives, students shall ensure that they do not opt for the courses with syllabus contents similar to courses already pursued.
xi. A pool of interdisciplinary/job-oriented/domain skill courses which are relevant to the industry are integrated into the curriculum of all disciplines.
xii. Students shall undergo summer internships, for a period of four week's duration at the end of second and third year of the programme. The internship at the end of second year shall be community oriented and industry internship at the end of third year.
xiii. There shall also be internship in the final semester of the programme along with the project work.
xiv. Undergraduate degree with Honors is introduced by the University for the students having good academic record.

8. Evaluation Process

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

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

THEORY COUSES

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

i. For theory subject, the distribution shall be 30 marks for Continuous Internal Assessment and 70 marks for the End-Examination.
ii. For practical subject, the distribution shall be 30 marks for Internal Evaluation and 70 marks for Semester End Examination.
iii. If any course contains two different branch subjects, the syllabus shall be written in two parts with 3 units each (Part-A and Part-B) and external examination question paper shall be set with two parts each for 35 marks.

a) Continuous Internal Evaluation

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

iii. First midterm examination shall be conducted for I, II units of syllabus with one either or type question from each unit and third either or type question from both the units. The second midterm examination shall be conducted for III, IV and V units with one either or type question from each unit.
iv. Final mid semester marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage given to the better mid exam and 20% to the other.

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

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

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

b) End Examination Evaluation:

End examination of theory subjects shall have the following pattern: There shall be 6 questions and all questions are compulsory.

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

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

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

PRACTICAL COURSES

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

a) For practical courses, there shall be a continuous evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks.
b) Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the regularity/record/viva and 15 marks for the internal test.
c) The end examination shall be evaluated for 70 marks, conducted by the concerned laboratory teacher and a senior expert in the subject from the same department.

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

d) In a practical subject consisting of two parts (Eg: Basic Electrical &Electronics Engineering Lab), the end examination shall be conducted for 70 marks as a single laboratory in 3 hours.

e) Engineering Graphics evaluation

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

Assessment Method	Mark
Continuous Internal	30
Semester End	70
Total	100

Day-to-day work shall be evaluated for 15 marks by the concerned subject teacher based on the reports/submissions prepared in the class and 15 marks for the internal test.

The end examination pattern for Engineering Graphics, shall consist of 5 questions, either/or type, of 14 marks each. There shall be no objective type questions in the end examination.

9. a) NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE

General Guidelines:

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

Evaluation Guidelines:

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

b) HEALTH AND WELLNESS, YOGA AND SPORTS

General Guidelines:

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

Evaluation Guidelines:

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

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

The laboratory records and mid semester test papers shall be preserved for a minimum of 1 year in the respective institutions and shall be produced to the Committees of the University as and when the same are asked for.

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.
- There shall be no Continuous Assessment marks for these projects.
- A student shall secure minimum 40% of marks for successful completion.

In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institution.

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, 30 marks for internal assessment and 70 marks for semester end examination.

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

Continuous Internal Assessment : (30 Marks)

Continuous assessment : 15 Marks
Internal test : 15 Marks

The end examination shall be evaluated for 70 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 : 20 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, 30 marks for internal assessment and 70 marks for semester end examination.

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

Continuous Internal Assessment : (30 Marks)
Continuous assessment : 15 Marks
Internal test : 15 Marks

The end examination shall be evaluated for 70 marks, conducted by the concerned course teacher and a senior expert in the subject from the same department.

Objective Test (MCQs, 50 Questions Each one mark) : 50 Marks
Viva voce : 20 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 organisations (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 **60 marks** for continuous assessment and **140 marks** for summative assessment. The supervisor assesses the student for 30 marks (Report: 20 marks, Seminar: 10 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 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 16 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 16 weeks for a 4-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. Honors is to be completed simultaneously with a Major degree program.

Registration for Honors:

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

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

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

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

17. Attendance Requirements:

i. A student shall be eligible to appear for the University external examinations if he/she acquires a minimum 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 by the College Academic Committee.

iii. Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

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

v. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek

readmission for that semester from the date of commencement of class work.

vi. If 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.

vii. For induction programme 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	Grade points Assigned
90 & above	S (Superior)	10
80 - 89	A (Excellent)	9
70 - 79	B (Very Good)	8
60 - 69	C (Good)	7
50 - 59	D (Average)	6
40 - 49	E (Pass)	5
< 40	F (Fail)	0
Absent	Ab (Absent)	0

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

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

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

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

$$SGPA = \Sigma (Ci \times Gi)/\Sigma Ci$$

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

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

$$CGPA = \Sigma (Ci \times Si)/ \Sigma Ci$$

where "Si" is the SGPA of the ith semester and Ci 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 S, A, B, C, D and F.

20. Award of Class:

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

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.5 (Without any supplementary
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 5.0 < 5.5

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 – 0.5) x 10

21. With–holding of Results

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

22. Multiple Entry / Exit option

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

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

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

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

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

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

(a) Exit Policy:

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

i) **UG Certificate in (Field of study/discipline)** - Program duration:
First Year (first two semesters) of the undergraduate program, 40 credits followed by an additional exit 6 credit bridge course. The 6 extra credits would be to make the certificate self-sufficient, with one 3-Credit Course on Taxation and one 3-Credit Course on Accounting that would help the candidates acquire job-ready competencies required to enter the workforce.

ii) **UG Diploma (in Field of study/discipline)** - Program duration:
First two years (first four semesters) of the undergraduate program, 88 credits followed by an additional exit of 8-credit bridge course with 2 Integrated 4 Credit courses in Major with 3+1 Theory and Lab distribution administrated as a Crash course in 1 month which would help the candidates acquire job-ready competencies required to enter the workforce.

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

(b) Entry Policy:

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

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

23. Gap Year Concept:

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

24. 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.

25. Minimum Instruction Days for a Semester:

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

26. Medium of Instruction:

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

27. Student Transfers:

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

28. 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 Vice-Chancellor is final.
e. The Universities may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Universities.
f. In the case of any doubt or ambiguity in the interpretation of the guidelines given, the decision of the Vice-Chancellor / Head of the institution is final.

Regulations for MALPRACTICES during the conduct of examinations

	Nature of Malpractices/Improper conduct	Punishment
1.a	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) - **FIRST TIME** (whether copied or not)	Expulsion from the examination hall and cancellation of the performance in that subject only. • To keep the CC footage of the act as an evidence. • To obtain a statement from student and get it authorized by observer and Chief superintendent.
1.b	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) - **SECOND TIME**(whether copied or not)	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations, project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. • To keep the CC footage of the act as an evidence. • To obtain a statement from student and get it authorized by observer and Chief superintendent.
1.c	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) - **REPITITION OF THE ABOVE ACT** (After second time and whether copied or not)	Nature of punishment to be given for the improper conduct shall be as per the recommendations of the committee. • The committee comprising of Principal, Vice principal, Chief superintendent, Controller of Examinations and HoD to discuss and initiate the action to be taken and recommend. • To keep the CC footage of the act as evidence. • To obtain a statement from student and invigilator and authorized by Chief superintendent.
2.a.	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any	Expulsion from the examination hall and cancellation of the performance in that subject only

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

		be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider/candidate not on rolls, he will be handed over to the police and a case is registered against him. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs. • To keep the CC footage of the act as an evidence. • To obtain a statement from student, invigilator, subject expert and authorized by observer and Chief superintendent.
4	If the candidate mishandles the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. Also,if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. In addition to the above punishment, a committee shall be constituted and recommends appropriate punishment for the improper conduct. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
5.	Uses objectionable, abusive or offensive language in the Examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject only. • To Obtain a statement from student and invigilator and get it authorized by Observer and Chief superintendent.

6.	Refuses to obey the orders of the Chief Superintendent/ACE/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of the act as an evidence. • To Obtain a statement from

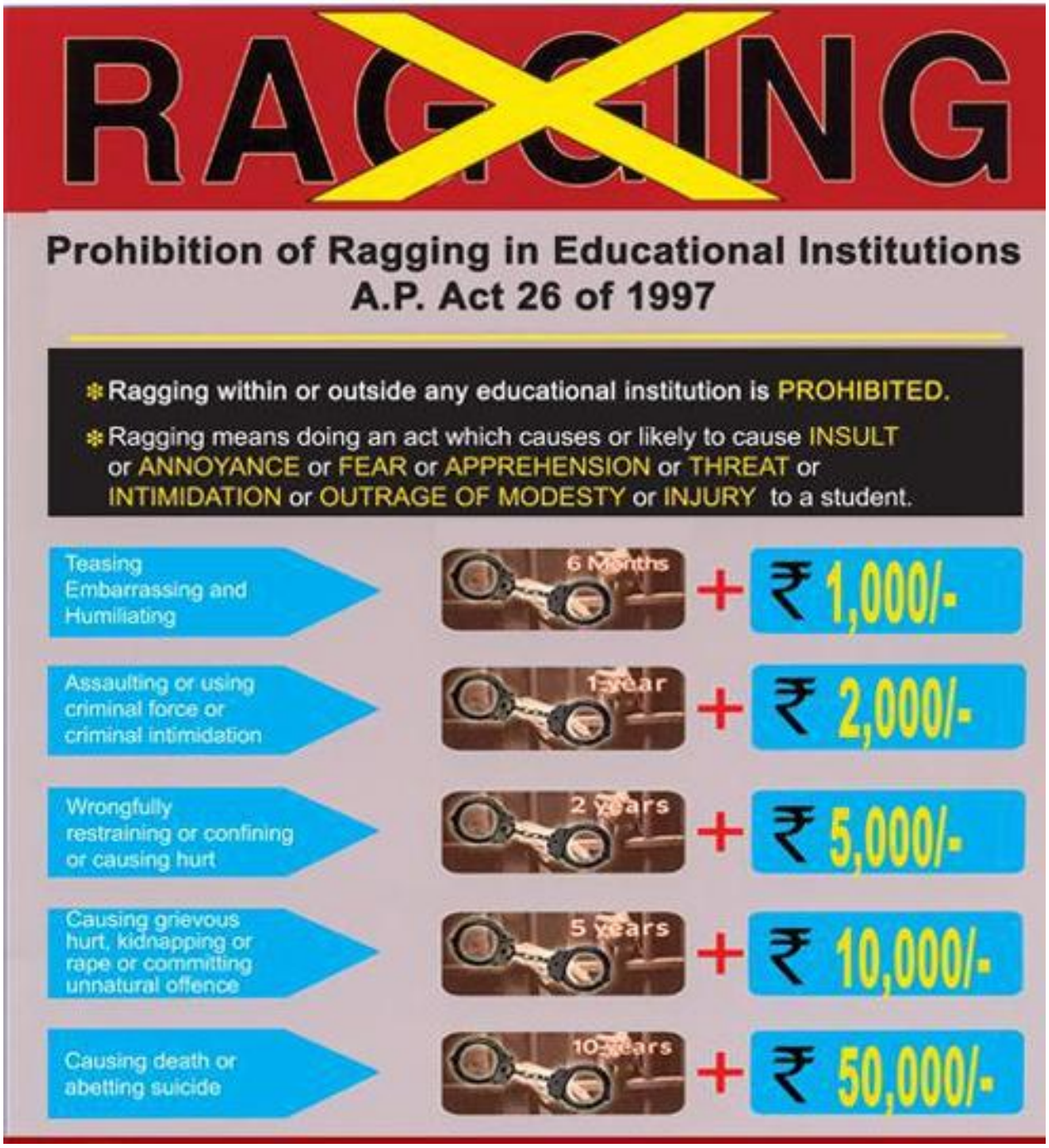
		student and invigilator and authorized by observer and Chief superintendent.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To obtain a statement from student and invigilator and authorized by observer and Chief superintendent. • The candidate shall be handed over to Police and register a case.
9.	If a student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	If the student belongs to our college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of

		the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief Superintendent.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. • To keep the CC footage of the act as an evidence(If any). • To obtain a statement from invigilator and any others as witness authorized by observer and Chief superintendent.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations. • To Obtain a statement from Valuer / Chief Valuer authorized by Spot Coordinator and Controller of Examinations.

General :

- Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
- The academic regulation should be read as a whole for the purpose of any interpretation.
- In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

* * *



LET US MAKE MVGR A RAGGING FREE CAMPUS

ABSOLUTELY NO TO RAGGING

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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 (R23)
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

Award of the B.Tech. Degree / B.Tech. Degree with a Minor if he/she fulfils the following:

i. Pursues a course of study for not less than three academic years and not more than six academic years. However, for the students availing Gap year facility this period shall be extended by two years at the most and these two years would in addition to the maximum period permitted for graduation (Six years).

ii. Registers for 120 credits and secures all 120 credits.

2. 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.

ii. Honors is to be completed simultaneously with B.Tech. programme.

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).

R23-MVGR
COURSE STRUCTURE
ELECTRONICS AND COMMUNICATION ENGINEERING
B. TECH. (Regular/Honors) COURSE STRUCTURE
(Applicable from the Academic Year 2023-24 Onwards)

I Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MATT101	Linear Algebra and Calculus	3	0	0	3
2	R23CHYT102	Chemistry	3	0	0	3
3	R23EEET201	Basic Electrical and Electronics Engineering	3	0	0	3
4	R23CSET201	Introduction to Programming	3	0	0	3
5	R23MECD201	Engineering Graphics	1	0	4	3
6	R23CHYL102	Chemistry Lab	0	0	2	1
7	R23EEEL201	Electrical and Electronics Engineering Lab	0	0	3	1.5
8	R23CSEL201	Computer Programming Lab	0	0	3	1.5
9	R23HSSM802	NSS/NCC/Scouts & Guides/Community Service	0	0	1	0.5
	Total Credits					**19.5**

II Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23HSST001	Communicative English	2	0	0	2
2	R23MATT102	Differential Equations and Vector Calculus	3	0	0	3
3	R23PHYT101	Engineering Physics	3	0	0	3
4	R23CMET201	Basic Civil and Mechanical Engineering	3	0	0	3
5	R23ECET301	Network Analysis	3	0	0	3
6	R23HSSL001	Communicative English Lab	0	0	2	1
7	R23PHYL101	Engineering Physics Lab	0	0	2	1
8	R23ECEL301	Network Analysis and Simulation Lab	0	0	3	1.5
9	R23MECW201	Engineering Workshop	0	0	3	1.5
10	R23CSEW201	IT workshop	0	0	2	1
11	R23HSSM801	Health and Wellness, Yoga and Sports	0	0	1	0.5
	Total Credits					**20.5**

III Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MECET005	Internet of Things	3	0	0	3
2	R23MECET006	Electronic Devices and Circuits	3	0	0	3
3	R23MECET001	Digital Electronics	3	0	0	3
4	R23MECET007	Signals, Systems and Stochastic Processes	3	0	0	3
5	R23MCSCT001	Data Structures and Algorithms	3	0	0	3
6	R23MSCST011	Operating Systems	3	0	0	3
7	R23MECEL002	Electronic Devices and Circuits Lab	0	0	3	2
8	R23MECEL003	Digital Logic Design Lab	0	0	3	2
9	R23MCSCL001	Data Structures and Algorithms Lab	0	0	3	2
	Total Credits					**24**

IV Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MECET008	Analog and Digital Communications	3	0	0	3
2	R23MECET009	EM Waves and Transmission Lines	3	0	0	3
3	R23MECET010	Analog Circuits	3	0	0	3
4	R23MECET003	Digital Signal Processing	3	0	0	3
5	R23MSCST007	Python Programming	3	0	0	3
6	R23MSCST010	Database Management Systems	3	0	0	3
7	R23MECEL004	Analog and Digital Communications Lab	0	0	3	2
8	R23MECEL005	Digital Signal Processing Lab	0	0	3	2
9	R23MSCSL005	Python Programming Lab	0	0	3	2
10	R23MENGAT01	Ethics & Human Values	2	0	0	-
Total Credits						**24**

V Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MEEET004	Control Systems	3	0	0	3
2	R23MECET002	Microprocessors and Microcontrollers	3	0	0	3
3	R23MECET011	Digital VLSI design	3	0	0	3
4	R23MECET012	Digital Image and Video Processing	3	0	0	3
5	R23MECETXXX	DSC-E1	3	0	0	3
6	R23MSCST005	Software Engineering	3	0	0	3
7	R23MECEL001	Microprocessors and Microcontrollers Lab	0	0	3	2
8	R23MSCSL003	Database Management Systems Lab	0	0	3	2
9	R23MECEP001	Community Project	0	0	2	2
10	R23MCIVT001	Environmental Studies	2	0	0	-
Total Credits						**24**

VI Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MECET013	Embedded Systems	3	0	0	3
2	R23MECET014	Analog VLSI design	3	0	0	3
3	R23MECET015	Antennas and Microwave Engineering	3	0	0	3
4	R23MCSCT006	OOP with JAVA	3	0	0	3
5	R23MECETXXX	DSC E2	3	0	0	3
6	R23MECETXXX	DSC E3	3	0	0	3
7	R23MECEL006	VLSI Lab	0	0	3	2
8	R23MCSCL004	OOP with JAVA Lab	0	0	3	2
9	R23MMATT007	Quantitative Problem Solving Techniques	2	0	0	2
Total Credits						**24**

VII Semester

S. No	Course Code	Course Title	L	T	P	Credits
1	R23MECET016	Industry 4.0 and IIOT (Self Study /MOOCS)	3	0	0	3
2	R23MECETXXX	DSC E4 (Self-Study/MOOCS)	3	0	0	3
3	R23MECETXXX	DSC E5 (Self-Study/MOOCS)	3	0	0	3
4	R23MECEP002	Mini Project	0	0	2	2
5	R23MECEL007	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	R23MSCST007	Computer Networks	3	0	0	3
	R23MCSCT008	Artificial Intelligence: Principles and Techniques	3	0	0	
	R23MSCST009	OOAD and Design Patterns	3	0	0	
2	R23MECEP003	Major-Dissertation/Academic Project-Major	0	0	16	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	R23MECET020	Optical Communications	3	V
2	DSC-E2	R23MECET021	Cellular and mobile Communications	3	VI
3	DSC-E3	R23MECET022	Radar and Satellite Communication	3	VI
4	DSC-E4	R23MECET023	Wireless Adhoc and Sensor Networks	3	VII
5	DSC-E5	R23MECET024	MIMO Wireless Communications	3	VII

Signal Processing & Instrumentation

S. No.	Type of Course	Course Code	Course Title	Credits	Sem
1	DSC-E1	R23MECET025	Artificial Intelligence and Machine Learning	3	V
2	DSC-E2	R23MECET026	Speech and Audio Processing	3	VI
3	DSC-E3	R23MECET027	Bio Medical Instrumentation	3	VI
4	DSC-E4	R23MECET028	Deep Learning	3	VII
5	DSC-E5	R23MECET029	Biomedical Signal processing	3	VII

VLSI & Embedded Systems

S. No.	Type of Course	Course Code	Course Title	Credits	Sem
1	DSC-E1	R23MECET030	Computer Organization and Architecture	3	V
2	DSC-E2	R23MECET031	System On Chip	3	VI
3	DSC-E3	R23MECET032	VLSI Physical Design	3	VI
4	DSC-E4	R23MECET033	Testing and Testability	3	VII
5	DSC-E5	R23MECET034	VLSI Design Flow: RTL to GDS	3	VII

B. Tech. (Honors) – Electronics and Communication Engineering

(Applicable from the Academic Year 2023-24 Onwards)

Communication Systems

S.No	Course Code	Course Title	Credits	Sem
1	R23MECEHT01	Information Theory and Coding	3	VI
2	R23MECEHT02	Modern Communication Systems	3	VI
3	R23MECEHT03	RF and Microwave design	3	VII
4	R23MECEHT04	GPS and Navigation systems	3	VII
5	R23MECEHT05	Software Defined Radio	3	VIII
6	R23MECEHT06	Satellite Internet Systems	3	VIII

Signal Processing & Instrumentation

S.No	Course Code	Course Title	Credits	Sem
1	R23MECEHT07	Advanced Digital Signal Processing	3	VI
2	R23MECEHT08	Transform Techniques	3	VI
3	R23MECEHT09	DSP Processors and Architectures	3	VII
4	R23MECEHT10	Soft Computing Techniques	3	VII
5	R23MECEHT11	RADAR Signal Processing	3	VIII
6	R23MECEHT12	Bio Medical Imaging	3	VIII

VLSI & Embedded Systems

S.No	Course Code	Course Title	Credits	Sem
1	R23MECEHT13	Real Time Operating Systems	3	VI
2	R23MECEHT14	Low Power VLSI design	3	VI
3	R23MECEHT15	Complex Programmable Logic Device and Field Programmable Gate Array	3	VII
4	R23MECEHT16	Application Specific Integrated Circuit Design	3	VII
5	R23MECEHT17	Scripting Languages	3	VIII
6	R23MECEHT18	UAV Design	3	VIII

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	R23MCSCT001	Data Structures & Algorithms	III	EOEC-L1	R23MCSCL001	Data Structures & Algorithms Lab	III
EOEC-T2	R23MSCST011	Operating Systems	III	EOEC-L2	R23MSCSL005	Python Programming Lab	IV
EOEC-T3	R23MSCST007	Python Programming	IV	EOEC-L3	R23MCSCL003	Database Management Systems Lab	V
EOEC-T4	R23MSCST010	Database Management Systems	IV	EOEC-L4	R23MCSCL004	OOP with JAVA Lab	VI
EOEC-T5	R23MCSCT005	Software Engineering	V				
EOEC-T6	R23MCSCT006	OOP with JAVA	VI				
EOEC-E1 Selfstudy /Moocs	R23MCSCT007	Computer Networks	VIII				
	R23MCSCT008	Artificial Intelligence: Principles and Techniques					
	R23MCSCT009	OOAD and Design Patterns					

I Semester

R23MATT101	LINEAR ALGEBRA AND CALCULUS (LAC)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus and Matrices	**3**	**0**	**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

1	Solve system of equation by Direct and Indirect methods.
2	Make use of Linear Algebra techniques to find higher powers and inverse of Matrices.
3	Make use of Mean value theorems to deduce Mathematical identities.
4	Use the concept of multivariable calculus to determine the maxima and minima of a multivariable function.
5	Estimate areas and volumes with help of Multiple integrals.
6	Formulate Mathematical models and estimate appropriate physical quantities.

SYLLABUS

Unit 1	**MATRICES**	**9 hr**

Rank of a matrix by echelon form, normal form. Cauchy –Binet formulae (without proof). Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

Unit 2	**LINEAR TRANSFORMATION AND ORTHOGONAL TRANSFORMATION**	**9 hr**

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

Unit 3	**CALCULUS**	**9 hr**

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

Unit 4	**PARTIAL DIFFERENTIATION AND APPLICATIONS (MULTI VARIABLE CALCULUS)**	**9 hr**

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

Unit 5	**MULTIPLE INTEGRALS (MULTI VARIABLE CALCULUS)**	**9 hr**

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

LEARNING RESOURCES	
TEXT BOOKS:	
1	B.S.Grewal,HigherEngineeringMathematics,44/e,KhannaPublishers,2017.
2	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,JohnWiley&Sons, 2018.
REFERENCE BOOKS:	
1	R.K.Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd.,2021 (9th reprint).
2	George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus,14/e, Pearson Publishers, 2018.
3	GlynJames, Advanced Modern Engineering Mathematics, 5/e, Pearson publishers, 2018.
4	Michael Green berg, Advanced Engineering Mathematics, 9^{th} edition, Pearson edn
5	K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand,2021

Bloom's level - Units catchment articulation matrix

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

R23CHYT102	CHEMISTRY (Common to EEE,ECE,CSE,IT & allied branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Chemistry at 10 + 2 level education	**3**	**0**	**0**	**3**

Course Objective

Students will get exposure

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

Course Outcomes

1	The student will be able to **analyze** the structure of various homo and hetero atomic molecules and also **estimate** the energies of the molecules using Principles of Quantum mechanics and molecular orbital theory.
2	The student will be able to **apply** the knowledge of modern engineering materials to solve real world problems and **adapt** to new developments in the field of material science, electronics and energy technology.
3	The student will be able to **analyze**, **compare, make use of** and **design** the batteries, sensors, fuel cells and various electroanalytical techniques.
4	The student will be able to **select, distinguish** and **appraise** the diversity and versatility of polymers, elastomers, plastics, conducting and biodegradable polymers, their widespread applications in various industries, and their environmental implications
5	The student will be able to have strong foundation in various analytical and spectroscopic techniques enabling him to **apply** and **evaluate** in quality control, scientific exploration and in various industries.
6	**Demonstrate** the ability to identify, synthesize, interpret, categorize, and characterize different materials and their significance to be used as suitable and appropriate engineering materials using the concepts of quantum mechanics, principles of storage devices, electrochemistry, polymer chemistry, and analytical instrumental methods of analysis to propose innovative solutions to engineering problems/ challenges of simple to complex nature.

SYLLABUS

Unit 1	**Structure and Bonding Models**	**9 hr**

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ^2, particle in one dimensional box

Molecular orbital theory – Bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order.

Unit 2	**Modern Engineering materials**	**9 hr**

Semiconductors - Introduction, basic concept, application

Super conductors - Introduction basic concept, applications.

Supercapacitors - Introduction, Basic Concept-Classification – Applications.

Nano materials - Introduction, classification, properties and applications of fullerenes, carbon nano tubes and Graphines nanoparticles.

Unit 3	**Electrochemistry and Applications**	**9 hr**

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of

conductivity, conductivity cell, conductometric titrations (acid-base titrations).
Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples. Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

Unit 4	**Polymer Chemistry**	**9 hr**

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation.
Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibers.
Elastomers–Buna-S, Buna-N–preparation, properties and applications.
Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications.
Bio-Degradable polymers - Poly Glycolic Acid (PGA), Poly Lactic Acid (PLA).

Unit 5	**Instrumental Methods and Applications**	**9 hr**

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

LEARNING RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ONLINE COURSES

1	https://archive.nptel.ac.in/courses/122/101/122101001/#

Bloom's level - Units catchment articulation matrix

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

R23EEET201	BASIC ELECTRICAL & ELECTRONICS ENGINEERING (Common to All branches of Engineering)					
	Total Contact Hours	48 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic electrical and electronics engineering	**3**	**0**	**0**	**3**

Course Objective

Students will gain understanding of laws and principles of electrical and electronics engineering and able to apply this knowledge to build simple circuits in relevant fields.

Course Outcomes: Student

1	Will be able to apply the basic principles of electrical and circuits to solve DC and AC circuits.
2	Will be able to analyze the construction and operation of various electrical machines and measuring instruments also select a machine for an application.
3	Will be able to analyze power generation, electric safety measures and examine electrical power consumption and tariff.
4	Will be able to appraiser a profound comprehension of semiconductor devices, basic electronic circuits, and instrumentation by examining the principles, characteristics, & application and analyze the block diagrams and interactions within electronic instrumentation systems.
5	Will be able to design simple combinational and sequential circuits of digital electronics
6	Will be able to combine the fundamental principles of electrical and electronics engineering to design & solve simple circuits and discuss power generation, control and safety.

SYLLABUS

Unit 1	**DC & AC Circuits**	**8 hr**

Electrical circuit elements (R), Ohm's Law and its limitations; KCL; KVL; Electrical circuit elements (L, C); Superposition theorem; A.C. Fundamentals; Voltage and current relationship with phasor diagrams in R, L, and C circuits; Concept of Impedance, Active power, reactive power, apparent power and power factor;

Unit 2	**Machines and Measuring Instruments**	**8 hr**

Construction, principle and operation of & Applications - DC Motor; DC Generator; Single Phase Transformer; Three Phase Induction Motor; Construction, principle and operation of & Applications – Alternator; Construction and working principle of PMMC Instruments; MI Instruments; Wheatstone bridge;

Unit 3	**Energy Resources, Electricity Bill & Safety Measures**	**8 hr**

Conventional and non-conventional energy resources, Layout and operation of various Power Generation systems - Hydel generation; Nuclear generation; Solar power generation.; Wind power generation. Power rating of household appliances, Definition of "unit" used for consumption of electrical energy; Two-part electricity tariff, calculation of electricity bill for domestic consumers; Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits; Earthing and types of earthing, Safety Precautions to avoid shock;

Unit 4	**Semiconductor Devices**	**8 hr**

Evolution of Electronics and Classification of Materials; PN Junction Diode and Characteristics; Zener Diode and Characteristics; Transistor (NPN and PNP) Operation; Transistor CB configuration; Transistor CE Configuration; Transistor

CC Configuration; Small signal Transistor CE amplifier;		
Unit 5	**Basic Electronic Circuits and Instrumentation**	**8 hr**
Half Wave Rectifier; Full Wave Bridge Rectifier; Rectifiers with filters; Zener regulator; DC Power supply (RPS); Public Address System; Frequency response of CE amplifier; Electronic Instrumentation System;		
Unit 6	**Digital Electronics**	**8 hr**
Number Systems; Binary Codes; Logic gates; Boolean Algebra; Half and Full adder; Flip Flops; Registers; Counters		
LEARNING RESOURCES		
TEXT BOOKS:		
1	D. C. Kulshreshtha, *Basic Electrical Engineering*, Tata McGraw Hill, 2019	
2	P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, *Power System Engineering*, Dhanpat Rai & Co, 2013	
3	R. S. Sedha, *A Textbook of Electronic Devices and Circuits*, S. Chand & Co, 2010	
REFERENCE BOOKS:		
1	V.K. Mehtha, *Principles of Electrical and Electronics Engineering*, S.Chand Technical Publishers, 2020	
2	S. K. Bhatacharya, *Basic Electrical and Electronics Engineering*, Person Publications, 2018	
3	R. P. Jain, *Modern Digital Electronics*, Tata Mc Graw Hill, 2009	
ONLINE COURSES		
1	https://nptel.ac.in/courses/108105053	
2	https://nptel.ac.in/courses/108108076	

Bloom's level - Units catchment articulation matrix

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

R23CSET201	INTRODUCTION TO PROGRAMMING (Common to All branches of Engineering)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**3**	**0**	**0**	**3**

Course Objective

- The course aims to equip students with advanced proficiency in C programming, fostering problem-solving skills and algorithmic design, while ensuring mastery in data manipulation, function implementation, and file handling techniques.

Course Outcomes

1	Students will develop essential problem-solving skills and ability to design efficient algorithms to address a wide range of challenges effectively.
2	Students will formulate solutions by constructing well-organized and efficient C programs, effectively using data types, program flow, and loop structures with appropriate utilization of keywords, operators and identifiers.
3	Students will have the ability to experiment on arrays, pointers, and dynamic memory allocation, effectively to develop strategies for manipulates data with precision and efficiency.
4	Students will construct solutions by utilizing functions, string handling, applying variable scope and storage classes effectively, and implementing recursion through C programming principles.
5	Students will create and develop skills in handling structures, unions, and self-referential structures, and demonstrate proficiency in file handling techniques for input and output operations in C.
6	Students will develop and author comprehensive programming expertise in C, encompassing computer problem-solving skills, array and pointer manipulation, function implementation, string handling, and data structure utilization through file operations.

SYLLABUS

UNIT 1	**Introduction To Computer Problem Solving**	**9 hr**

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

UNIT 2	**Introduction To C Programming**	**9 hr**

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

UNIT 3	**Arrays & Pointers**	**9 hr**

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

UNIT 4	**Functions & Strings**	**9 hr**

Introduction Function: Declaration, Function Definition, Function Call, Categories of

Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion. Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.		
UNIT 5	**Structures & File Handling**	**9 hr**
Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields. Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.		
LEARNING RESOURCES		
TEXT BOOKS:		
1	A Structured Programming Approach Using C, Forouzan, Gilberg, Cengage.	
2	How to solve it by Computer, R. G. Dromey, and Pearson Education.	
3	Programming In C A-Practical Approach. Ajay Mittal, Pearson	
REFERENCE BOOKS:		
1	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.	
2	Computer Programming. Reema Thareja, Oxford University Press	
3	The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.	
4	Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.	
5	Let us C, YaswanthKanetkar, 16th Edition,BPB Publication.	
6	Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008	
WEB REFERENCES:		
1	http://www.c4learn.com/	
2	http://www.geeksforgeeks.org/c/	
3	http://nptel.ac.in/courses/122104019/	
4	http://www.learn-c.org/	
5	https://www.tutorialspoint.com/cprogramming/	
ONLINE COURSES:		
1	https://mvgrce.codetantra.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	BL6		X			
CO3	BL3			X		
CO4	BL6				X	
CO5	BL6					X
CO6	BL6	X	X	X	X	X

R23MECD201	ENGINEERING GRAPHICS (Common to All branches of Engineering)					
	Total Contact Hours	75(15L+ 60P)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic mathematics, imagination skills	**1**	**0**	**4**	**3**

Course Objective: To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing

Course Outcomes: On completion of the course, the student should be able to

1	Apply the principles of curves, scales, orthographic and isometric projections. in engineering drawing (BL3).
2	Interpret orthographic projections like front, top and side views related to points, lines, planes and solids.(BL5)
3	Demonstrate the projection of solids in various positions in the first quadrant. (BL3)
4	Examine the principles behind development of surfaces. (BL4)
5	Develop orthographic and isometric projections of solids. (BL6)

SYLLABUS

Unit 1	**Curves, scales and polygons**	

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and
Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

Unit 2	**Orthographic projections**	

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes
Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Unit 3	**Projections of solids**	

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

Unit 4	**Sections of solids and Development of Surfaces**	

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.
Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Unit 5	**Conversions of Views**	

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

Conversion of orthographic views to isometric views. **Computer graphics:** Creating 2D&3D drawings of objects including PCB and Transformations using AutoCAD	
LEARNING RESOURCES	
TEXT BOOKS:	
1	N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 2016.
REFERENCE BOOKS:	
1	K.L. Narayana and P. Kannaiah, *Engineering Drawing*, Tata McGraw Hill, Third Edition, 2013.
2	M.B.Shah and B.C. Rana, *Engineering Drawing*, Pearson Education Inc,2009.
3	Dhananjay Jolhe, *Engineering Drawing with an Introduction to AutoCAD*, Tata McGraw Hill, 2017
ADDITIONAL REFERENCE MATERIAL	
1	https://nitc.ac.in/imgserver/uploads/attachments/Ed__5c3343c5-c3f9-468a-b114-8f33556810b4_.pdf
ONLINE COURSES	
1	https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing
2	https://onlinecourses.nptel.ac.in/noc21_me128/preview
3	https://www.udemy.com/course/engineering-drawing-graphics/

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		
CO2	BL5	X	X	X		
CO3	BL3			X	X	X
CO4	BL4				X	X
CO5	BL6	X	X	X	X	X

R23CHYL102	CHEMISTRY LAB (Common to EEE,ECE,CSE,IT & allied branches)					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Chemistry at 10 + 2 level education	**0**	**0**	**2**	**1**

Course Objective	
Verify the fundamental concepts with experiments	
Course Outcomes: At the end of the course, the student will be able to	
1	Determine the cell constant and conductance of solutions.
2	Prepare advanced polymers and nanomaterials.
3	Measure the strength of an acid present in secondary batteries.
4	Understand, analyze and apply the principles of UV - Visible and IR spectroscopic techniques.
5	Understand and determine the potentials using Potentiometry.
List of Experiments	
1	Measurement of 10Dq by spectrophotometric method.
2	Conductometric titration of strong acid vs. strong base.
3	Conductometric titration of weak acid vs. strong base.
4	Determination of cell constant and conductance of solutions.
5	Potentiometry - determination of redox potentials and emfs.
6	Determination of Strength of an acid in Pb-Acid battery.
7	Preparation of a Bakelite.
8	Verify Lambert-Beer's law.
9	Wavelength measurement of sample through UV-Visible Spectroscopy.
10	Identification of simple organic compounds by IR.
11	Preparation of nanomaterials by precipitation method.
12	Estimation of Ferrous Iron by Dichrometry.

LEARNING RESOURCES

TEXT BOOKS:	
1	Chemistry lab Manual. Prepared by Department of Chemistry, MVGR College of Engineering (A)
REFERENCE BOOKS:	
1	"Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar
ADDITIONAL REFERENCE MATERIAL	
1	https://www.youtube.com/@spardhayavardhatheyvidya3470

R23EEEL201	**Electrical &Electronics Engineering Lab** (Common to EEE,ECE,CSE,IT & allied branches)					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	BEEE	**0**	**0**	**3**	**1.5**

Course Objective

To impart knowledge on design and practical verification basic electrical and electronic circuits and simple energy calculation.

Course Outcomes: Student will be able to

1	Design and analyze simple circuits to verify basic electrical laws and theorems.
2	Design and analyze electrical circuits to measure resistance, power and energy consumption.
3	Understand the voltage buildup procedure in DC shunt generator.
4	Design simple electronic circuits to analyze the behavior of electronic components and verify their applications.
5	Explain the operation of digital circuits.

List of Experiments

1	Verification of KCL and KVL
2	Verification of Superposition theorem
3	Measurement of Resistance using Wheat stone bridge
4	Magnetization Characteristics of DC shunt Generator
5	Measurement of Power and Power factor using Single-phase wattmeter
6	Calculation of Electrical Energy for Domestic Premises
7	Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
8	Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
9	Implementation of half wave and full wave rectifiers
10	Plot Input & Output characteristics of BJT in CE and CB configurations
11	Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
12	Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Additional experiments

1	Measurement of Earth Resistance using Megger
2	Frequency response of CE amplifier
3	Simulation of RC coupled amplifier with the design supplied

LEARNING RESOURCES

TEXT BOOKS:

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

3	R. S. Sedha, *A Textbook of Electronic Devices and Circuits*, S. Chand & Co, 2010
REFERENCE BOOKS:	
1	V.K. Mehtha, *Principles of Electrical and Electronics Engineering*, S.Chand Technical Publishers, 2020
2	S. K. Bhatacharya, *Basic Electrical and Electronics Engineering*, Person Publications, 2018
3	R. P. Jain, *Modern Digital Electronics*, Tata Mc Graw Hill, 2009
ADDITIONAL REFERENCE MATERIAL	
1	https://www.udemy.com/course/complete-course-on-electronic-devices-and-circuits/
2	http://nptel.iitm.ac.in/
3	http://www.learningware.in/

<table>
<tr><td rowspan="3">R23CSEL201</td><td colspan="6">COMPUTER PROGRAMMING LAB
(Common to all branches of Engineering)</td></tr>
<tr><td>Total Contact Hours</td><td>45 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>NIL</td><td>0</td><td>0</td><td>3</td><td>1.5</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">• The course aims to give students hands – on experience and train them on the concepts of the C- programming language.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Read, understand, and trace the execution of programs written in C language.</td></tr>
<tr><td>2</td><td colspan="6">Select the right control structure for solving the problem.</td></tr>
<tr><td>3</td><td colspan="6">Develop C programs which utilize memory efficiently using programming constructs like pointers.</td></tr>
<tr><td>4</td><td colspan="6">Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS</td></tr>
<tr><td>1</td><td colspan="6">WEEK 1:
Familiarization with programming environment.
i Basic Linux environment and its editors like Vi, Vim & Emacs, gedit etc.
ii Exposure to Turbo C, gcc
iii Writing simple programs using printf(), scanf()</td></tr>
<tr><td>2</td><td colspan="6">WEEK 2
Developing the algorithms/flowcharts for the following sample programs
i Sum and average of 3 numbers
ii Conversion of Fahrenheit to Celsius and vice versa
iii Simple interest calculation</td></tr>
<tr><td>3</td><td colspan="6">WEEK 3
Simple computational problems using arithmetic expressions.
i Finding the square root of a given number
ii Finding compound interest
iii Area of a triangle using heron’s formulae
iv Distance travelled by an object</td></tr>
<tr><td>4</td><td colspan="6">WEEK 4:
Simple computational problems using the operator’ precedence and associativity
i Evaluate the following expressions.
a. A+B*C+(D*E) + F*G
b. A/B*C-B+A*D/3
c. A+++B---A
d. J= (i++) + (++i)
ii Find the maximum of three numbers using conditional operator
iii Take marks of 5 subjects in integers, and find the total, average in float</td></tr>
<tr><td>5</td><td colspan="6">WEEK 5:
Problems involving if-then-else structures.:
i Write a C program to find the max and min of four numbers using if-else.</td></tr>
</table>

	ii Write a C program to generate electricity bill. iii Find the roots of the quadratic equation. iv Write a C program to simulate a calculator using switch case. v Write a C program to find the given year is a leap year or not.
6	**WEEK 6:** Iterative problems: i Find the factorial of given number using any loop. ii Find the given number is a prime or not. iii Compute sine and cos series iv Checking a number palindrome v Construct a pyramid of numbers.
7	**WEEK 7:** Array manipulation, linear search i Find the min and max of a 1-D integer array. ii Perform linear search on1D array. iii The reverse of a 1D integer array iv Find 2's complement of the given binary number. v Eliminate duplicate elements in an array
8	**WEEK 8:** Matrix problems, String operations, Bubble sort i Addition of two matrices ii Multiplication two matrices iii Sort array elements using bubble sort iv Concatenate two strings without built-in functions v Reverse a string using built-in and without built-in string functions
9	**WEEK 9:** Pointers and structures, memory dereference. i Write a C program to find the sum of a 1D array using malloc() ii Write a C program to find the total, average of n students using structures iii Enter n students data using calloc() and display failed students list iv Read student name and marks from the command line and display the student details along with the total. v Write a C program to implement realloc()
10	**WEEK 10:** i Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields ii Create and display a singly linked list using self-referential structure. iii Demonstrate the differences between structures and unions using a C program. iv Write a C program to shift/rotate using bitfields. iv) Write a C program to copy one structure variable to another structure of the same type.
11	**WEEK 11:** Simple functions using call by value, solving differential equations using Eulers theorem. i Write a C function to calculate NCR value. ii Write a C function to find the length of a string. iii Write a C function to transpose of a matrix.

	iv Write a C function to demonstrate numerical integration of differential equations using Euler's method
12	**WEEK 12:** Recursive functions: i Write a recursive function to generate Fibonacci series. ii Write a recursive function to find the lcm of two numbers. iii Write a recursive function to find the factorial of a number. iv Write a C Program to implement Ackermann function using recursion. v Write a recursive function to find the sum of series.
13	**WEEK 13:** Simple functions using Call by reference, Dangling pointers. i Write a C program to swap two numbers using call by reference. ii Demonstrate Dangling pointer problem using a C program. iii Write a C program to copy one string into another using pointer. iv Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.
14	**WEEK 14:** File operations i Write a C program to write and read text into a file. ii Write a C program to write and read text into a binary file using fread() and fwrite() iii Copy the contents of one file to another file. iv Write a C program to merge two files into the third file using command-line arguments. v Find no. of lines, words and characters in a file vi) Write a C program to print last n characters of a given file.
TEXT BOOKS:	
1	Ajay Mittal, Programming in C: A practical approach, Pearson.
2	Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill
REFERENCE BOOKS:	
1	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
2	C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE
ONLINE COURSES:	
1	https://mvgrce.codetantra.com

R23HSSM802	NSS/NCC/SCOUTS&GUIDES/COMMUNITY SERVICE					
	Total Contact Hours	15 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**1**	**0.5**

Course Objective

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

Course Outcomes

1	Demonstrate the importance of discipline, character and service motto.
2	Solve some societal issues by applying acquired knowledge, facts, and techniques.
3	Explore human relationships by analyzing social problems.
4	Develop service-oriented approach to extend their help for the fellow beings and downtrodden people.
5	Develop leadership skills and civic responsibilities.

SYLLABUS

Unit 1	General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance. **Activities:** i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc. iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc. iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.	**5 hr**
Unit 2	**NATURE & CARE** **Activities:** i) Nature & Care Best out of waste competition. ii) Poster and signs making competition to spread environmental awareness. iii) Recycling and environmental pollution article writing competition. iv) Organizing Zero-waste day. v) Digital Environmental awareness activity via various social media platforms. vi) Virtual demonstration of different eco-friendly approaches for sustainable living. vii) Write a summary on any book related to environmental issues.	**5 hr**
Unit 3	**COMMUNITY SERVICE** **Activities:** i) Community Service Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media-authorities- experts-etc. 24 JNTUGV B. Tech. R23 Regulations ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS, iii) Conducting consumer Awareness. Explaining various legal provisions etc. iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education. v) Any other programmes in collaboration with local charities, NGOs etc.	**5 hr**

LEARNING RESOURCES

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

II Semester

<table>
<tr><td rowspan="3">R23HSST001</td><td colspan="6">COMMUNICATIVE ENGLISH
(Common to All Branches of Engineering)</td></tr>
<tr><td>Total Contact Hours</td><td>30 (L)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>Nil</td><td>2</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">The student will be able to apply the concepts of comprehension, Interpretation and structured presentation in varied contexts and demonstrate skilled communication.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Developing the ability to comprehend, analyze and elicit information.</td></tr>
<tr><td>2</td><td colspan="6">Demonstrating the skill of Structured thinking.</td></tr>
<tr><td>3</td><td colspan="6">Developing Competency to summarize and paraphrase content in different materials.</td></tr>
<tr><td>4</td><td colspan="6">Demonstrating the skill of constructive presentation.</td></tr>
<tr><td>5</td><td colspan="6">Building communicative competence.</td></tr>
<tr><td colspan="7">SYLLABUS</td></tr>
<tr><td>Unit 1</td><td colspan="5">THEME: HUMAN VALUES
Sample Text: The Power of a Plate of Rice (short story) by Ifeoma Okoye
Supplementary Text: The Lament by Anton Chekov
Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences. (Remedial learning with additional resources.)
Grammar: Parts of Speech, Basic Sentence Structures-forming questions. (Remedial learning with additional resources.)
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words</td><td>6 hr</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit 2</td><td colspan="5">Theme: NATURE
Sample Text: Night of the Scorpion (poem) by Nissim Ezekiel
Supplementary Text: ‘IF’ by Rudyard Kipling
Listening: Answering a series of questions after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices - linkers, use of articles and zero article prepositions.
Vocabulary: Homonyms, Homophones, Homographs.</td><td>6 hr</td></tr>
<tr><td colspan="7"></td></tr>
</table>

Unit 3	Lesson: BIOGRAPHY of Steve Jobs Supplementary Text: Biography of Tenzing Norgay **Listening**: Listening for global comprehension and summarizing. **Speaking**: Discussing specific topics in pairs or small groups and reporting what is discussed. **Reading:** Reading a text in detail by making basic inferences-recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing, Note-making, paraphrasing **Grammar**: Verbs - tenses; subject-verb agreement **Vocabulary**: Compound words, Collocations	**6 hr**
Unit 4	Lesson: INSPIRATION: *The Toys of Peace* by Saki Supplementary Text: *The Man Who Planted Trees* by Jean Giono **Listening**: Making predictions while listening to conversations/ transactional dialogues without video; listening with video. **Speaking:** Role plays for the practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. **Reading**: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing**: Letter Writing: Official Letters, Resumes. **Grammar:** Reporting verbs, Direct & Indirect speech, Active & Passive Voice. **Vocabulary**: Words often confused, Jargon.	**6 hr**
Unit 5	Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay) **Listening**: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension. **Speaking**: Formal oral presentations **Reading**: Reading comprehension. **Writing**: Writing structured essays on specific topics. **Grammar**: Editing short texts –identifying and correcting common errors in grammar (articles, prepositions, tenses, subject-verb agreement) **Vocabulary:** Technical Jargon.	**6 hr**

LEARNING RESOURCES

TEXT BOOKS:	
1	Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023.
2	Empowering English by Cengage Publications, 2023.
REFERENCE BOOKS:	
1	Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2	Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3	Murphy, Raymond. English Grammar in Use, 4thEdition, Cambridge University

	Press, 2019.
4	Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building Superior Vocabulary. Anchor, 2014.

WEB RESOURCES:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/32
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

Bloom's level - Units catchment articulation matrix

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

R23MATT102	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to All Branches of Engineering)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus	**3**	**0**	**0**	**3**

Course Objective

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

Course Outcomes

1	Solve first order differential equations and make use of them to deal with real word problems like law of cooling, growth, decay and electrical circuits.
2	Solve the higher order differential equations to make use of them to deal with real word problems like LCR circuits and simple harmonic motion.
3	Solve the partial differential equations by various methods.
4	Interpret the physical meaning of different operators such as gradient, curl and divergence.
5	Estimate the work done against a field, circulation and flux using vector calculus.
6	Formulate Mathematical models and estimate appropriate physical quantities.

SYLLABUS

Unit 1	**DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE**	**9 hr**

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

Unit 2	**LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS)**	**9 hr**

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

Unit 3	**PARTIAL DIFFERENTIAL EQUATIONS**	**9 hr**

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

Unit 4	**VECTOR DIFFERENTIATION**	**9 hr**

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

Unit 5	**VECTOR INTEGRATION**	**9 hr**

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

LEARNING RESOURCES

TEXT BOOKS:

1	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e,John Wiley& Sons, 2018.
2	B.S.Grewal,HigherEngineeringMathematics,44/e,KhannaPublishers,2017.
REFERENCE BOOKS:	
1	Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
2	Michael Green berg, Advanced Engineering Mathematics, 9th edition, Pearson edn
3	George B.Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus,14/e, Pearson Publishers, 2018.
4	R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
5	B.V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education, 2017

Bloom's level - Units catchment articulation matrix

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

R23PHYT101	ENGINEERING PHYSICS (Common to All Branches of Engineering)					
	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 identifying the importance of the optical phenomenon like interference, diffraction etc. Enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

Course Outcomes

1	Student will be able to **analyze** the intensity variation of light due to interference, diffraction and polarization
2	Student will be able to **investigate** the crystallographic phase of the unknown specimen by using the X-ray diffraction method
3	Student will be able to **interpret** the various polarization mechanisms and their frequency dependence in dielectrics; and **choose** a magnetic material for a given application based on the domain model.
4	Student will be able to **deduce** the quantized facets for a free electron in a potential box, and extend the same to **explain** the electrical conductivity and Fermi energy of metals.
5	Student will be able to **classify** the solids, **analyze** the semiconductor charge carrier concentrations, and **identify** the semiconductor typeby using the Hall effect.
6	Student will be able to **elaborate** the optical phenomena, crystallographic phase, magneto-dielectric physiognomies, quantum confinement effects, and the rudiments of semiconductor band model.

SYLLABUS

Unit 1	**WAVE OPTICS**	**9 hr**

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

Unit 2	**CRYSTALLOGRAPHY AND X-RAY DIFFRACTION**	**9 hr**

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes. **X-ray diffraction:** Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

Unit 3	**DIELECTRIC AND MAGNETIC MATERIALS**	**9 hr**

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector –Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dilectric constant – Frequency dependence of polarization – dielectric loss. **Magnetic Materials:** Introduction - Magnetic dipole

moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro& Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.		
Unit 4	**QUANTUM MECHANICS AND FREE ELECTRON THEORY**	**9 hr**
Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well. **Free Electron Theory:** Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory –electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy.		
Unit 5	**SEMICONDUCTORS**	**9 hr**
Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation - Hall effect and its applications.		

LEARNING RESOURCES

TEXT BOOKS:	
1	A Text book of Engineering Physics - M. N. Avadhanulu, P.G.Kshirsagar& TVS Arun Murthy, S.Chand Publications, 11thEdition (2019).
2	Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press, 1st Edition (2015).
REFERENCE BOOKS:	
1	Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning, 2nd Edition (2021).
2	Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 1st Edition (2018)
3	Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press, 1st Edition (2010).
4	Engineering Physics - M.R. Srinivasan, New Age international publishers 1st Edition (2009)
ONLINE COURSES:	
1	https://archive.nptel.ac.in/courses/122/107/122107035/
2	https://www.youtube.com/watch?v=GQ5XpeS3e3U&list=PLLy_2iUCG87B_Tmfs0y2tR8GNIkyRIKpW
3	https://archive.nptel.ac.in/courses/112/106/112106227/
4	https://archive.nptel.ac.in/courses/115/101/115101107/
5	https://archive.nptel.ac.in/courses/108/108/108108122/

Bloom's level - Units catchment articulation matrix

CO	Blooms Level	Unit-1	Unit-2	Unit-3	Unit-4	Unit-5
CO1	BL4	X				
CO2	BL5		X			
CO3	BL5			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R23CMET201	BASIC CIVIL AND MECHANICAL ENGINEERING					
	Total Contact Hours	48	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**3**	**0**	**0**	**3**

Course Objectives

- Get familiarized with the scope and importance of Civil and Mechanical Engineering in different sectors and industries.
- Introduce the preliminary concepts of Building Planning, Building Construction, Materials and the related tests.
- Provide preliminary knowledge of surveying and understand the importance of the water resources in terms of quantity and quality.
- Explain different engineering materials and manufacturing processes.
- Provide an overview of different thermal and mechanical systems; introduce basics of robotics and its applications.

Course Outcomes

1	Compile the role of a Civil Engineer in his multifaceted tasks and Discuss the principles of building planning and various construction aspects including materials
2	Solve for areas of irregular boundaries by means of lengths and bearings and for reduced level of an object
3	Elaborate the importance of Transportation in Nation's economy and the engineering measures related to highways in terms of geometrics and water resources and storage structures to appreciate the social responsibility of water conservation in terms of quality and quantity.
4	Adapt and integrate the mechanical engineering technologies in various Industrial sectors, and choose appropriate engineering materials for engineering applications.
5	Express the working of different manufacturing processes, refrigeration and air-conditioning cycles, IC engines, electric and hybrid vehicles.
6	Express and write the working of power plants, mechanical power transmission systems, and different robotic configurations.

SYLLABUS

PART A: BASIC CIVIL ENGINEERING

Unit 1	**Basics of Civil Engineering:**	**8 hr**

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-Technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks-Cement concrete- Steel-Tests on these materials. Factors to be considered in Building Planning- Nature of Buildings- Typical Layouts of a Residential Building-Industrial Building- Commercial Building like a Supermarket / Hotel / Theatre.

Unit 2	**Surveying**	**8 hr**

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

Unit 3	Transportation Engineering, Water Resources and Environmental Engineering:	8 hr

Transportation Engineering, Water Resources and Environmental Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences - Basic geometric design elements of a highway- Camber- Stopping Sight Distance- Super elevation-Introduction.

Water Resources and Environmental Engineering: Sources of water- Quality of water- Specifications and Tests- Introduction to Hydrology- Hydrograph –Rain water Harvesting- Rain water runoff- Water Storage Structures (Simple introduction to Dams and Reservoirs).

PART B: BASICMECHANICAL ENGINEERING

Unit 4	Introduction to Mechanical Engineering and Engineering Materials	8 hr

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

Unit 5	Manufacturing Processes and Thermal Engineering	8 hr

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering– working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

Unit 6	Power plants, Mechanical Power Transmission and Introduction to Robotics	8 hr

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

LEARNING RESOURCES

TEXT BOOKS:

1	M.S.Palanisamy, Basic Civil Engineering, Fourth Edition, Tata Mcgraw Hill publications (India) Pvt. Ltd, 2017.
2	S.S. Bhavikatti, Introduction to Civil Engineering, , First Edition, New Age International Publishers,2022.
3	Satheesh gopi, Basic Civil Engineering,First Edition, Pearson publications,2009.
4	V.Ganesan, Internal Combustion Engines, 4th edition, Tata McGraw Hill publications Pvt. Ltd, 2017.
5	S.S. Rattan, Theory of Machines, Fourth edition, McGraw Hill Education; 2017
6	Jonathan Wicker and Kemper Lewis, An introduction to Mechanical Engineering, 3rd edition, Cengage learning India Pvt. Ltd, 2012.

REFERENCE BOOKS:	
1	S.K. Duggal, Surveying, Vol- I and Vol-II, 4th Edition,Tata McGraw Hill Publishers, 2017.
2	Santhosh Kumar Garg, Hydrology and water resources engineering, 23rd Edition,Kahnna publishers, Delhi,2016
3	Santhosh Kumar Garg, Irrigation Engineering and Hydraulic Structures, 38th Edition,Kahnna publishers, Delhi,2023
4	S K Khanna and C E G Justo and Veeraraghavan, Highway Engineering,10th Edition Nemchand Brothers Publications,2019
5	Indian Standard Drinking water Specifications – IS 10500-2012
6	Appuu Kuttan KK, Robotics, I.K. Volume-I, International Publishing House Pvt. Ltd, 2013.
7	L. Jyothish Kumar, Pulak M Pandey, 3D printing & Additive Manufacturing Technology, Springer publications, 2017.
8	Mahesh M Rathore, Thermal Engineering, Tata McGraw Hill publications (India) Pvt. Ltd, 2010.
ADDITIONAL REFERENCE MATERIAL	
1	Subramanian KP, Highway, Railway, Airport and Harbour Engineering, First Edition, Scitech Publications (India) Pvt. Limited, 2010
2	M S Shetty, Concrete Technology (Theory & Practice), Revised Edition, S Chand Publishers, 2006
3	Dr. S.C. Rangwala, Engineering Materials, 3rd edition, Charotor Publishing House, 2018.
4	P. K. Nag. Power Plant Engineering, 4th edition, McGraw Hill Education, 2017
5	James D. Halderman , Curt Ward, Electric and Hybrid Electric Vehicles, Pearson Education, 2023.
ONLINE COURSES	
1	https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ce40/
2	https://www.udemy.com/course/surveying/
3	https://archive.nptel.ac.in/courses/112/103/112103316/
4	https://nptel.ac.in/courses/112107291

Bloom'slevel - Unitscatchmentarticulationmatrix

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

R23ECET301	NETWORK ANALYSIS (Common to All Branches of Engineering)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basics of Electrical and Electronics Engineering	**3**	**0**	**0**	**3**

Course Objective

The objectives of this course are to make the students:

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

Course Outcomes

At the end of the course, students shall be able to

1	Apply Network theorems, Mesh and Nodal Analysis Techniques to solve complex electrical circuits.
2	Evaluate Transient Responses for first and second-order electrical circuits using differential equations and Laplace transform for both DC and AC excitations.
3	Analyze A.C. Circuits in Steady State for series R-L, R-C, and R-L-C circuits using mesh and nodal analysis.
4	Apply Resonance Concepts and Analyze Coupled Circuits.
5	Apply Two-Port Network Analysis Techniques.
6	Synthesize Solutions for Complex Electrical Circuits

SYLLABUS

Unit 1	**Circuit Analysis and Theorems**	**9 hr**

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

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

Unit 2	**Transient Analysis and Laplace Transforms**	**9 hr**

Transient Analysis : Transients: First order differential equations, Definition of time constants, R-L circuit, R-Ccircuit with DC excitation, evaluating initial conditions procedure, second order differentialequations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DCexcitationand AC excitation, Responseas related to s-planerotationofroots.

Laplace Transforms: Introduction, Laplace transformation, basic theorems, problem solvingusing Laplace transform, partial fraction expansion, Heaviside's expansions, problem solvingusing Laplacetransform.

Unit 3	**Steady State Analysis of AC Circuits**	**9 hr**

SteadyStateAnalysisofA.CCircuits:Impedance concept, phase angle,series R-L, R-C, R- L-C circuits problem solving. Complex impedance and phasor notation for

R-L, R-C, R-L-C. Problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving using Laplace transforms also.		
Unit 4	**Resonance and CoupledCircuits**	**9 hr**
Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case-resistance present in both branches, anti-resonance at allfrequencies. **CoupledCircuits**: Self-inductance, Mutualinductance, Coefficientofcoupling, analysis of coupledcircuits, Naturalcurrent, Dotrule of coupled circuits, conductively coupled equivalent circuits -problem solving.		
Unit 5	**Two-PortNetworks**	**9 hr**
Two-PortNetworks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solvingusing dependent sourcesalso. Image and iterative impedances. Image and iterative transfer constants. Insertion loss. Attenuators and pads. Lattice network and its parameters. Impedance matching networks.		

LEARNING RESOURCES

TEXT BOOKS:	
1	NetworkAnalysis–MEVanValkenburg, Prentice Hall of India, revised 3rd Edition, 2019.
2	Engineering Circuit Analysis by WilliamH.Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020.
3	Network lines and Fields by John. D.Ryder 2ndEdition, PHI.
REFERENCE BOOKS:	
1	D.Roy Choudhury, Networks and Systems, New Age International Publications, 2013.
2	Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series, 7th Edition, TataMcGraw 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	Basic Circuit Analysis by DR Cunninghan, Jaico Publishers.
2	Network Analysis and Filter Design by Chadha, UmeshPublications
3	Franklin Kuo, Network Analysis and Synthesis, 2nd Ed.,Wiley India.
4	S. K. Bhattacharya, Network Analysis and Synthesis, Pearson Education India.
ONLINE COURSES :	
1	https://archive.nptel.ac.in/courses/108/105/108105159/
2	https://archive.nptel.ac.in/courses/108/104/108104139/
3	https://nptel.ac.in/courses/117106116

Bloom'slevel – Units catchment articulation matrix

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

R23HSSL001	COMMUNICATIVE ENGLISH LAB (Common to All Branches of Engineering)					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**2**	**1**

Course Objective

The main objective of the course is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills to become industry ready.

Course Outcomes

1	Demonstrate understanding of the different aspects of English language proficiency with emphasis on LSRW skills.
2	Develop communication skills by exposing the student to various language learning activities.
3	Analyze and apply techniques to comprehend information in audio/video material.
4	Develop professionalism by facilitating debates and group discussions.
5	Demonstrate effective presentation skills.

List of Topics

1	Communication Skills & JAM
2	Articulation of sounds & Listening to comprehend information
3	Role Play or Conversational Practice
4	E-mail Writing
5	Resume Writing, Cover letter writing
6	Group Discussions-methods & practice
7	Debates - Methods & Practice
8	PPT Presentations/ Poster Presentation
9	Interview skills

LEARNING RESOURCES

REFERENCE BOOKS:

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

WEB RESOURCES

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/

R23PHYL101	ENGINEERING PHYSICS LAB (Common to All Branches of Engineering)					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Higher Secondary School Physics	**0**	**0**	**2**	**1**

Course Objective

To complement classroom learning with laboratory experiments. Calibration of instruments like travelling-microscope, spectrometer, 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

1	Student will be able to **conduct** experiments to reconnoitre the interference and diffraction patterns of light.
2	Student will be able to **find** the signature variation of magnetic field due to current; and the hysteresis energy loss in a magnetic material.
3	Student will be able to **measure** the physiognomies of the semiconductor devices like the energy band gap (E_g) and the temperature coefficient of resistance (α).
4	Student will be able to **observe** the pendulum oscillations and **determine** the impelling parameters like rigidity modulus (η), acceleration due to gravity (g), etc.
5	Student will be able to **verify** the laws of vibrations and **determine** the unknown fork frequency by forming standing waves on stretched strings.

List of Experiments

1	Determination of radius of curvature of a given plano-convex lens by Newton's rings.
2	Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3	Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
4	Determination of wavelength of Laser light using diffraction grating
5	Determination of energy gap of a semiconductor using p-n junction diode
6	Magnetic field along the axis of a current carrying circular coil by Stewart and Gee's Method
7	Determination of temperature coefficients of a thermistor
8	Determination of rigidity modulus of the material of the given wire using Torsional pendulum
9	Determination of frequency of the electrically maintained tuning fork by Melde's experiment
10	Sonometer: Verification of the laws of stretched string

Additional experiments

1	Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum

LEARNING RESOURCES

TEXT BOOKS:

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

	Publishers, 2017
REFERENCE BOOKS:	
1	A Textbook of Engineering Physics Practical- C.S. Robinson and Dr. Ruby Das, Laxmi Publications Pvt. Ltd. 1st Edition, 2016.
ADDITIONAL REFERENCE MATERIAL	
1	www.vlab.co.in

R23ECEL301	NETWORK ANALYSIS AND SIMULATION LAB					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**3**	**1.5**

Course Objective

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

Course Outcomes

At the end of the course, students shall be able to

1	Verify Kirchoff's laws and network theorems.
2	Measure time constants of RL & RC circuits.
3	Analyze behavior of RLC circuit for different cases.
4	Design resonant circuit for given specifications.
5	Characterize and model the network in terms of all network parameters.

SYLLABUS

List of Experiments:

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

LEARNING RESOURCES

TEXT BOOKS:

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

REFERENCE BOOKS:

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

3	Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku, McGraw-Hill Education
ADDITIONAL REFERENCE MATERIAL	
1	Chakrabarti, A., "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co., Seventh - Revised edition, 2018
2	S. K. Bhattacharya, - Network Analysis and Synthesis, Pearson Education India
3	K. S. Suresh Kumar, - Electric Circuit Analysis, Pearson Publications, 2013.
4	Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013.

R23MECW201	ENGINEERING WORKSHOP (Common to All Branches of Engineering)					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**3**	**1.5**

Course Objective

Students will understand various engineering trades such as carpentry, tin smithy, foundry, fabrication, fitting and electrical house wiring skills and required safety practice required and address common trouble shooting in day- today practice.

Course Outcomes	
1	Identify workshop tools and their operational capabilities.
2	Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
3	Apply concept of fitting and sheet metal understanding in various applications.
4	Apply basic electrical engineering knowledge for House Wiring Practice.
Syllabus	
1	**Demonstration**: Safety practices and precautions to be observed in workshop.
2	**Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints. a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridle joint
3	**Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets. a)Tapered tray b) Conical funnel c) Elbow pipe d)Brazing
4	**Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises. a) V-fit b)Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5	**Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections. a) Parallel and series b) Two-way switch c) Go down lighting d) Tube light e) Three phase motor f) Soldering of wires
6	**Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7	**Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8	**Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.
Additional experiments	
1	Making of study lamp using combination of carpentry and house wiring trades.
2	Frame making of dissemination using carpentry and welding.
3	Electric Load calculation in a living room.
4	emonstration of connection in street lights using single control.

LEARNING RESOURCES

TEXT BOOKS:	
1	W. Felix, Basic *Workshop Technology: Manufacturing Process*, Independently Published, 2019.
2	Bruce J. Black, *Workshop Processes, Practices and Materials*, Routledge publishers, 5th Edn. 2015.

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

<table>
<tr><td rowspan="3">R23CSEW201</td><td colspan="6">IT WORKSHOP
(Common to all branches of Engineering)</td></tr>
<tr><td>Total Contact Hours</td><td>30 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>NIL</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">● To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables , operating systems, Compression, Multimedia, Antivirus tools and Office Tools such as Word processors, spreadsheets, and Presentation tools.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Students will be able to analyze Hardware troubleshooting.</td></tr>
<tr><td>2</td><td colspan="6">Students will be able to identify Hardware components and inter dependencies.</td></tr>
<tr><td>3</td><td colspan="6">Students will be able to choose safeguard computer systems from viruses/worms.</td></tr>
<tr><td>4</td><td colspan="6">Students will be able to Create document and power point presentation.</td></tr>
<tr><td>5</td><td colspan="6">Students will be able to develop calculations using spreadsheets.</td></tr>
<tr><td colspan="7">List of Experiments</td></tr>
<tr><td>1</td><td colspan="6">Week-1: PC Hardware & Software Installation
1) Identify the peripherals of a computer, components in a CPU, and functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.
2) Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students must go through the video showing the PC assembling process. A video would be given as part of the course content.</td></tr>
<tr><td>2</td><td colspan="6">Week-2:
1) Students should install MS windows on their personal computer. The lab instructor should verify the installation and follow it with a Viva.</td></tr>
<tr><td>3</td><td colspan="6">Week-3:
1) Every student should install Linux on the computer. This computer should have Windows installed. The system should be configured as dual boot (VMWare) with Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.
2) Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva.</td></tr>
<tr><td>4</td><td colspan="6">Week-4: Internet & World Wide Web
1) Orientation & Connectivity Boot Camp: Students should connect to their Local Area Network and access the Internet. In the process, they configure the TCP/IP setting. Finally, students should demonstrate to the instructor how to access the websites and email. Without internet connectivity, instructors must simulate the WWW</td></tr>
</table>

	on the LAN. 2) Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars, and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
5	Week-5: 1) Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student. 2) Cyber Hygiene: Students would be exposed to the various threats on the internet and asked to configure their computers to be safe on the internet. They need to customize their browsers to block pop-ups, and block active X downloads to avoid viruses and worms.
6	Week-6: LaTeX and WORD 1) Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) Office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent(FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word – Accessing, overview of toolbars, saving files, Usinghelp and resources, rulers, format painter in word. 2) Using LaTeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in Word, Drop Cap in Word, Applying Text effects, Using Character Spacing,Borders, and Colors, Inserting Header and Footer, Using Date and Time options in LaTeX and Word.
7	Week-7: 1) Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes. 2) Creating a Newsletter: Features to be covered:- Table of Contents, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs, and Mail Merge in word.
8	Week-8: EXCEL Excel Orientation: The mentor needs to tell the importance of the MS Office or equivalent (FOSS)tool Excel as a Spreadsheet tool give the details of the four tasks and features that would be covered in each. Using Excel – Accessing an overview of toolbars, saving Excel files, Using help and resources. 1) Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto-fill, Formatting Text. 2) Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in Excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyperlinking, Count function.
9	Week-9: 1) LOOKUP/LOOKUP : Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

10	Week-10: POWERPOINT 1) Students will be working on essential PowerPoint utilities and tools which help them create introductory PowerPoint presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint. 2) Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.
11	Week-11: 1) Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes, etc), and Inserting – Background, textures, Design Templates, Hidden slides.
12	Week-12: AI TOOLS – Chat GPT 1) Prompt Engineering: Experiment with different prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.. 2) Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a scene description, and let the model generate the rest of the content. This can be a funway to brainstorm creative ideas. 3) Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.
LEARNING RESOURCES	
TEXT BOOKS:	
1	Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream Tech, 2003
2	Introduction to Information Technology, ITL Education Solutions Limited, Pearson Education, 2012, 2nd edition
REFERENCE BOOKS:	
1	The Complete Computer Upgrade and Repair Book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
2	PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
3	LaTeX Companion, Leslie Lamport, PHI/Pearson

R23HSSM801	HEALTH AND WELLNESS, YOGA AND SPORTS (Common to All Branches of Engineering)					
	Total Contact Hours	15 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**1**	**0.5**

Course Objective

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

Course Outcomes

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

SYLLABUS

Unit 1	Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups. **Activities:** Organizing health awareness programmes in community ii) Preparation of health profile iii) Preparation of chart for balance diet for all age groups	**5 hr**
Unit 2	Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice. **Activities:** Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar	**5 hr**
Unit 3	Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and 49 Modern Olympics, Asian games and Commonwealth games. **Activities:** i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.	**5 hr**

LEARNING RESOURCES

REFERENCE BOOKS:

1	Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2	T. K. V. Desikachar. The Heart of Yoga: Developing a Personal Practice
3	Archie J. Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4	Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to

	Surviving Anywhere. Third Edition, William Morrow Paperbacks, 2014
5	The Sports Rules Book/ Human Kinetics with Thomas Hanlon. 3rd ed. Human Kinetics, Inc.2014

III Semester

R23MECET005	INTERNET OF THINGS					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Procedural Programming	**3**	**0**	**0**	**3**

Course Objectives:

1. To provide a comprehensive understanding of the fundamental concepts of IoT and to familiarize students with the enabling technologies of IoT.
2. To equip students with detailed knowledge of various IoT communication protocols, and to develop the ability to select appropriate protocols for specific IoT applications.
3. To introduce students to various IoT prototyping boards and to develop skills in programming IoT systems using relevant tools and libraries.
4. 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.
5. 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.

LEARNING RESOURCES

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 1st Ed, 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'slevel – Units catchment articulation matrix						
CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL3	X	X			
CO2	BL4		X	X		
CO3	BL4			X		
CO4	BL5				X	
CO5	BL5				X	X
CO6	BL6	X	X	X	X	X

R23MECET006	ELECTRONIC DEVICES AND CIRCUITS					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Engineering Physics, BEEE	**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 switchand 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	**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 AND 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	Electronic Devices and Circuits- S Salivahanan, N Suresh Kumar, Tata Mc-Graw Hill, Third Edition, 2012.	
2	Electronic Devices and Circuit Theory-R.L. Boylestad and LouisNashelsky, Pearson Publications, Tenth Edition.	
3	K.Lal Kishore, "Electronic Circuit Analysis", 2nd Ed, B S Publications, 2008	
ADDITIONAL REFERENCE MATERIAL		
1	Electronic Devices and Circuits Lecture Notes and Study Material PDF - BTech Geeks	
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

R23MECET001	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 Group1:

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 Group1:

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 Kaurnaugh - Maps (3,4Variables) 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 Group1:

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, Implementation of Boolean functions using decoders; 7-Segment Display Decoder, Encoders and Priority Encoders; Multiplexers, Implementation of Boolean functions using multiplexers; De-Multiplexers; Design of Higher Order Circuits with lower Order circuits.

Unit IV	FLIPFLOPS AND REGISTERS	8 hr
Competency Group1: 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 Group1: 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.		

LEARNING RESOURCES	
TEXTBOOKS:	
1	Digital Design, 4th Edition, Morris Mano, Michael D. Ciletti, Pearson
2	Fundamentals of Logic Design, 5th 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, 2nd 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

R23MECET007	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 densityfunctions 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 Group1:

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 Group1:

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

Competency Group1:
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.

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;

Unit IV	RANDOM VARIABLES AND OPERATIONS ON RANDOM VARIABLE	8 hr

Competency Group1:
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;

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.

Unit V	RANDOM PROCESS AND NOISE	8 hrs

Competency Group1:
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.

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.

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 and S.H. Nawab, PHI, 2nd edition, 2011.
3	Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles, TMH, 4th Edition, 2002.

REFERENCE BOOKS:

1	Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd edition, 2008.
2	Signals & Systems – P. Ramakrishna Rao, Shankar Prakriya, McGraw Hill Education, 2nd edition, 2013
2	Signals & Systems – A. Anand Kumar, PHI, 2nd edition, 2013.
3	Probability theory and stochastic process, Y. Mallikarjuna Reddy, Universities Press,4th 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/
ONLINE COURSES	
1	https://nptel.ac.in/courses/108/106/108106163
2	https://nptel.ac.in/courses/108/104/108104100/

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

R23MCSCT001	DATA STRUCTURES & ALGORITHMS (for MEC, ECE, EEE, CIV and CHE)					
	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, *Data Structures and algorithm analysis in C*, Pearson, 2nd Edition.	
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, *Fundamentals of data structures in C*, Silicon Press, 2008.	
3	Richard F, Gilberg , Forouzan, Cengage, *Data Structures*, 2/e.	
REFERENCE BOOKS:		
1	Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.	
2	C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft	
3	Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum	
4	Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.	
5	Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.javatpoint.com/data-structure-tutorial	
2	https://www.programiz.com/dsa	
3	https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf	

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

Bloom's level – Units catchment articulation matrix

CO	Blooms Level	UnitI	UnitII	Unit III	UnitIV	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

R23MSCST011	OPERATING SYSTEMS (Common to all Branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**3**	**0**	**0**	**3**

Course Objective

Students will gain a comprehensive understanding of operating systems, coveringtopics such as system architecture, functionalities, structures, processes, file systems, storage management, and advanced concepts like inter-process communication, multithreading, disk scheduling, and RAID, enabling them to grasp the fundamental principles and practical aspects of managing computer systems effectively.

Course Outcomes

1	Students will be able to analyse the diverse structures and functionalities of operating systems.**(BL4)**
2	Students will be able to design and make use of efficient process management strategies, employing system calls and various threading models to improve overall system responsiveness.**(BL6)**
3	Students will be able to analyze the system's performance and effectiveness by comparing different strategies for deadlock resolution and memory management.**(BL3)**
4	Students will be able to analyze the performance of virtual memory management techniques, including TLB, different page table structures, and page replacement algorithms. Examine system behavior to identify and understand the causes of thrashing and evaluate the effectiveness of various file management methods and directory structures.**(BL5)**
5	Students will be able to analyze the effectiveness of various file system structures and management techniques. Evaluate the efficiency of free space management techniques and disk scheduling algorithms. Examine RAID levels to assess their impact on disk and swap space management.**(BL5)**
6	Students will be able to adapt to build basic internals of operating system framework that integrates diverse OS concepts (process management strategies, efficient file system structures, and virtual memory management techniques), choose different approaches for inter-process communication to enhance system responsiveness and collaboration, and discuss various solutions for ensuring improved performance and reliability in storage systems.**(BL6)**

SYLLABUS

Unit I	**INTRODUCTIONTOOSANDCONCEPTSOFPROCESSANDTHREADING**	**8 hr**

What Operating Systems do? Computer System architecture;OS Functionalities:Process Management, Memory Management, Storage Management, Protection and Security; Computing Environment: Traditional Computing, Client Server computing, Peer to Peer computing, web based

computing, OS Services; System calls, Typesof System calls; Operating System Structure: Simple, Layered, Microkernels, Modules; Introductionto Processes:Process, Process States, Process Control Block.Threads.;Operations On Processes: Process Creation, Process Termination (fork(), exec(), exit() systemcalls); Inter-Processcommunication: Shared memory, Message Passing;		
Unit II	**PROCESSSCHEDULINGANDSYNCHRONIZATION**	**8 hr**
Multithreading Models: Overview, Benefits, Many to One, One to One, Many to Many. Process Scheduling: Scheduling queues, Schedulers, Context switch; Process Scheduling: Basic Concepts, CPU Scheduler, Preemptive Scheduling, Dispatcher, Scheduling Criteria; Scheduling Algorithms (Non-pre-emptive): FCFS, SJF; Scheduling Algorithms II(pre-emptive): Priority Scheduling, Round Robin; Multilevel Queue, Multilevel Queue feedback, Process Synchronization: Introduction to process synchronization. Producer Consumer Problem; Critical Section Problem, Peterson's Solution, Synchronization Hardware; Semaphore, Classical problems of synchronization: Bounded-buffer Problem, Readers Writers Problem; Dining Philosophers Problem, Monitors: Introduction, Usage;		
Unit III	**DEADLOCKSANDMEMORYMANAGEMENT**	**8 hr**
Deadlocks: Introduction, System Model, Deadlock Characterization; Methods for Handling Deadlocks Deadlock Prevention; Deadlock Avoidance (Part -1) Safe state, resource allocation graph algorithm; Deadlock Avoidance (Part -2) Banker's algorithm, Deadlock Detection single instance of each resource type; Deadlock Detection several instances of resource type and Recovery from Deadlocks; Memory Management, Address Binding, Logical vs Physical Address space; Swapping, Contiguous Memory; Paging (Basic Method);		
Unit IV	**PAGINGTECHNIQUES,PAGEREPLACEMENTANDACCESSING FILES TECHNIQUES**	**8 hr**
Hardware, TLB, Protection, Shared Pages,; Structure of the Page table, hierarchy, hashed,; Inverted page table, Segmentation; Virtual memory management, Demand paging; Page Replacement Algorithms: FIFO, Optimal page replacement; LRU Page replacement, Thrashing: causes of thrashing,; File concept, File Attributes, File operations, File types, File Structure; Access methods: Sequential Access, Direct Access, Directory Structure: Single level directory, Two level directory;		
Unit V	**FILEORGANIZATIONANDDISKSCHEDULINGTECHNIQUES**	**8 hr**
Tree structured directories, Acyclic graph directories, File System Mounting File Sharing; File Protection: types of access, Access control, File allocation methods: Contiguous allocation,; File allocation methods: Linked allocation, Indexed allocation, Free space management: Bit vector, Linked list, Grouping,; Overview of Mass Storage Structure: Magnetic disks, Magnetic Tapes, Disk Structure; Disk Scheduling: FCFS,SSTF,SCAN,; CSCAN,LOOK,CLOOK; Disk Management, Swap Space Management; Raid Structure: Levels: 0-6, RAID levels 0+1;		
LEARNING RESOURCES		
TEXT BOOKS:		
1	"Operating System Concepts" by Abraham Silberschatz, Peter B.Galvin, and Greg Gagne.	

2	"Modern Operating Systems" byAndrewS.Tanenbaum.
REFERENCE BOOKS:	
1	"OperatingSystems:InternalsandDesignPrinciples"byWilliamStallings.
ADDITIONAL REFERENCE MATERIAL	
1	"Operating Systems: Three Easy Pieces" by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci Dusseau (Free online book available at: http://pages.cs.wisc.edu /~remzi/OSTEP/)
2	"LinuxKernelDevelopment"byRobertLove.
3	"FileSystemForensicAnalysis"byBrianCarrier.
ONLINE COURSES	
1	**Coursera:"OperatingSystemsandSystemProgramming"** ● OfferedbyStanfordUniversity,thiscoursecoversfundamentalconcep tsand principles of operatingsystems. ● https://www.coursera.org/specializations/codio-introduction-operating-systems
2	**edX:"IntroductiontossOperatingSystems"** ● ProvidedbyGeorgiaInstituteofTechnology,thiscourseexploresthedesi gnandimplementation ofmodern operatingsystems. ● Link: https://www.udacity.com/course/introduction-to-operating-systems--ud923
3	**MITOpenCourseWare:"OperatingSystemEngineering"** ● AfreeonlinecoursefromMIT,offeringin-depthcoverageofoperatingsystem designand implementation. **Link:** ● https://ocw.mit.edu/courses/6-828-operating-system-engineering-fall-2012/

Bloom'slevel - Unitscatchmentarticulationmatrix

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

R23MECEL002	ELECTRONIC DEVICES AND CIRCUITS LAB					
	Total Contact Hours	45 (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	FETCharacteristics
8	CE Amplifier
9	CC Amplifier (Voltage series feedback amplifier)
10	FET -CS Amplifier
11	FET -CD Amplifier
12	RC-phaseshiftOscillator
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 LouisNashelsky, Pearson Publications, Tenth Edition.
3	K.Lal Kishore, "Electronic Circuit Analysis", 2ndEdition, 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

R23MECEL003	DIGITAL LOGIC DESIGNLAB					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**0**	**0**	**3**	**2**

Course Objective

- 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, ThirdEdition. 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=PL3Soy1ohxlP1TLpcbYXYcVWItRy_XrUk8

Note: The students are required to design and draw the internal logical structure of the following digital Circuits and 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 be verified and implement the logical operations on the FPGA Hardware in the Laboratory.

Softwarerequirements:

Vivado Xilinx Design Suite softwaretool

Hardwarerequirements:

Nexys-4 DDR FPGA, ComputerSystemswithrequired specifications

<table>
<tr><td rowspan="3">R23MCSCL001</td><td colspan="6">DATA STRUCTURES & ALGORITHMS LAB
(for MEC, ECE, EEE, CIV and CHE)</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>Basic Programming</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">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.</td></tr>
<tr><td>2</td><td colspan="6">Student will be able to implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation.</td></tr>
<tr><td>3</td><td colspan="6">Student will be able to develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.</td></tr>
<tr><td>4</td><td colspan="6">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.</td></tr>
<tr><td>5</td><td colspan="6">Student will be able to devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, trees, graphs.</td></tr>
<tr><td>6</td><td colspan="6">Student will be able to recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems.</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS</td></tr>
<tr><td>1</td><td colspan="6">WEEK 1(SEARCH TECHNIQUES)
Write a C Program to search an element in the given list using Linear Search Technique. (using recursive and non-recursive functions)
Write a C Program to search an element in the given sorted list using Binary Search Technique. (using recursive and non-recursive functions)</td></tr>
<tr><td>2</td><td colspan="6">WEEK 2(SORTING TECHNIQUES)
Write a C Program using recursive function to sort a given list of integers in ascending order using Bubble Sort Technique.
Write a C Program using recursive function to sort a given list of integers in ascending order using Quick Sort Technique.
Write a C Program using recursive function to sort a given list of integers in ascending order using Merge Sort Technique.</td></tr>
<tr><td>3</td><td colspan="6">WEEK 3(LINKED LIST)
Write a C Program to create a Single linked list and perform basic operations on Single Linked List.</td></tr>
<tr><td>4</td><td colspan="6">WEEK 4 (OTHER VARIANTS OF LINKED LIST)
Write a C Program to create a Circular linked list and perform basic operations.</td></tr>
</table>

	• Write a C Program to create a Double linked list and perform basic operations.
5	**WEEK 5 (STACKS & APPLICATIONS)** • Write a C Program to implement Stack operations using arrays. • Write a C Program to implement Stack operations using linked list. • Write a C Program to implement Infix to postfix conversion using stacks. • Write a C Program to evaluate the Postfix Expression using stacks.
6	**WEEK 6 (QUEUES)** • Write a C Program to implement Queue operations using arrays. • Write a C Program to implement Queue operations using linked list • Write a C Program to implement Circular Queue operations.
7	**WEEK 7 (BINARY TREE)** • Write a C Program to implement Binary Tree Creation. • Write a C Program to implement Recursive Binary Tree Traversals.
8	**WEEK 8 (BINARY SEARCH TREE(BST))** • Write a C Program to implement Binary Search Tree creation. • Write a C program to implement Insertion, Deletion, Search operations on Binary Search Tree.
9	**WEEK 9 (GRAPHS & TRAVERSAL TECHNIQUES)** • Write a C Program to create a Graph (using Adjacency Matrix or Adjacency List). • Write a C Program to implement Graph Traversals -Breadth First Search and Depth First Search.
10	**WEEK 10 (GRAPH APPLICATIONS)** • Write a C Program to implement Prim's & Kruskal's Algorithm for finding Minimum Cost Spanning Tree. • Write a C Program to implement Single Source Shortest Path - Dijkstra's Algorithm.
11	**WEEK 11 (HEAPS)** • Write a C Program to implement Binary Heap (Min Heap or Max Heap).
12	**WEEK 12 (HASHING)** • Write a C Program to implement Collision Resolution Techniques using Linear probing (Open Addressing) Technique using Division method as hash function.
<u>LEARNING RESOURCES</u>	
TEXT BOOKS:	
1	Mark Allen Weiss, *Data Structures and algorithm analysis in C*, Pearson, 2nd Edition.
2	Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, *Fundamentals of data structures in C*, Silicon Press, 2008.
3	Richard F, Gilberg , Forouzan, Cengage, *Data Structures*, 2/e.

REFERENCE BOOKS:	
1	Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.
2	C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3	Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4	Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.
5	Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick
ADDITIONAL REFERENCE MATERIAL	
1	https://www.javatpoint.com/data-structure-tutorial
2	https://www.programiz.com/dsa
3	https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf
ONLINE COURSES	
1	https://onlinecourses.nptel.ac.in/noc24_cs45/preview
2	https://www.coursera.org/learn/data-structures
3	https://www.coursera.org/specializations/boulder-data-structures-algorithms

IV Semester

R23MECET008	ANALOG AND DIGITAL COMMUNICATIONS					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Signals, Systems and Stochastic Processes	**3**	**0**	**0**	**3**

Course Objective

- 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**

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;

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

Unit 2	**ANGLE MODULATION**	**8 hr**

Competency Group1: 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

Competency Group2: 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

Unit 3	RADIO TRANSMITTERS, RECEIVERS & PULSE MODULATION	8 hr

Competency Group1: 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.

Competency Group2: 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.

Unit 4	DIGITAL CARRIER MODULATION	8 hr

Competency Group1: 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 Group2: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 Group1: 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; Shanon-Fano coding, Huffman coding, efficiency calculations, Gaussian channel capacity (Hartley – Shannon's Law) Channels, bandwidth –S/N trade off.

Competency Group2: 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.

LEARNING RESOURCES

TEXT BOOKS:

1	Communication Systems- Simon Haykin, JohnWiley, 2nd Ed.2005.
2	Communication Systems - R.P. Singh, SP Sapre, Second Edition TMH, 2007.
3	Digital and Analog Communication Systems- K.Sam Shanmugam.Wiley, 4th 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, 3RD Edition, 2007.
4	Analog communication - P. Ramakrishna Rao, 1st Edition, 2011
5	Digital Communication – P. Ramakrishna Rao, 1st 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

R23MECET009	EM WAVES & TRANSMISSION LINES					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Engineering Mathematics, Engineering Physics	3	0	0	3

Course Objective

- 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 | **ElectromagneticWaveEquations** | **8 hr**

Competency Group 1 :

Maxwell'sequationsindifferential 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 VectorandPoynting 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; Brewsterangle; criticalangle,

totalinternalreflection,surfaceimpedance.		
Unit 4	**TransmissionLines**	**8 hr**
Competency Group 1 : Definition, Types, Applications, equivalent circuit of two wire parallel transmissionlines, Primary constants, Line Equations; Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities; Infinite Line Concept, Lossless and Low Loss Characterization; **Competency Group2**: 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, quarterwave matching; Related problems.		
Unit 5	**Antenna Fundamentals**	**8 hr**
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; **Competency Group2**: Beam Efficiency, Directivity, Gain and Resolution; Aperture Efficiency, Effective Height and length; Friss transmission equation and statements of antenna theorems.		

LEARNING RESOURCES

TEXT BOOKS:

1	ElementsofElectromagnetics–MatthewN.O.Sadiku, Oxford Univ. Press, 4th ed., 2007.
2	Electromagnetic Field Theory Fundamentals- by Bhagat Singh Guru, Hüseyin R. Hiziroglu , Cambridge university press, 3rd edition.
3	Antenna Theory - C.A. Balanis, John Wiley & Sons, 2nd Edition, 2009.

REFERENCE BOOKS:

1	Electromagnetic Waves and Radiating Systems–E.C.Jordan and K.G.Balmain, PHI, 2nd Ed, 2000.
2	Engineering Electromagnetics- William H. HaytJr. And John A Buck, TMH, 7th Ed.
3	Electromagnetic waves and transmission lines – Y Mallikarjuna Reddy, University press private Ltd, 2nd edition.
4	Computational Electromagnetics with MATLAB, Fourth Edition - Matthew N.O. Sadiku, OxfordUniv.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

R23MECET010	ANALOG CIRCUITS					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Electronic Devices and Circuits, Network Analysis	**3**	**0**	**0**	**3**

Course Objective

This course aims to help students grasp the various non-linear wave shaping circuits, analyze various power amplifiers and tuned amplifiers, understand the operation and characteristics of op-amp, design and analyze applications of IC741 Operational amplifier, 555 Timer, 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 and79xx 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

R23MECET003	DIGITAL SIGNAL PROCESSING					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Signals, Systems, and Stochastic Processes, Mathematics	**3**	**0**	**0**	**3**

Course Objective

The student will be able to

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

R23MSCST007	PYTHON PROGRAMMING (Common to all branches)					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic C Programming	**3**	**0**	**0**	**3**

Course Objective

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

Course Outcomes

1	Studentswillbeabletoapplythebasicbuildingblocksofpythonlanguage.**(BL3)**
2	Studentswillbeabletodistinguishbetweenvariousconditionalcontrol statementsandsimplifytheproblemsusingfunctions.**(BL4)**
3	Studentswillbeableto experimentwith various non-scalardatatypes.**(BL3)**
4	Studentswillbeabletoexamine the data using fileoperationsandpandas library.**(BL4)**
5	Studentswillbeabletodecide suitable widgetstoimplementGraphical Userapplications.**(BL5)**
6	Studentswillbeabletodesignanddevelopreal time applicationsusing PythonProgrammingconstructsandGUI tkinter module. **(BL6)**

SYLLABUS

Unit I	**BASICS–DATATYPES,OPERATORS,BUILT-INMODULES**	**8 hr**

DataTypes,EscapeSequences,
VariablesandBasicInput/Output;AssignmentStatements,Operators; Arithmetic Expressions, Operator precedence, Type Casting, Program Comments andDocstrings; Program Format and Structure, REPL, IDLE, Running a Script from a TerminalCommand Prompt;
Built-In Functions and Modules; UserDefinedmodulescreationand importingauserdefinedmodule; NumPy – Functions on 1D arrays, Functions on 2D arrays;PandasModule- Creation of Series, DataFrames, indexing objects;

Unit II	**DECISION-MAKINGSTATEMENTS,LOOPSANDUSER-DEFINED FUNCTIONS**	**8 hr**

ConditionalStatements;Whileloop,forloop; range ()function,nestedloops;While-else, For- else, break,continue,pass;
Functions:Syntaxandbasicsoffunctionandusage;
PassingParameters,argumentsinafunction–Default,keyword,positionalandVariable - length arguments; localandglobalscopeofvariable;returnstatement,recursivefunction, recursion vs iteration;

Unit III	**STRINGS,LISTS,TUPLESANDDICTIONARIES**	**8 hr**

Strings-AStringisasequence,Stringsareimmutable,
Stringslice,Stringmethods;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 –DictionaryCreation, operations,Loopingthroughdictionaries;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 usingshutil(),deleteafile(os.remove());
Pandas-DataFrame creation with dictionaries, list of dictionaries, dictionary of

series, renaming columns and rows labels; ImportingdatafromCSVtoDataFrame(Pandas), Inspecting data in DataFrame (head (), tail (), info()), Statistical summary (describe ()); Slicing and Sorting in Pandas; Modifying DataFrames, Data Cleaning in Pandas;		
Unit V	**TKINTERGUI,EVENTDRIVENPROGRAMMING,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; Check Button and Radio button widgets; Menu and Menu button widgets; List box and Scroll bar widgets; Message box and Top level widget; File Dialogwidget;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Kenneth A.Lambert.-Fundamentals of Python: FirstPrograms‖, 2nd Edition,Publisher:CengageLearning	
2	Reema Thareja.-Python Programming using Problem Solving Approach	
3	R.NageswaraRao, -CorePython Programming	
REFERENCE BOOKS:		
1	WesleyJ.Chun.-CorePythonProgramming-SecondEdition‖,PrenticeHall	
2	JohnVGuttag.-IntroductiontoComputationand ProgrammingUsingPython‖,PrenticeHallofIndia	
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

R23MSCST010	DATA BASE 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 anyredundancy and also gain the knowledge on handling transaction data in concurrent wayandrecoveringfrom the failures.

Course Outcomes

1	Students will be able to **choose** and appreciate the RDBMS over file system and also be able to**apply**theknowledgeofERModelingdesignthe databasefromtheclientrequirements. **(BL3)**
2	StudentsWillbeableto**analyze**theSQLquerypatternandclassifythequery patternsbasedontheclientrequirements. **(BL4)**
3	Studentswillbeableto**Examine**thedatabasedesignandclassifythedifferent levelsofdependenciesusingNormalForms and students will be able to identify how triggers are useful in data auditing purpose.**(BL4)**
4	Studentswillbeableto**compareandchoose** differentindexing mechanisms tostoredatainsecondarystoragedevicesaspertherequirements.**(BL5)**
5	Studentswillbeableto**justify**theimportanceofconcurrencyandrecovery Management. **(BL5)**
6	Studentswillbeableto**design**thecompletedatabasewithoutredundant storageand abletosolvetheuserqueries. **(BL5)**

SYLLABUS

Unit I	**INTRODUCTIONTODATABASEMANAGEMENTSYSTEM,ERMODELING**	**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 & PhysicalSchema) and data independence, Database Management System Structure.; Introduction to ERModel, Entity, Entity Set, Attribute – Entity Vs Attribute; Relationship & Relationship Set –Entity Vs Relation ship–Binary Relationship, Ternary Relationship; Introduction to Keys (CandidateKey, PrimaryKey, SuperKey, UniqueKey, Not NullKey)–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	**RELATIONALALGEBRA&RELATIONALCALCULUS**	**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(STRUCTUREDQUERYLANGUAGE)	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**
FDsandDecomposition: Problems caused by redundancy, FD (definition), Armstrong ‘s axioms; FD identification fromrelations,Equivalence of twoFD sets; Dependency preserving Decomposition, examples;Lossless join, verification, examples; **Normal Forms:** First normal form, partial dependency, Second normalForm; Transitive dependency, third normal form, Motivation for BCNF; BCNF, Multivalueddependency,Fourthnormalform.;Triggers;		
Unit V	**INDEXING, TRANSACTIONMANAGEMENT,CONCURRENCYCONTROL & RECOVERYMANAGEMENT**	**8 hr**
Types of indexes (Clustered index, unclustered index primary index, secondary index), Tree based index versus and Hashbased 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;		

LEARNING RESOURCES

TEXTBOOKS:	
1	DatabaseSystemConcepts,Silberschatz,Korth,McGrawhill,SixthEdition. McGrawHill.
2	DatabaseManagementSystems,RaghuramaKrishnan,JohannesGehrke
REFERENCE BOOKS:	
1	FundamentalsofDatabaseSystems,ElmasriNavathePearsonEducation.
2	AnIntroductiontoDatabasesystems,C.J.Date,A.Kannan,S.SwamiNadhan, Pearson,EightEditionforUNITIII.
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	

R23MECEL004	Analog & Digital Communications Lab					
	Total Contact Hours	45(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, 2nd Ed.2005.
2	Communication Systems - R.P. Singh, SP Sapre, Second Edition TMH, 2007.
3	Digital and Analog Communication Systems- K.Sam Shanmugam.Wiley, 4th 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, 3RD Edition, 2007.

R23MECEL005	Digital Signal Processing Lab					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Signals, Systems, and Stochastic Processes	**0**	**0**	**3**	**2**

Course Objective	
• 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

<table>
<tr><td rowspan="3">R23MSCSL005</td><td colspan="6">PYTHON PROGRAMMING LAB
(Common to all branches)</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>C Programming</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">Students will implement python programming constructs which are used to develop both desktop and graphical user applications.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Studentswillbeabletoapplythebasicbuildingblocksofpythonlanguagelike variables,operatorsandmodules.</td></tr>
<tr><td>2</td><td colspan="6">Studentswillbeabletoapplyconditionalcontrolstatementsandfunctions.</td></tr>
<tr><td>3</td><td colspan="6">Studentswillbeabletoapplyvariousfileoperationsandanalyzethedatausing pandaslibrary.</td></tr>
<tr><td>4</td><td colspan="6">Students will be able to choose and decide the suitable widgets to design and develop Graphical User Interface (GUI) applications.</td></tr>
<tr><td colspan="7">ListofExperiments</td></tr>
<tr><td>1</td><td colspan="6">Week – 1: DATA TYPES, OPERATORS, BUILT-IN FUNCTIONS
1. Writeapythonscripttoillustratedatatypes(int,char,float,string).
2. Writea pythonprogramtoperformthe following expressionsusingoperatorprecedence
(1) 5+3*2
(2) 2*3**2
(3) 2**3**2
(4) (2**3)**2
3. Writeapythonprogramtoillustratetypeconversionfunctions
4. Writeapythonprogramtoillustratepi,sqrt,cos,sinfunctionsofmathmodule</td></tr>
<tr><td>2</td><td colspan="6">Week – 2: PROGRAMS WITHOUT CONTROL STATEMENTS
1. Writeaprogramtocalculatesimpleinterest
2. Writeapythonprogramtocalculatecompoundinterest
3. WriteapythonprogramtoprintASCIIvalueofacharacter
4. Writeapythonprogramtofindtheareaofacircle
5. Writeapythonprogram tofindtheareaofatriangle
6. Writeaprogramtoperformstringconcatenation</td></tr>
<tr><td>3</td><td colspan="6">Week – 3: PROGRAMS ON NUMPY MODULE
1. Write a programtowork with 1D array operations including indexing and slicing.
2. Write a programtowork with 2D array operations</td></tr>
<tr><td>4</td><td colspan="6">Week – 4: PROGRAMS ON CONTROL STATEMENTS
1. Writeapythonprogramfindthepowerofa number without built-in functions.
2. Writeapythonprogramtocountthenumberofevenandoddnumbers upto the given range.
3. Writeapythonprogramtoprint the multiplication table for a given number.
4. Writeapythonprogram to displayminimum andmaximum amongthree numbers.</td></tr>
<tr><td>5</td><td colspan="6">Week – 5: PROGRAMS ON FUNCTIONS
1. Write a python program to find if a number is prime or not with</td></tr>
</table>

	and without recursion. 2. Write a python program to display Fibonacci series using iteration and recursion. 3. Writeapythonprogramtofindthefactorialofanumber with and without recursion.
6	**Week – 6: PROGRAMS ON STRINGS** 1. Write a program to work with string built-in functions 2. Writeapythonprogramtodetermine number oftimesagivenletteroccursin a string 3. Writeapythonprogramtocheckif astringisapalindromeornot. 4. Illustrate in operator and write a python program to count number of lowercase characters in a string. 5. Write aprogram toreplace all the occurrencesof letter 'a' with letter 'x' ina string.
7	**Week – 7: PROGRAMS ON LISTS** 1. Write a program to implement the following list functions a)len() b)extend() c)sort() d) append() e)insert() f)remove() 2. Write a program to pass list as an argument to a function 3. Writeapythonprogramtofindthelargestandsmallestnumberinalist. 4. Writeapythonprogramtomergetwolistsandsortit. 5. Writeapythonprogramtoremovetheduplicateitemsfrom alist. 6. Writeapythonprogramtofindsumofelementsin a list
8	**Week – 8: PROGRAMS ON TUPLES , DICTIONARIES** 1. Writeaprogramto createalist oftupleswith thefirstelement asthe numberand thesecond element as the squareof the first element. 2. Write a python program that takes the list of tuples and sorts the list oftuplesin increasingorder bythe last element ineach tuple. 3. Write a program to implement the following dictionary methods a) keys() b) values() c)items() d) pop() e)delete() 4. Writeapythonprogramtoaddakeyvaluepairtoadictionaryand update thedictionarybased on the key. 5. Write a Program to do a reverse dictionary lookup in python.
9	**Week – 9: PROGRAMS ON FILES** 1. Write a programtoimplementread(),readline(), readlines(), write(), writelines()methods on files. 2. Write a programtoimplementseek(),tell()andflush()methodswith differentarguments in a file. 3. Writeaprogramtogenerate20randomnumbersinthe rangeof1to100and writeto a file.
10	**Week – 10: PROGRAMS ON PANDAS MODULE** 1. Write a programto importdatafromCSVtoDataFrameand inspectdatainDataFrameusinghead(),tail(), info() and describe() functions in pandas. 2. Write a programtoperformsortingandslicingoperations in pandas. 3. Write a program to perform dataframe modification and data cleaning in pandas.

11	**Week – 11: PROGRAMS ON GUI** 1. Design and develop a GUIapplication todisplay-HelloWorld. 2. Designand develop a GUIapplicationusingLabel,EntryandButtonwidgets. 3. Designand develop a GUIapplicationusingTkinterGeometrymethodspack(),grid(),place(). 4. Design and develop a GUIapplicationusingCheckButtonandRadiobuttonwidgets.
12	**Week – 12: PROGRAM ON GUI CONTI…** 1. Design and develop a GUIapplicationusingMenuandMenubuttonwidgets. 2. Design and develop a GUIapplicationusingListboxandScrollbarwidgets. 3. Design and develop a GUIapplicationusingMessageboxandFileDialogwidget
Demonstrationexperiments	
1	DemonstrationofPythonIDLEtoimplementsolutions.
2	DemonstrationonColabnotebooktoread,accessanddisplaydatafrom google drive.
3	Demonstrationonjupyternotebooktolinkandaccessdata.
LEARNING RESOURCES	
TEXTBOOKS:	
1	Kenneth A.Lambert.-Fundamentals of Python: FirstPrograms‖, 2nd Edition, Publisher:CengageLearning
2	Reema Thareja.-Python Programming using Problem Solving Approach
3	R.NageswaraRao, -CorePython Programming‖
REFERENCEBOOKS:	
1	WesleyJ.Chun.-CorePythonProgramming-SecondEdition‖,PrenticeHall
2	JohnVGuttag.-IntroductiontoComputationandProgrammingUsing Python‖,PrenticeHallofIndia.
3	PythonPracticeBookRelease2014,AnandChitipothu.
ADDITIONAL REFERENCE MATERIAL	
1	https://www.w3schools.com/python/
2	https://www.tutorialspoint.com/python/index.htm
3	https://docs.python.org/3/tutorial/
4	https://www.pythontutorial.net/tkinter
5	https://www.python-course.eu/python3_course.php
6	https://www.geeksforgeeks.org/python-tkinter-tutorial/
7	https://www.tutorialspoint.com/python/python_gui_programming.htm
8	https://www.programiz.com/python-programming

R23MENGAT01	ETHICS &HUMAN VALUES					
	Total Contact Hours	30 (L)	**L**	**T**	**P**	**C**
	Prerequisite	-	**2**	**0**	**0**	**2**

Course Objective

Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence and Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

Course Outcomes

1	Apply the concept of Self -Exploration and Natural Acceptance in their daily lives to achieve continuous happiness and prosperity. **(BL3)**
2	Analyse the relationship between the sentient 'I' and the material 'Body', identifying how their characteristics and activities contribute to overall harmony and health **(BL4)**
3	Evaluate the impact of trust and respect as foundational values in human relationships on achieving comprehensive human goals such as resolution, prosperity, fearlessness **(BL5)**
4	Analyse the interconnectedness and mutual fulfilment among the four orders of nature (material order, plant/bio order, animal order, and human order), and evaluate how recyclability and self-regulation contribute to the overall harmony in nature **(BL4)**
5	Evaluate strategies for transitioning from the current state to a Universal Human Order by assessing the role of professional competence **(BL5)**
6	Design a comprehensive strategy for transitioning from the present state to a Universal Human Order, showcasing creativity, vision, and an ability to integrate various aspects of the course. **(BL6)**

SYLLABUS

Unit 1	**Need, Basic Guidelines, Content and Process for Value Education**	**6 hrs**

Purpose and motivation for the course, Self-Exploration, Its content and process; 'Natural Acceptance' and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity correctly, Method to fulfill the above human aspirations

Unit 2	**Understanding Harmony in the Human Being - Harmony in Myself**	**6 hrs**

Human being as a co-existence of the sentient 'I' and the material 'Body, needs of Self ('I') and 'Body', Body as an instrument of 'I', characteristics and activities of 'I' and harmony in 'I', harmony of I with the Body, Programs to ensure Sanyam and Health.

Unit 3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**	**6 hrs**

Human-human relationship; meaning of Justice, nine universal values in relationships, Trust and Respect as the foundational values of relationship, Understanding the harmony in the society, Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Undivided Society, Universal Order- from family to world family.

Unit 4	**Harmony in the Nature and Existence**	**6 hrs**

Harmony in Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature, Understanding

Existence as Coexistence, Holistic perception of harmony at all levels of existence.		
Unit 5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**	**6 hrs**
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order: Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.		

TEXT BOOKS:	
1	R R Gaur, R Sangal, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics" Excel Books, New Delhi, 2010
REFERENCE BOOKS:	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
ADDITIONAL REFERENCE MATERIAL	
1	http://www.fdp-si.aicte-india.org/download.php#1
ONLINE COURSES	
1	https://uhv.org.in/uhv-1
2	https://uhv.org.in/uhv-2

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 4		X			
CO3	BL 5			X		
CO4	BL 4				X	
CO5	BL 5					X
CO6	BL 6	X	X	X	X	X

V Semester

R23MEEET004	**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

- 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	Willbeabletoapplytechniquestofindtransferfunctionofaphysicalsystem.**(BL3)**
2	Willbeabletoanalyzethetransientandsteadystateperformanceofthesystem.**(BL4)**
3	Will be able to analyze stability of LTI systems.**(BL4)**
4	Willbeabletoevaluatethesystemperformanceintimedomainandfrequencydomain.**(BL5)**
5	WillbeabletoevaluatetheperformanceofSISOsystemsandMIMOsystems.**(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;
Blockdiagram reduction rules; Transfer Function through BDR techniques; Signal Flow Graphs, Mason's Gain formula; Effects of feedback;

Unit2	**TimeResponseAnalysis**	**8 hr**

Standardsignals, First order time response;Second order time response;Time domain specifications; Steady state error; Static error constants; Dynamic error constants; Effect of P, PI, PID controllers; Servomotors

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 analysisusing Nyquist plot;

Unit5	StateVariableAnalysis	8 hr
Concept of state, State variables and statemodel; Statemodel fromTransfer function; Transfer function from state model;Solution of state equation; State transition matrix; Properties of state transition matrix; Controllability; Observability		
LEARNINGRESOURCES		
TEXTBOOKS:		
1	I.J.Nagrathand M. Gopal,Control Systems Engineering, Fifthedition. PrenticeHall of India Pvt.Ltd., Publishers, 2010.	
2	Katsuhiko Ogata, Modern Control Engineering, Fifthedition. New Age International(P) Limited, Publishers, 2007.	
REFERENCEBOOKS:		
1	A.NagoorKani,ControlSystems,Thirdedition.RBAPublications,2017.	
2	B.C.KuoandFaridGolnaraghi,AutomaticControlSystems,Eighthedition.John Wileyandsons, 2003.	
3	U.A.Bakshi,V.U.Bakshi,ControlSystems,Thirdedition.TechnicalPublications, 2012.	
ADDITIONALREFERENCEMATERIAL		
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'slevel-Unitscatchmentarticulationmatrix

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

R23MECET002	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. (BL3)
2	Apply instruction set, assembler directives and operators to structure programs efficiently, implementing procedures, macros, and system-level programming techniques.(BL3)
3	Examine and differentiate interfacing modules like 8255 PPI, 8259 PIC.(BL4)
4	Distinguish between microprocessor and microcontroller hardware architectures and functional blocks.(BL4)
5	Appraise timer/counter, interrupts and serial communication functional blocks of AVR microcontroller.(BL5)
6	Create advanced assembly language programs and machine-level software to achieve optimized solutions for tasks such as high-speed data processing, image/video processing, or communication protocols.(BL6)

SYLLABUS

Unit I	**Introduction to 8086 Microprocessor**	**8 hr**

Architecture of 8086; Register Organization; Pin configuration and Signal Description of 8086; Physical Memory Organization, General Bus Operation; I/O Addressing Capability, Special Processor Activities; Timings of Signals in Minimum and Maximum Mode of 8086 System; Addressing Modes of 8086.

Unit II	**8086 Microprocessor Features, Programming and Interfacing**	**8 hr**

Instruction Set of 8086,Assembler Directives & Operators, Stack Structure of 8086, Interrupts and interrupt Handling;Procedures and Macros;6:Machine Language Instruction Formats, Machine Level Programs, Assembly Language Programming tools, Programming with an Assembler;Illustrative Assembly Level Language Programs.

Unit III	**Interfacing of Peripherals with 8086 & Introduction to AVR Microcontroller**	**8 hr**

Architecture of 8255 PIO (Programmable input Output Port); Modes of Operation of 8255,ADC 0808 & DAC 0800 interfacing; Architecture of Programmable Interrupt Controller 8259A,Architecture of programmable communication interface 8251 USART ; Introduction to Microcontrollers, Atmel AVR Architecture Overview - Introduction, Families;Registers of AVR, Nonvolatile and Data Memories;Port System Features,Peripheral Features-Internal Subsystems; AVR ATmega128 - Overview and AVR families;

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

Assembly Programming AVR microcontroller- Introduction, The AVR Instruction

Set, Assembler Directives, Addressing Modes of AVR; AVR Programming in C, AVR Programming tools – WinAVR, AVRSTUDIO IDE usage.Serial Communication Subsystem - UART,:Analog-to-Digital Conversion; Interrupt Subsystem, Timing Sub system; PWM - Wave Generation in AVR.		
Unit V	**Interfacingwith AVR Controller**	**8 hrs**
Programming - I/O Ports, Input Devices - Switches, Keypads, Sensors; Output Devices- LED, Seven-Segment LED Displays;Dot Matrix Display, LCD, BUZZER;Hardware and Software Interfacing with the AVR - RS 232(UART);USB, EEPROM; SPI, I2C; DS1307 RTC programming with AVR.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Advanced Microprocessors and Peripherals by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2nd edition, 2009.	
2	Atmel AVR Microcontroller Primer: Programming and Interfacing, Steven F. Barrett, Morgan & Claypool,2008	
3	The AVR Microcontroller 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	
ONLINE COURSES		
1	https://www.youtube.com/playlist?list=PLnZLfHvLkNN2ttBlIgzvo6lGFprOoanEl	
2	https://www.youtube.com/watch?v=_qxueXKHg04&list=PLDe416SoceX2lUjvXKaeAfnq04WqH91Bk	

Bloom's level - Units catchment articulation matrix

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

R23MECET011	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.

LEARNINGRESOURCES

TEXT BOOKS:

1	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang,TMH,

	3rd 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

R23MECET012	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

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.		
LEARNING RESOURCES		
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

R23MECET020	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	Analyzefundamental concepts of Optical Fibers and its characteristics for fiber optic systems (BL4)
2	Analyze the impact of different fiber loss mechanismsand 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 inOptical 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, chalgenide 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 ofPhotodetectors.

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, linkpower 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, *Optical Fiber Communications*, 5th Edition,Tata McGraw-Hill India,2013.	
2	Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki, *Optical Networks-APracticalPerspective*, 3rd Edition, MorganKaufmann Publishers, 2009	
REFERENCE BOOKS:		
1	John M Senior, *Optical Fiber Communications-Principles and Practice*,3rd Edition, Pearson Education Ltd., 2010.	
2	Z.Ghassemlooy W.Popoola S.Rajbhandar, *Optical Wireless Communications System and Channel Modelling with MATLAB*, 2nd edition, CRCPress, 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'slevel – 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

R23MECET025 (DSC-E1)	Artificial Intelligence & Machine Learning					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	SSSP	3	0	0	3

Course Objectives

1. Students will get exposure to describe the fundamentals of AI and its applications.
2. Students will able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes: Students will 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, Kohnen'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. Yegnanrayana, "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'slevel – Unitscatchmentarticulationmatrix

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

R23MECET030 (DSC-E1)	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**;**		

LEARNING RESOURCES

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	NPTEL :Computer science - Introduction to computer architecture(nptel.ac.in)

Bloom's level - Units catchment articulation matrix

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

R23MSCST005	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-IPI,SPICE, ISO 9001:2000); The Capability Maturity Model Integration (CMMI);

Unit II	**PROCESS MODELS & SOFTWARE REQUIREMENTS**	**8 hr**

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

Unit III	**REQUIREMENTS ENGINEERING & DESIGN ENGINEERING**	**8 hr**

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

Unit IV	TESTING STRATEGIES & METRICS	8 hr
A Strategic Approach to Software Testing, Test Strategies for Conventional Software - Unit and Integration Testing; Testing Strategies - Validation Testing, System Testing; Black Box Testing - Graph-Based Testing Methods; White box testing - Basis path testing;A Framework for Product Metrics - Measures, Metrics, and Indicators; Metrics for the Requirements Model - Function-Based Metrics; Metrics for the Design Model-Architectural Design Metrics and Metrics for Source Code; Metrics for Testing		
Unit V	**QUALITY MANAGEMENT & RISK MANAGEMENT**	**8 hrs**
Quality Management - Software Quality (McCall's software quality factors) ; Review Techniques - Informal and Formal Review Techniques; Software Quality Assurance - Elements of SQA, SQA Tasks, Goals and Metrics; Statistical SQA, ISO 9000 Quality Standards; Reactive vs. Proactive Risk Strategies; Software Risks; Risk Identification; Risk Projection, Risk Refinement; RMMM Plan;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th Edition, McGrawHill International Edition.	
2	Software Engineering- Sommerville, 7th edition, Pearson education.	
REFERENCE BOOKS:		
1	Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers	
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

R23MECL001	MICROPROCESSORS AND MICROCONTROLLERS LAB					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	DE,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 and execute programs using MASM and WinAVR.					
2	Will be able to perform Machine Coding of Assembly programs					
3	Will be able to perform programs on Micro 86/88 Hardware Kit and ATMega128 board.					
List of Experiments						
1	Perform simple arithmetic operations using 8086 Microprocessor Hardware Kit.					
2	Perform 16-bit Signed and unsigned Operations using MASM software.					
3	Perform Logical Operations using MASM software.					
4	Identification & displaying the activated key(s) using DOS & BIOS function calls.					
5	Perform Strings related Operations using MASM software.					
6	Interface 8086 Microprocessor with 8255 PPI.					
7	Interface 8086 Microprocessor with 8259 PIC.					
8	Perform Reading and Writing on a Parallel Port of ATMega128 Microcontroller.					
9	Programming of USART and timers in ATMega128 Microcontroller.					
10	Perform Analog to Digital Conversion and PWM Generation using ATMega128 Microcontroller.					
11	Interface LEDs, Switches and 16x2 LCD unit with ATMega128 Microcontroller.					
12	Perform Reading and Writing on EEPROM of ATMega128 Microcontroller.					
Additional experiment						
1	DS1307 RTCinterfacing with I2C of ATMega128 Microcontroller.					
Demonstration experiment						
1	DC Motor and Servo Motor interfacing withATMega128 Microcontroller.					
LEARNING RESOURCES						
TEXT BOOKS:						
1	Advanced Microprocessors and Peripherals by A.K.Ray, K.M.Bhurchandi, Tata McGraw Hill Publications, 2nd edition, 2009.					
2	The AVR Microcontroller And Embedded Systems Using Assembly And C Muhammad Ali Mazidi, Sarmad Naimi, And Sepehr Naimi, Prentice Hall, 2011.					
3	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

R23MSCSL003	DATABASE MANAGEMENT SYSTEMS LAB (Common to all branches)					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**0**	**0**	**3**	**2**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

List of Experiments

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

Additional experiments

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

Demonstration experiments

1	Case study - Library Management system

2	Case study- E-commerce store management
3	Case Study**-** Hospital management
LEARNING RESOURCES	
TEXTBOOKS:	
1	Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition. McGrawHill.
2	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke
3	Learning SQL, Alan Beaulieu, O'Reilly Media, Inc., 3rd Edition,
ADDITIONAL REFERENCE MATERIAL	
1	https://docs.oracle.com/cd/B19306_01/server.102/b14200/toc.htm
2	https://dev.mysql.com/doc/refman/8.0/en/select.html

R23MCIVT001	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

1	Develop comprehensive environmental management and conservation plans (**BL6**)
2	Create programs for energy, water conservation, and waste reduction. (**BL6**)
3	Formulate proposals for combating climate change (**BL6**)
4	Develop models to study climate dynamics and impacts (**BL6**)
5	Develop strategies to mitigate climate change impacts (**BL6**)

SYLLABUS

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

Biodiversity and ecosystem functionality; Natural resources; Environmental pollution; Environmental episodes; Environmental legislation.

Unit II	**LIFE STYLE FOR ENVIRONMENT**	**5 hr**

Sustainability Challenges; Save Energy; Save Water; Reduce waste; Healthy Lifestyles.

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

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

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

Greenhouse gas effect; Paleoclimate; Energy Balance;Water Cycle; Atmospheric motion.

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

Ocean changes; Cryosphere dynamics; Volcanoes; Biosphere and climate regulation;Mitigation strategies.

LEARNING RESOURCES

TEXTBOOKS:

1	E. Bharucha, *Textbook of Environmental Studies for Undergraduate Courses*, 2nd ed. Hyderabad, India: Universities Press, 2012.
2	J.K. Arora, B.K. Tyagi, K.S. Bath, R. Bal, and S.S. Ladhar, *Activity Book on Climate Change*. Punjab State Council for Science & Technology, 2022.

REFERENCE BOOKS:

1	R. T. Wright and D. F. Boorse, *Environmental Science: Toward a Sustainable Future*, 13th ed. Boston, MA: Pearson, 2017.
2	United Nations Development Programme, *Climate Box. An interactive learning toolkit on climate change*. New York, NY, 2018.

ADDITIONAL REFERENCE MATERIAL	
1	https://missionlife-moefcc.nic.in/Download-Creatives-Save-Energy.php?id=MTE=
ONLINE COURSES	
1	https://enterprise.edx.org/APSCHE/program/df4909e1-a837-4c49-b575-a909c3990bf8/progress

Bloom's level - Units catchment articulation matrix

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

VI Semester

R23MECET013	Embedded Systems					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	**MPMC**	**3**	**0**	**0**	**3**

Course Objective

Students will ….

- 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

R23MECET014	Analog VLSI Design					
	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 create integrated circuits that process or interface with real-world continuous signals in an efficient, reliable, and cost-effective manner.

Course Outcomes

1	ExplaintheMOS deviceoperation andits modelling(BL5)
2	DesignandanalysisofthesinglestageMOSamplifiers.(BL5)
3	Designandanalysisofthemulti stage and differential MOSamplifiers.(BL5)
4	Designandanalysisofdifferent feedback topologies and basic operationalamplifiers(BL5)
5	Design andanalysisofvariouscurrentmirrorcircuits.(BL5)
6	CreateanalogMOSsubcircuitswithrequiredspecifications.(BL6)

SYLLABUS

Unit 1	**MOSFET Biasing**	**8 hr**

Competency Group1:
Basic structure and operation of pMOS and nMOS using ideal i-v Characteristics; Self-biasing using depletion mode MOSFET; Fixed biasing using depletion mode MOSFET; Self-biasing using enhancement mode MOSFET.

Competency Group2:
Feedback configuration biasing using enhancement mode MOSFET;MOS Transistor Frequency Response; Short-Channel Effects in MOS Transistors; Weak Inversion in MOS Transistors, Substrate Current Flow in MOS Transistors.

Unit 2	**Basic Gain Stages and its frequency responses**	**8 hr**

Competency Group1:
Common-source NMOS and PMOS transistor with its small-signal equivalent circuit,Common-Source Amplifier with resistive load;Common-Source Amplifier with Source Resistor;Common-Drain (Source-Follower) Amplifier; Common-Gate Configuration.

Competency Group2:
Frequency response of CS with the open and short circuit time constants; Frequency response of CD with the open and short circuit time constants; and Frequency response of CG with the open and short circuit time constants; miller effect and miller capacitance.

Unit 3	**Multistage and Differential Amplifiers**	**8 hr**

Competency Group1:
Cascade Circuit- Cascaded CS amplifier; CS-CD cascade amplifier; CS-CG Cascode amplifier; Darlington configuration in MOS.

Competency Group2:
Basic FET Differential pair -DC Transfer Characteristics,Small-Signal Equivalent Circuit Analysis;Two-Sided Output;MOSFET Differential Amplifier with Active Load;MOSFET Diff-Amp with Cascode Active Load.

Unit 4	**Feedback and basic operational Amplifiers**	**8 hr**

Competency Group1:
Advantages and Disadvantages of Negative Feedback,Basic Feedback Concepts;Ideal Feedback Topologies-Series–Shunt Configuration,Shunt–Series Configuration;Series–Series Configuration;Shunt–Shunt Configuration.

Competency Group2: Basics of operational amplifier, Inverting and non-inverting amplifier; CMRR, slew rate, offset voltage, input bias current; Log-antilog amplifier; Controller Sources and some non-linear effects.		
Unit 5	**Operational Amplifiers circuits**	**8 hr**
Competency Group1: CMOS Operational Amplifier Circuit;Three-Stage CMOS Operational Amplifier; Folded Cascode CMOS Operational Amplifier Circuit; offset voltage compensation network. **Competency Group2**: Basic Currentmirrors, Cascode Current mirrors ; CMOS Current-Mirror Operational Amplifier Circuit; CMOS Cascode Current-Mirror Op-Amp Circuit; JFET OP-AMP circuits.		

LEARNING RESOURCES	
TEXT BOOKS:	
1	Microelectronics: Circuit Analysis and Design-Donald A. Neamen,Fourth Edition, McGraw Hill
2	Electronic Devices and Circuit Theory-Robert L. Boylestad,Louis Nashelsky, Eleventh Edition, PEARSON
3	DesignofAnalogCMOSIntegratedCircuits-BehzadRazavi,TMHEducation.
REFERENCE BOOKS:	
1	AnalogIntegratedCircuitDesign-DavidA. Johns,KenMartin,WileyStudent Edn, 2013.
2	P.E.Allen & D.R.Holberg,"CMOSAnalogCircuitDesign",3rdEdition,Oxford UniversityPress,2011.
3	T.C.Carusone,D.A.Johns&K.Martin,"AnalogIntegratedCircuitDesign",2nd 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=PLyYrySVqmyVPzvVlPW-TTzHhNWg1J_0LU
ONLINE COURSES	
1	https://nptel.ac.in/courses/117/106/117106030/
2	https://onlinecourses.nptel.ac.in/noc25_ee06/preview

Bloom'slevel - Unitscatchmentarticulationmatrix

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**

R23MECET015	ANTENNAS AND MICROWAVE ENGINEERING					
	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 techniquesto 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;Helicalantennas normalandaxilmodes, Applications of wire antennas;

Unit 2	**MICROWAVE ANTENNASAND ARRAYS**	**8hr**

Yagi-Udaantenna Characteristics; Reflector antennas-types, parabolic reflector characteristics, types of feeds; Horn Antennas–Types, Design Characteristics of Pyramidal Horn antenna; Micro-stripAntennas: 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 klystronand reflex klystron; Slow Wave Structures, HelixTWT-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 MICROWAVEMEASUREMNETS**	**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;Lowand high VSWR measurement; ImpedanceMeasurement;		

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,*Microwaveengineering*,4thedition,Wiley,2012
4	SamuelY.Liao,*MicrowaveDevicesandCircuits,*3rdEdition,PHI, 2004.
REFERENCE BOOKS:	
1	Antennas and WavePropagation – K.D. Prasad, Satya Prakashan, Tech IndiaPublications, 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 EducationIndia, 3rdEdition2009.
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'slevel – 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

R23MCSCT006	OOP WITH JAVA (for MEC, ECE, EEE, CIV and CHE)					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	DataStructures	**3**	**0**	**0**	**3**

Course Objective

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

Course Outcomes

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

SYLLABUS

Unit I	**BASICS OF JAVA**	**8 hr**

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

Unit II	**CLASS FUNDAMENTALS**	**8 hr**

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

Unit III	**INHERITANCE, INTERFACES AND ABSTRACT CLASS**	**8 hr**

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

Method overriding; super keyword, Using final with inheritance; Abstract classes, Multiple inheritance issues; Interfaces – Defining an interface, implementing interfaces; Packages - Defining a Package, Finding Package with CLASSPATH, importing packages, Access Protection; Exploring java.util Package (Random, String Tokenizer, Scanner); Exploring java.io package (Byte and Character streams, File class);		
Unit IV	**EXCEPTION HANDLING AND MULTITHREADING**	**8 hr**
Exception Handling Fundamentals, Exception Types, Uncaught Exceptions; Using Try and Catch, Multiple Catch Clauses, Nested Try Statements; Throw, Throws and Finally; Handling of User Defined Exceptions; The Java Thread Model, Thread Life Cycle, Comparison of Thread and Process. The Main Thread; Creating a Thread: Implementing Runnable Interface, Extending Thread class; Creating Multiple Threads, isAlive () and join(); Synchronization (Keyword and Block), Thread Priorities;		
Unit V	**EVENT HANDLING, AWT, SWING**	**8 hr**
Delegation Event Model: Events, Event sources, Event Listeners; Event Classes, Event Listeners (Action Listener, Window Listener); Key Listener, keyboard events; Mouse Listeners, mouse events; AWT classes, AWT Controls (Button, Text Field, Label, Checkbox); Layout manager: BorderLayout, GridLayout, FlowLayout; Swings: JLabel, JButton, JTextField, JCheckbox; Collections: Array List, iterator;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Herbert Schildt, "Java The Complete Reference" 9th Edition, Oracle Press	
2	Paul Deitel and Harvey Deitel, "Java How to Program", 11th Edition, Pearson.	
REFERENCE BOOKS:		
1	Herbert Schildt, "Java: A Beginner's Guide", 9th Edition, McGraw Hill, 2022	
2	Bruce Eckel, "Thinking in Java", 9th Edition, Mind View, 2022.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.w3schools.com/java	
2	https://docs.oracle.com/javase/tutorial/	
3	https://www.geeksforgeeks.org/java/	
ONLINE COURSES		
1	https://www.udemy.com/courses/search/?q=java	
2	https://www.coursera.org/specializations/java-programming	

Bloom's level - Units catchment articulation matrix

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

R23MECET021 DSC-E2	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 thebasic elements of cellularsystemsand the effects of interferenceoncellularsystem performance (BL4)
3	Analyse different types of interferencepresent in cellular systems and methods to reduce interferences (BL4)
4	Examine thefrequencymanagement andchannel 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	**INTRODUCTIONTOCELLULARMOBILESYSTEMS**:	**8 hr**

Evolution of mobile radio communications;Generations of mobile wireless systems (1G, 2G, 2.5G, 3G and 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	**ELEMENTSOFCELLULARMOBILERADIOSYSTEMS**	**8 hr**

Generaldescriptionof theproblem;maximumnumberoffrequency channelspercell;consideration of the components of Cellularsystem; concept of frequency reuse channels;Co-channelInterferenceReductionFactor;desiredC/I fromanormalcaseina 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 Omnidirectional 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	FREQUENCYMANAGEMENTANDCHANNELASSIGNMENT	8 hr
Numberingand grouping;setupchannels:accessandpagingchannelschannelassignmentstocellsites and mobile units**;** Fixed channel assignmentand Non-fixed channel assignment; to operate with additional spectrum;hand off,Types ofhands 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., 2nd Edition, Prentice Hall, NJ, 2002	
3	Mobile communication- G K Behera, SCIETECH PUBLICATIONS PVT LTD,2008.	
REFERENCE BOOKS:		
1	Wireless Communications-AndreaGoldsmith, 2005 CambridgeUniversityPress.	
2	PrinciplesofMobileCommunications -Gordon L.Stuber,Springer International 2nd Edition,2007.	
3	Wireless and Mobile Communications-LeeMcGraw Hills, 3rd 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'slevel - Unitscatchmentarticulationmatrix

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

R23MECET026 DSC-E2	Speech and Audio Processing					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Signals & Systems, Digital Signal Processing	**3**	**0**	**0**	**3**

Course Objective

This course will enable students:

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		**8 hr**

III		
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.		
LEARNING RESOURCES		
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'slevel – 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**

R23MECET031 DSC-E2	SYSTEM ON CHIP					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	**DVLSI, AVLSI**	**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.

LEARNINGRESOURCES	
TEXT BOOKS:	
1	RochitRajsunah,System-on-a-chip:DesignandTest,ArtechHouse,2007.
2	PrakashRaslinkar, Peter Paterson &Leena Singh, System-on-a-chip verification:Methodology and Techniques, Kluwer Academic Publishers,2000.
REFERENCEBOOKS:	
1	M.Keating, D.Flynn, R.Aitken, A, GibbonsShi, 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
ADDITIONALREFERENCE 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__b30TVT809tegqOdJvz2EDdzNOdDWW6rRFoji_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

R23MECET022 DSC-E3	RADAR & SATELLITE COMMUNICATION					
	Total Contact Hours	**42 (L)**	**L**	**T**	**P**	**C**
	Pre-requisite	**EMWTL, AC & DC**	**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*, Introduction to Radar Systems*, 3rd edition, McGraw-Hill, 2017.
2	Timothy Pratt, Charles Bostian and Jeremy Allnutt*, Satellite Communications*, 2nd Edition, WSE, Wiley Publications, 2003.
REFERENCE BOOKS:	
1	Peyton Z. Peebles, *Radar Principles*, John Wiley & Sons Edition, 2007.
2	Dr.D.C.Agarwal, *Satellite Communications: Covering latest digital satellite technologies and systems,* 2nd edition, Khanna Publishers, 2007.
3	Madhavendra Richharia, *Mobile Satellite Communications: Principles and Trends*, 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

R23MECET027 DSC-E3	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 Radiograpy, 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, 3rdEdition, 2014.
2	Biomedical Instrumentation and Measurements–C. Cromwell, F.J.Weibell, E.A. Pfeiffer – Pearson education 2ndEdition.
3	A course in Electrical and Electronics Measurements and Instrumentation, by A.K.Sawhney, Dhanpat Rai & Co. 3rdedition Delhi, 2010.
REFERENCE BOOKS:	
1	Introduction to Bio-Medical Engineering – Michael M. Domach, Pearson, 2nd Edition.
2	Introduction to Biomedical Equipment Technology by Joseph J.Carr, John M.Brown, Prentice Hall 4th Edition.
3	Biomedical signal analysis– Rangaraj, M. Rangayyan– Wiley Inter science– John willey&Sons Inc 2nd 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	Unit I	UnitI I	Unit III	UnitI V	Unit V
CO1	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL4				X	
CO5	BL5					X
CO6	BL6	X	X	X	X	X

R23MECET032 DSC-E3	VLSI Physical Design					
	Total Contact Hours	40 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	VLSI Design, DE				

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	Analyze the impact of transistor sizing on standard cell performance and evaluate its role in library characterization and VLSI design flow.(BL4)
2	Examine the interdependencies between design constraints, pad placement, power planning, and clock planning to optimize circuit performance in VLSI design. (BL4)
3	Investigate the impact of global placement techniques and power distribution in VLSI design. (BL4)
4	Evaluate the effectiveness of modern global routing techniques and constraint graphs for VLSI design.(BL5)
5	Assess packaging technologies and justify their influence on electrical design.(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**	**8hr**

Standard Cells ;Transistor Sizing;Input-Output Pads;Library Characterization; Electronic Design Automation (EDA);VLSI Design Flow ;VLSI Design Styles ; Layout Layers ; Design Rules;

Unit 2	**PARTITIONING &FLOORPLANNING**	**8hr**

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**	**8hr**

Global Placement; Min-Cut Placement; Analytic Placement; Detail Placement; Timberwolf algorithm; Clock Tree Synthesis; Distributed RC Network; Power Analysis;

Unit 4	**ROUTING**	**8hr**

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**	**8hr**

Introduction: 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 Packages; Package Wiring And Terminals,package

electrical design;Heat transfer in electronic packages; Package manufacture;	
LEARNING RESOURCES	
TEXT BOOKS:	
1	Physical Design essentials, AnAsic 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 AidedLogical Designwith Emphasison VLSI, JohnWiley, 1993.
ONLINE COURSES	
1	**https://onlinecourses.nptel.ac.in/noc25_cs73**

Bloom'slevel – Units catchment articulation matrix

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

R23MECEL006	VLSI LAB					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	STLD, Digital VLSI, Analog VLSI	**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 performnce 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	CMOSDigitalIntegratedCircuitsAnalysisandDesign,Sung-MoKang,TMH, 3rdEd.2011
2	CMOS Analog IC Design: Fundamentals, ThirdEdition, ErikBruun, 2022

REFERENCE BOOKS:

1	Digital Integrated Circuits,A Design Perspective, JanM.Rabaey, Anantha Chandrakasan, BorivojeNikolic.

ADDITIONAL REFERENCE MATERIAL

1	https://www.youtube.com/watch?v=JRcyHuyb1V0
2	https://www.youtube.com/watch?v=CyKh7xpvfqI

<table>
<tr><td rowspan="3">R23MCSCL004</td><td colspan="6">OOP WITH JAVA LAB</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>-</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">Students will have the ability to apply object-oriented programming concepts in Java to develop and implement modular and reusable software solutions.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Students will be able to implement object-oriented programming concepts such as classes, inheritance, polymorphism, and exception handling to build modular Java applications.</td></tr>
<tr><td>2</td><td colspan="6">Students will be able to examine and debug Java programs to identify and resolve logical errors, ensuring correctness and efficiency.</td></tr>
<tr><td>3</td><td colspan="6">Students will be able to assess the design and performance of Java applications, optimizing for scalability, maintainability, and resource management.</td></tr>
<tr><td>4</td><td colspan="6">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.</td></tr>
<tr><td colspan="7">ListofExperiments</td></tr>
<tr><td>1</td><td colspan="6">Week 1: Introduction to Java and Structured Programming
1. Write a simple Java program that prints "Hello, World!" to the console.
2. Write a Java program that takes user input using the Scanner class.
3. Write a Java program to demonstrate all primitive data types.
4. Implement a Java program that converts a floating-point number to an integer.
5. Create a Java program that uses the final keyword to define constants.</td></tr>
<tr><td>2</td><td colspan="6">Week 2: Operators, Control Statements - Selection
1. Implement a Java program that uses arithmetic, relational, and logical operators.
2. Write a Java program to find the largest of three numbers using if-else statements.
3. Use the ternary operator to implement a simple conditional check.</td></tr>
<tr><td>3</td><td colspan="6">Week 3: Control Statements - Iteration
1. Write a Java program that prints all even numbers between 1 and 100 using a for loop.
2. Create a Java program that calculates the factorial of a given number using a while loop.
3. Write a JAVA program to display the Fibonacci sequence.
4. Implement a menu-driven program using a do-while loop.</td></tr>
<tr><td>4</td><td colspan="6">Week 4: Arrays
1. Write a Java program to reverse a one-dimensional array of integers.
2. Write a Java program to search for an element in an array.
3. Implement a Java program to find matrix multiplication using two-dimensional arrays.</td></tr>
<tr><td>5</td><td colspan="6">Week 5: Classes and Methods</td></tr>
</table>

	1. Create a class with fields and methods, then instantiate and use it. 2. Implement a method to calculate the area of a rectangle (accepting length and width as parameters). 3. Create a program that returns the area of different shapes (circle, square, rectangle) using method overloading.
6	**Week 6: Constructors, this Keyword, and Garbage Collection** 1. Implement a class with parameterized constructors and demonstrate object initialization. 2. Use 'this' keyword to resolve variable shadowing within methods and constructors. 3. Write a program that simulates garbage collection using System.gc() and observe the results.
7	**Week 7: Inheritance and Polymorphism** 1. Create a superclass and subclass to demonstrate basic inheritance. 2. Override a method in the subclass and call it from the main method. 3. Use the super keyword to call the parent class constructor and method.
8	**Week 8: Abstract Classes and Interfaces** 1. Write an abstract class with an abstract method and a concrete method. 2. Implement an interface and demonstrate how to implement it in a class. 3. Create a scenario where interfaces solve the multiple inheritance problem.
9	**Week 9: Exception Handling** 1. Write a program that demonstrates basic exception handling using try-catch blocks. 2. Implement a program that handles multiple exceptions using multiple catch clauses. 3. Create a custom exception class and use it to handle a specific error in a program.
10	**Week 10: Multithreading** 1. Implement a thread by extending the Thread class and demonstrate thread execution. 2. Create a program that demonstrates thread life cycle and state transitions. 3. Implement thread synchronization to avoid race conditions in a multi-threaded environment.
11	**Week 11: Event Handling, AWT** 1. Create a simple AWT program that displays a window with a button, text field, and label. 2. Implement mouse and keyboard event listeners in an AWT program.
12	**Week 12: Swings** 1. Create a Swing-based GUI with a JFrame, JButton, and JLabel, demonstrating layout managers like FlowLayout or BorderLayout. 2. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.

LEARNING RESOURCES	
TEXTBOOKS:	
1	Herbert Schildt, "Java The Complete Reference" 9th Edition, Oracle Press
2	Paul Deitel and Harvey Deitel, "Java How to Program", 11th Edition, Pearson.
REFERENCEBOOKS:	
1	Herbert Schildt, "Java: A Beginner's Guide", 9th Edition, McGraw Hill, 2022
2	Bruce Eckel, "Thinking in Java", 9th Edition, Mind View, 2022.
ADDITIONAL REFERENCE MATERIAL	
1	https://www.w3schools.com/java
2	https://docs.oracle.com/javase/tutorial/
3	https://www.geeksforgeeks.org/java/
4	https://www.javatpoint.com/java-tutorial
5	https://www.udemy.com/courses/search/?q=java
6	https://www.coursera.org/specializations/java-programming
7	https://www.freecodecamp.org/news/tag/java/
8	https://www.tutorialspoint.com/java/index.htm

R23MMATT007	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))
2	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC Tier I & II | Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author)) https://amzn.in/d/3OTZ5uI
3	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (Adda247 Publications (Author))
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
5	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC Tier I & II | Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author))
6	Quantitative Aptitude for CAT 2025 | 11th Edition (Latest) | Quant | CAT Preparation Exam Book with Solved Previous Years Papers (PYQ) | McGraw Hill edge Access: Mock Tests, Expert Sessions & Strategies (Arun Sharma (Author))
7	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (Adda247 Publications (Author))

VII Semester

R23MECET016	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 4.0and 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 Referece Architerture of IIOT(BL4)
4	Integrate and Evaluate Software Defined Networks (SDN) in IIoT Systems(BL5)
5	Apparaise 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 IoTApplication 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. *Introduction to IoT*. Cambridge University Press	
2	S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0.* CRC Press.	
REFERENCE BOOKS:		
1	Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)	
2	Industrial Internet of Things: CybermanufacturingSystems"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	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

R23MECET023 DSC-E4	Wireless Adhoc and Sensor Networks					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	ADC, CN	**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	AnalyzeChallenges 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 centricity, 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
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 **Competency Group2**: Basics of Time Synchronization; Time Synchronization Protocols, Localization- Overview; Ranging Techniques, Range-Based Localization; Range-Free Localization, Event-Driven Localization.		
Unit 5	**Network Security**	**8hr**
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 **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.		

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'slevel - Unitscatchmentarticulationmatrix

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

R23MECET028 DSC-E4	Deep Learning					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Prerequisite	AIML	**3**	**0**	**0**	**3**

Course Objective

- 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, Denoisingautoencoders, 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.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Deep Learning- Ian Goodfelllow, 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

R23MECET033	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 fo 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'slevel – Unitscatchmentarticulationmatrix

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

R23MECET024 DCS-E5	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.

LEARNING RESOURCES	
TEXTBOOKS:	
1	"Coding for MIMO Communication Systems" by Tolga M. Duman, Ali Ghrayeb – 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. Sidiropoulus, 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

R23MECET029 DSC-E5	BIOMEDICAL SIGNAL PROCESSING					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	DSP,RVSP	**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/	

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

R23MECET034 DSC-E5	VLSI DESIGN FLOW: RTL TO GDS					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	DE, VLSI	**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, logicoptimization, 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 hours**

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 hours**

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 hours**

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 hours**
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 hours**
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.		
LEARNINGRESOURCES		
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

R23MECEL007	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)designingisanintegralpartofeachelectronicsproductsandthisprogramisdesignedtomakestudents capabletodesign theirown projects PCBup to industrialgrade.	
Course Outcomes	
1	Determine appropriate components to makecircuits.
2	DesignofaPower Supply Module
3	DesignoftypesofRectifiers
4	AnalyzetheDesignofaSecuritySystem
5	Design of an electronic printed circuit board for a specific application using standardsoftware
List of Experiments	
1	IntroductiontoPCBDESIGN andEDAToolSoftware
2	Parameter setting orPCBDesign.
3	Designofa±5VPowersupply.
4	SchematicCreationandsimulationofanelectroniccircuit
5	DesignandSimulateON/OFFSwitchesCircuits
6	Designandsimulation ofaHalfandFullWaveRectifier
7	DesignofaPCBlayout ofLowpass filter
8	DesignofaPCBlayoutofCEAmplifier
9	DesignandSimulateSimple7Segment Circuits
10	DesignofanIRProximitySensor–TouchlessDoorBellusingZeroPCB
11	DesignofaLaser LightSecurityAlarm.
12	DesignofaMobilePhoneDetectorCircuit.
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

R23MECEL007	ELECTROMAGNETIC SIMULATION					
	Total Contact Hours	30	**L**	**T**	**P**	**C**
	Pre-requisite	EMWTL, AME	**0**	**0**	**3**	**2**

Course Objective

- 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	● Introduction to fundamentals of Antennas and parameters. ● Fundamentals of Microwave and transmission line theory. ● Hands on available EM simulation tool basics.
Weeks 3-4	● Simulation of Rectangular Microstrip Edge feed Antenna. ● Simulation of Rectangular Microstrip Inset feed Antenna. ● Simulation of Co-axial feed Antenna..
Weeks 5-6	● Learning Optometric analysis of an antenna. ● Simulation of dipole antenna. ● Simulation of Circular Polarized Antenna.
Weeks 7-8	● Simulation of Rectangular wave guide. ● Simulation of Array antenna.
Weeks 9-10	● Simulation of Micro strip line filter. ● Simulation of Reconfigurable antenna.
Weeks 11-12	● Simulation of Antennas using (UWB, DGS, Fractal techniques) ● Simulation of MIMO/DRA antennas.
Weeks 13-14	● Practical measurements through Vector Network Analyzer. ● Implementing an IEEE paper/Student own project using so far learnt concepts.
Week 15	● End Exam

LEARNING RESOURCES	
TEXTBOOKS/ REFERENCE BOOKS:	
1	Balanis Constantine A., *Antenna Theory Analysis and design* (John Wiley &Sons, 3rd Edition, 2005).
2	Microwave Engineering by David M. Pozar, 4th edition, Wiley, 2011.
3	Warren L.Stutzman, Gary A.Thiele, *Antenna Theory and Design* (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

R23MECEL007	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

R23MECEL007	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	hhttp://www.deeplearningbook.org
2	https://deepakdvallur.weebly.com/machine-learning-laboratory.html

R23MECEL007		Drone Technology	L	T	P	C
		Total Contact Hours: 30	0	0	3	2
		Prerequisite: Engineering Mathematics, Physics, Programming Skills				

CO	Blooms Level	Students shall
CO1	BL3	Apply knowledge of aerodynamics and flight mechanics to the design process.
CO2	BL4	Examine the components of UAV navigation systems and their interrelationships.
CO3	BL4	Evaluate the integration of UAVs in various fields.
CO4	BL5	Integrate knowledge of basic aerodynamics and flight mechanics with UAV applications.
CO5	BL5	Develop a comprehensive understanding of UAV regulations and guidelines.
CO6	BL6	Assess current trends and developments in the UAV industry.

Unit 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
Unit 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
Unit 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
Unit 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
Unit 5: UAV Regulations and Ethics
UAV regulations and guidelines
UAV ethical considerations

UAV privacy and security issues
UAV environmental impact
UAV future trends and developments

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/.

R23MECEL007	EMBEDDED SYSTEMS					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	MPMC,ES	**0**	**0**	**2**	**2**

Course Objective

- 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

R23MSCST007	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 CodesFraming: 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
ConnectingDevices-Switches,Hubs,Routers,Bridges,Gateways;IPv4addressing-Classful,Classless; IPv4 Datagram Format,IPv6 Datagram Format; Address Mapping: ARP; RARP,BOOTP, DHCP; Routing: Routing table, Optimization, Distance Vector Routing ; Link State Routing, Path Vector Routing;		
Unit V	**TRANSPORT LAYER AND APPLICATION LAYER**	**8 hr**
TRANSPORT LAYER: TCP Datagram Format; UDP Datagram Format; Congestion Control: Data Traffic, Open Loop, Closed Loop; Quality of Service: Flow characteristics, Scheduling ; Flow Control: Leaky Bucket and Token Bucket; **REMOTE LOGIN & APPLICATION LAYER:** Telnet, Electronic Mail; DNS, Distribution of Name Space, DNS in the Internet; WWW and HTTP.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Data Communications and Networking, Behrouz Forouzan ,4th Edition,McGrawHill.	
REFERENCE BOOKS:		
1	Computer Networks –Andrew S Tanenbaum,4th Edition, Pearson Education/PHI.	
2	Computer Networking: *A Top Down Approach-James F Kurose and Keith W Ross,* 6th Edition, Pearson Education.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.geeksforgeeks.org/computer-network-tutorials	
2	https://www.javatpoint.com/computer-network-tutorial	
3	https://www.tutorialspoint.com/data_communication_computer_network	
ONLINE COURSES		
1	https://onlinecourses.nptel.ac.in/noc22_cs19	
2	https://www.coursera.org/learn/illinois-tech-computer-networking	

Bloom's level - Units catchment articulation matrix

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

R23MCSCT008	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 and Design Adversarial Search Strategies in Real-World Scenarios. (**BL3**)
2	Analyze and Compare the Applications and Limitations of Propositional Logic and First-Order Logic in Knowledge Representation and Reasoning. (**BL4**)
3	Apply Machine Learning Techniques and Neural Network Models to Solve Real-World Problems Across Various Domains. (**BL3**)
4	Analyze and Compare the Effectiveness of the Find-S and Candidate Elimination Algorithms in Designing a Learning System, Focusing on Version Spaces and Their Applications. (**BL4**)
5	Evaluate the Effectiveness and Applicability of Decision Tree Learning and Single and Multi-Layer Perceptrons in Solving Classification Problems Across Various Domains. (**BL5**)
6	Design and Develop an Integrated Intelligent System that Utilizes AI Search Algorithms, Knowledge Representation, and Machine Learning Techniques, Including Decision Trees and Neural Networks, to Solve Complex Real-World Problems. (**BL6**)

SYLLABUS

Unit I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**8 hrs**

Introduction to Artificial Intelligence (AI), machine learning, deep learning, Types of AI, Advantages and Applications of AI; Agents in Artificial Intelligence, Types of agents; State Space Search: Uninformed search: (Iterative Deepening, Bidirectional search); Informed search: Best First Search; A* Algorithm; Hill Climbing Algorithms in Artificial Intelligence (Simple and Steepest Ascent);Constraint satisfaction problems (Constraint propagation: Arc Consistency), Backtracking Algorithm for CSP's; Knowledge-Based Agent (KBA): Architecture and Various level of KBA.

Unit II	**KNOWLEDGE REPRESENTATION AND REASONING**	**8 hrs**

Knowledge representation (KR), Approaches to KR, Techniques of KR; Propositional Logic, Logical Connective and Equivalence; Rules of Inference; PEAS description of Wumpus world; First Order Logic in AI, Inference in First-Order Logic; Knowledge Engineering in First-order logic; Forward Chaining and backward chaining in AI; Reasoning in Artificial intelligence;

Unit III	**BASICS AND TYPES OF MACHINE LEARNING**	**8 hrs**

Conceptual introduction to Machine Learning and Neural Networks: Biological Neural Networks and Artificial Neural Networks; Supervised Learning: (Linear and Non-Linear regression); Logistic Regression; Classification: Decision Tree and

Support Vector Machines; Unsupervised Learning (clustering approach); Association; Semi-Supervised Learning; Reinforcement Learning		
Unit IV	**MACHINE LEARNING TRAINING EXAMPLES**	**8 hrs**
Well Posed Learning Problems, Designing A Learning System, Perspectives and Issues in Machine Learning; Introduction to Concept Learning: A Concept Learning as a Task; Concept Learning as Search; Find-S: Finding a Maximally Specific Hypothesis; Version Spaces Representation: The List-Then-Eliminate Algorithm, Compact Representation for Version Spaces; Candidate Elimination Algorithm and Example; Remarks on Version Spaces and Candidate-Elimination: Converge, Order of Training Examples, Usage of Partially Learned Concepts; Inductive Bias		
Unit V	**DECISION TREE LEARNING AND SINGLE AND MULTI-LAYER PERCEPTRON**	**8 hrs**
Introduction, Decision Tree Representation and Appropriate Problems for Decision Tree Learning;ID3 Algorithm: An Illustrative Example; Hypothesis Space Search and Inductive Bias in Decision Tree Learning; Neural Network Representation, Appropriate Problems for Neural Network Learning; Perceptrons - Representational Power of Perceptrons, The Perceptron Training Rule; Gradient Descent and The Delta Rule, Stochastic Approximation to Gradient Descent; Multilayer Networks and The Back Propagation Algorithm - A Differentiable Threshold Unit; The Back Propagation Algorithm		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Tom M. Mitchell "Machine Learning", Indian Edition.	
2	Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Third Edition.	
3	Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence", Tata McGraw-Hill Education, 3rd Edition, 2010.	
REFERENCE BOOKS:		
1	Christopher M. Bishop, "Pattern recognition and machine learning", Springer,2007.	
2	Ethem Alpaydin, "Introduction to Machine Learning", PHI, Third edition, 2015.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.javatpoint.com/artificial-intelligence-ai/	
2	https://www.geeksforgeeks.org/machine-learning/	

Bloom's level - Units catchment articulation matrix

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

R23MSCST009	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.oodesign.com/	
6	https://praveenthomasln.wordpress.com/2012/03/03/interfaces-types-and-roles-s8-cs/	
7	https://www.uml-diagrams.org/uml-25-diagrams.html	
8	https://www.tutorialspoint.com/uml/uml_2_overview.htm#:~:text=UML%202.0%20offers%20four%20interaction,of%20interactions%20as%20interaction%20occurrences.	
ONLINE COURSES		
1	NPTEL :: Computer Science and Engineering - NOC:Object-Oriented Analysis and Design	
2	https://onlinecourses.nptel.ac.in/noc22_cs99/preview	

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