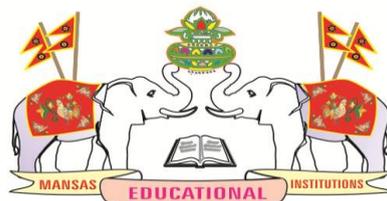# ACADEMIC REGULATIONS & CURRICULUM

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

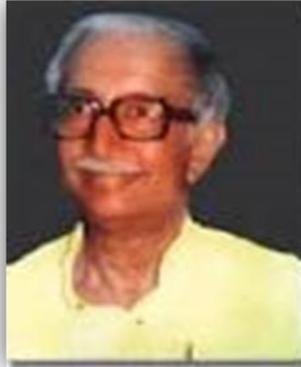**CIVIL ENGINEERING
(B.Tech. Programme)**

**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
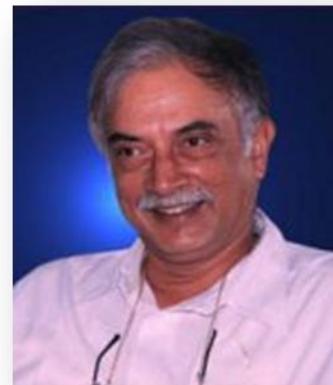Raja Saheb of Vizianagaram
Founder Chairman-MANSAS
Ex-Minister for Education and Health, Govt. of AP
Ex Member of Parliament

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	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 will be Project work in the final semester of the programme.

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, 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	Marks
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   : 50 Marks
Each one mark)
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 organizations (government/private) in pursuance of his/her career aspiration. The student is also expected to complete the Main Project during this period. At the end of the year, the candidate shall submit the main project report.

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 18 credits for award of B.Tech.(Honors) degree from same branch/department/discipline registered for major degree. This is in addition to the credits essential for obtaining the Undergraduate degree in Major Discipline.

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

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

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

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

vii. A student registered for Honors shall pass in all subjects that constitute the

requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree program.

viii. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

ix. The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical Engineering.

Enrolment into Honors:

i. Students of a Department/Discipline are eligible to opt for Honors program offered by the same Department/Discipline.

ii. The enrolment of student into Honors is based on the CGPA obtained in the major degree program. CGPA shall be taken up to IV semester in case of regular and Lateral entry students. Students having 7 CGPA without any backlog subjects will be permitted to register for Honors.

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

iv. 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.,

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

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

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

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

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

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

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

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by the letters 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

Ragging

ABSOLUTELY
NO TO RAGGING

---

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

ACADEMIC REGULATIONS (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 <u>six</u> consecutive academic years from the year of admission, shall forfeit their seat.

3. Minimum Academic Requirements

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

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

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

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

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

4. Course Pattern

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

ii.   A student eligible to appear for the end examination in a subject but absent at it or has failed in the end examination may appear for that subject at the next supplementary examination offered.

iii.   When a student is detained due to lack of credits/shortage of attendance the student may be re-admitted when the semester is offered after fulfilment of academic regulations, the student shall be in the academic regulations into which he/she is readmitted.

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

COURSE STRUCTURE - B. Tech. (Regular/Honors) - Civil Engineering
(Applicable from the academic year 2023-24 onwards)

I Semester

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	R23MATT101	Linear Algebra and Calculus	3	0	0	3
2	R23CHYT101	Engineering 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	R23CHYL101	Engineering Chemistry Laboratory	0	0	2	1
7	R23EEEL201	Electrical and Electronics Engineering Laboratory	0	0	3	1.5
8	R23CSEL201	Computer Programming Laboratory	0	0	3	1.5
9	R23HSSM802	NSS/ NCC/ Scouts &Guides/ Community Service	0	0	1	0.5
				Total Credits		19.5

II Semester

Sl. No.	Course Code	Course Name	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	R23CIVT301	Engineering Mechanics	3	0	0	3
6	R23HSSL001	Communicative English Laboratory	0	0	2	1
7	R23PHYL101	Engineering Physics Laboratory	0	0	2	1
8	R23CIVL301	Engineering Mechanics and Building Practices Laboratory	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

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	R23MCIVT003	Fluid Mechanics	3	0	0	3
2	R23MCIVT004	Strength of Materials	3	0	0	3
3	R23MCIVT005	Construction Materials and Concrete Technology	3	0	0	3
4	R23MCIVT006	Environmental Engineering	3	0	0	3
5	R23MCSCT001	Data Structures and Algorithms	3	0	0	3
6	R23MSCST011	Operating Systems	3	0	0	3
7	R23MCIVL001	Surveying Field Work	0	0	3	2
8	R23MCIVL002	Construction Material Testing Laboratory	0	0	3	2
9	R23MCSCL001	Data Structures and Algorithms Lab	0	0	3	2
					Total Credits	24

IV Semester

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	R23MCIVT007	Structural Analysis	3	0	0	3
2	R23MCIVT008	Soil Mechanics	3	0	0	3
3	R23MCIVT009	Open Channel Hydraulics	3	0	0	3
4	R23MCIVT010	Building Planning and Drawing	3	0	0	3
5	R23MSCST007	Python Programming	3	0	0	3
6	R23MSCST010	Database Management Systems	3	0	0	3
7	R23MCIVL003	CAD and GIS Laboratory	0	0	3	2
8	R23MCIVL004	Soil Mechanics Laboratory	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

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	R23MCIVT011	Design of Reinforced Concrete Structures	3	0	0	3
2	R23MCIVT012	Engineering Hydrology	3	0	0	3
3	R23MCIVT013	Construction Technology and Project Management	3	0	0	3
4	R23MCIVT014	Highway Engineering	3	0	0	3
5	R23MCIVTXXX	DSC-E1	3	0	0	3
6	R23MCSCT005	Software Engineering	3	0	0	3
7	R23MCIVL005	Building Information Modeling Laboratory	0	0	3	2
8	R23MCSCL003	Database Management Systems Lab	0	0	3	2
9	R23MCIVP001	Community Project	0	0	2	2
10	R23MCIVAT02	Environmental Studies	2	0	0	0
					Total Credits	**24**

VI Semester

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	R23MCIVT015	Foundation Engineering	3	0	0	3
2	R23MCIVT016	Estimation and Costing	3	0	0	3
3	R23MCIVT017	Design of Steel Structures	3	0	0	3
4	R23MCSCT006	OOP with JAVA	3	0	0	3
5	R23MCIVTXXX	DSC-E2	3	0	0	3
6	R23MCIVTXXX	DSC-E3	3	0	0	3
7	R23MCIVL006	Applied Computational Methods Laboratory	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						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R23MCIVT018	GIS Applications in Civil Engineering (Self-Study/MOOCS)	3	0	0	3
2	R23MCIVTXXX	E4 (Self-Study/MOOCS)	3	0	0	3
3	R23MCIVTXXX	E5 (Self-Study/MOOCS)	3	0	0	3
4	R23MCIVP002	Mini Project	0	0	2	2
5	R23MCIVL007	Structural Detailing	0	0	3	2
				Total Credits		**13**

VIII Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R23MCSCT007	Computer Networks (Self-Study/MOOCS)	3	0	0	3
	R23MCSCT008	Artificial Intelligence: Principles and Techniques (Self-Study/MOOCS)	3	0	0	
	R23MCSCT009	OOAD and Design Patterns (Self-Study/MOOCS)	3	0	0	
2	R23MCIVP003	Major-Dissertation/Academic Project-Major	0	0	16	8
				Total Credits		**11**

DEPARTMENT ELECTIVE COURSES

Sl. No.	Type of Course	Course Code	Course Title	L	T	P	Credits
Construction Management							
1	DSC-E1	R23MCIVT019	Building Construction and Services	3	0	0	3
2	DSC-E2	R23MCIVT020	Contracts and Legal Issues	3	0	0	3
3	DSC-E3	R23MCIVT021	Project Administration and Safety Management	3	0	0	3
4	DSC-E4	R23MCIVT022	Ground Improvement Techniques (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R23MCIVT023	Solid Waste Management (Focus on C&D) (Self-study/MOOCS)	3	0	0	3
Water Resources and Environmental Engineering							
1	DSC-E1	R23MCIVT028	Earth Sciences	3	0	0	3
2	DSC-E2	R23MCIVT029	Environmental Impact Assessment	3	0	0	3
3	DSC-E3	R23MCIVT030	Irrigation Engineering and Hydraulic Structures	3	0	0	3
4	DSC-E4	R23MCIVT031	Availability and Management of Groundwater Resources (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R23MCIVT032	Rural Water Resources Management (Self-study/MOOCS)	3	0	0	3
Transportation and Geotechnical Engineering							
1	DSC-E1	R23MCIVT037	Traffic Engineering and Transport Planning	3	0	0	3
2	DSC-E2	R23MCIVT038	Railways, Airports and Harbours	3	0	0	3
3	DSC-E3	R23MCIVT039	Highway Construction Practices	3	0	0	3
4	DSC-E4	R23MCIVT040	Sustainable Transportation Systems (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R23MCIVT041	Multimodal Urban Transport Systems (Self-study/MOOCS)	3	0	0	3

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					

R23MATT101	LINEAR ALGEBRA & CALCULUS (Common to all branches of Engineering)					
	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.**(BL 3)**
2	Make use of Linear Algebra techniques to find higher powers and inverse of Matrices. **(BL 3)**
3	Make use of Mean value theorems to deduce Mathematical identities. **(BL 3)**
4	Use the concept of multivariable calculus to determine the maxima and minima of a multivariable function. **(BL 3)**
5	Estimate areas and volumes with help of Multiple integrals. **(BL 3)**
6	Formulate Mathematical models and estimate appropriate physical quantities. **(BL 6)**

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	ErwinKreyszig, AdvancedEngineeringMathematics, 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, 9th 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

R23CHYT101	**ENGINEERING CHEMISTRY**					
	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
●   To familiarize engineering chemistry and its applications
●   To impart the concept of soft and hard waters, softening methods of hard water
●   To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement.

Course Outcomes	
1	The student will be able to **select** a suitable water treatment method for a given industrial application through **assessing** the quality of water. **(BL 5)**
2	The student will be able to **select** a suitable energy storage device for a given application as well he/she will also **design** a suitable process for corrosion prevention in industry**. (BL 5)**
3	The student will be able to recommend a suitable polymer/ plastic/ elastomer for a given industrial application. He /She will also **assess** the suitability of a given fuel. **(BL 5)**
4	The student will be able to **select** a suitable composite/ refractory/ lubricant/ binding material for a given application. **(BL 5)**
5	The student will be able to **discuss** a suitable colloid or nanomaterial for a given application. **(BL 6)**
6	The student will be able to **discuss** a colloid/ nanomaterial/ polymer; **recommend** a suitable building material/composite/ refractory/ lubricant; **select** a suitable energy storage device and **assess** the quality of water for a given industrial application **(BL 6)**

SYLLABUS		
Unit 1	**Water Technology**	**9 hr**
Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.		
Unit 2	**Electrochemistry and Applications**	**9 hr**
Electrodes –electrochemical cell, Nernst equation, cell potential calculations. Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell. **Corrosion:** Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).		
Unit 3	**Polymers and Fuel Chemistry**	**9 hr**
Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization. **Thermoplastics and Thermo-setting plastics-:** Preparation, properties and applications of poly styrene. PVC Nylon 6,6 and Bakelite.		

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers. **Fuels –** Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.	

Unit 4	Modern Engineering Materials	9 hr
Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications **Refractories-** Classification, Properties, Factors affecting the refractory materials and Applications. **Lubricants**- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications. **Building materials-** Portland Cement, constituents, Setting and Hardening of cement.		

Unit 5	Surface Chemistry and Nanomaterials	9 hr
Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc		

LEARNING RESOURCES

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

REFERENCE BOOKS:	
1	H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2	D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.
3	Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23EEET201	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING** (Common to all branches of Engineering)					
	Total Contact Hours	42 (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: After the completion of this course, the student

1	Will be able to apply the basic principles of electrical and circuits to solve DC and AC circuits. **(BL 3)**
2	Will be able to analyze the construction and operation of various electrical machines and measuring instruments also select a machine for an application. **(BL 3)**
3	Will be able to analyze power generation, electric safety measures and examine electrical power consumption and tariff. **(BL 4)**
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. **(BL 4)**
5	Will be able to design simple combinational and sequential circuits of digital electronics **(BL 6)**
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. **(BL 6)**

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	BL3	X	X				
CO2	BL3		X				
CO3	BL4			X			
CO4	BL4				X	X	
CO5	BL6						X
CO6	BL6	X	X	X	X	X	X

	INTRODUCTION TO PROGRAMMING					
	(Common to all branches of Engineering)					
R23CSET201	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**. (BL 3)**
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. **(BL 6)**
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. **(BL 3)**
4	Students will construct solutions by utilizing functions, string handling, applying variable scope and storage classes effectively, and implementing recursion through C programming principles. **(BL 6)**
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**. (BL 6)**
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. **(BL 6)**

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.	

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

	ENGINEERING GRAPHICS					
R23MECD201	(Common to all branches of Engineering)					
	Total Contact Hours	15(L)+60(P)	**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. **(BL 3)**
2	Interpret orthographic projections like front, top and side views related to points, lines, planes and solids. **(BL 5)**
3	Demonstrate the projection of solids in various positions in the first quadrant. **(BL 3)**
4	Examine the principles behind development of surfaces. **(BL 4)**
5	Develop orthographic and isometric projections of solids. **(BL 6)**

SYLLABUS

Unit 1	**Curves, scales and polygons**	**15 hr**

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**	**15 hr**

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**	**15 hr**

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**	**15 hr**

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	15 hr

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

TEXTBOOKS:	
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

R23CHYL101	**ENGINEERING CHEMISTRY LABORATORY**					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Chemistry at 10 + 2 level education	**0**	**0**	**2**	**1**

Course Objective	
To verify the fundamental concepts with experiments	

Course Outcomes	
At the end of the course, the students will be able to	
1	Determine the cell constant and conductance of solutions.
2	Prepare advanced polymer materials.
3	Determine the physical properties like surface tension, adsorption and viscosity.
4	Estimate the Iron and Calcium in cement.
5	Calculate the hardness of water.

List of Experiments	
1	Determination of Hardness of a groundwater sample.
2	Estimation of Dissolved Oxygen by Winkler's method.
3	Determination of Strength of an acid in Pb-Acid battery.
4	Preparation of a polymer (Bakelite).
5	Determination of percentage of Iron in Cement sample by colorimetry.
6	Estimation of Calcium in port land Cement.
7	Preparation of nanomaterials by precipitation method.
8	Adsorption of acetic acid by charcoal.
9	Determination of percentage Moisture content in a coal sample.
10	Determination of Viscosity of lubricating oil by Redwood Viscometer 1.
11	Determination of Viscosity of lubricating oil by Redwood Viscometer 2.
12	Determination of Calorific value of gases by Junker's gas Calorimeter.

LEARNING RESOURCES	
TEXT BOOKS:	
1	Engineering 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 LABORATORY** (Common to all branches of Engineering)					
	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/

R23CSEL201	**COMPUTER PROGRAMMING LABORATORY** (Common to all branches of Engineering)		**L**	**T**	**P**	**C**
	Total Contact Hours	45 (P)	0	0	3	1.5
	Pre-requisite	NIL				

Course Objective

● The course aims to give students hands – on experience and train them on the concepts of the C- programming language.

Course Outcomes

1	Read, understand, and trace the execution of programs written in C language.
2	Select the right control structure for solving the problem.
3	Develop C programs which utilize memory efficiently using programming constructs like pointers.
4	Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.

LIST OF EXPERIMENTS

1	**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()
2	**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
3	**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
4	**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
5	**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. 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** (Common to all branches of Engineering)		**L**	**T**	**P**	**C**
	Total Contact Hours	15 (P)				
	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.

		COMMUNICATIVE ENGLISH					
R23HSST001		(Common to all branches of Engineering)					
	Total Contact Hours	30 (L)		**L**	**T**	**P**	**C**
	Pre-requisite	Nil		**2**	**0**	**0**	**2**

Course Objective

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

Course Outcomes

1	Developing the ability to comprehend, analyze and elicit information. **(BL 6)**
2	Demonstrating the skill of Structured thinking. **(BL 3)**
3	Developing Competency to summarize and paraphrase content in different materials**. (BL 6)**
4	Demonstrating the skill of constructive presentation**. (BL 3)**
5	Building communicative competence. **(BL 6)**

SYLLABUS

Unit 1	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.	**6 hr**
Unit 2	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.	**6 hr**
Unit 3	Lesson: BIOGRAPHY of Steve Jobs Supplementary Text: Biography of Tenzing Norgay **Listening**: Listening for global comprehension and summarizing.	**6 hr**

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

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

	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to all branches of Engineering)					
R23MATT102	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. **(BL 3)**
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**. (BL 3)**
3	Solve the partial differential equations by various methods. **(BL 3)**
4	Interpret the physical meaning of different operators such as gradient, curl and divergence**. (BL 3)**
5	Estimate the work done against a field, circulation and flux using vector calculus. **(BL 5)**
6	Formulate Mathematical models and estimate appropriate physical quantities. **(BL 6)**

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.

TEXT BOOKS:

1	ErwinKreyszig, Advanced Engineering Mathematics, 10/e, JohnWiley & 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 **(BL 4)**
2	Student will be able to **investigate** the crystallographic phase of the unknown specimen by using the X-ray diffraction method **(BL 5)**
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. **(BL 5)**
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. **(BL 4)**
5	Student will be able to **classify** the solids, **analyze** the semiconductor charge carrier concentrations, and **identify** the semiconductor type by using the Hall effect. **(BL 4)**
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. **(BL 6)**

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 dielctric 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, 11[th]Edition (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_2iUCG87 B_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 I	Unit II	Unit III	Unit IV	Unit V
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** **(Common to All Branches of Engineering)**					
	Total Contact Hours	48 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**3**	**0**	**0**	**3**

Course Objectives (Common to all branches of Engineering)

● 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 transportation and 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	Apply the multifaceted roles and responsibilities of a Civil Engineer in real-world contexts, and demonstrate the principles of building planning along with the use of appropriate construction techniques and materials in designing and executing building projects. **BL3**
2	Apply standard surveying methods to calculate the area of irregular boundaries using given lengths and bearings, and determine the reduced level (RL) of an object using appropriate leveling techniques. **BL3**
3	Use transportation engineering concepts to analyze their impact on the nation's economy, and demonstrate engineering measures in highway geometrics, water resources, and storage structures to illustrate the social responsibility of conserving water in terms of quality and quantity. **BL3**
4	Use mechanical engineering technologies in various industrial sectors, and select appropriate engineering materials for specific engineering applications. **BL3**
5	Demonstrate the working principles of various manufacturing processes, refrigeration and air conditioning cycles, internal combustion (IC) engines, and electric and hybrid vehicles. **BL3**
6	Illustrate the working of power plants, mechanical power transmission systems, and various robotic configurations using suitable engineering methods and explanations. **BL3**

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: BASIC MECHANICAL 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'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23CIVT301	ENGINEERING MECHANICS						
	Total Contact Hours	42 (L)		L	T	P	C
	Pre-requisite	Engineering physics, Engineering Mathematics		3	0	0	3

Course Objective

- To acquire the ability to use principles of engineering mechanics to solve different rigid body mechanics problems.

Course Outcomes

1	Apply principles of forces, equilibrium, friction, and kinetics to solve problems related to applied mechanics. **(BL3)**
2	Analyze shear force and bending moment diagrams for different types of beams under various loading conditions. **(BL4)**
3	Apply geometric and mathematical concepts to determine the centroid of regular, composite, and built-up sections. **(BL3)**
4	Apply different principles in of moment of inertia to calculate the moment of inertia for regular and composite sections. **(BL3)**
5	Analyze statically determinate plane trusses using methods of joints and sections, including identification of zero-force members. **(BL4)**
6	Create integrated structural models by applying principles of mechanics, centroid, moment of inertia, and structural analysis to solve real-world engineering problems. **(BL6)**

SYLLABUS

Unit 1	**Introduction to Engineering Mechanics, Systems of Forces, Friction**	**9 hr**

Introduction to Engineering Mechanics– Basic Concepts. Scope and Applications
Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application –Couples and Resultant of Force Systems.
Friction: Introduction**,** limiting friction and impending motion, Coulomb's slaws of dryfriction, coefficient of friction, Cone of Static friction.

Unit 2	**Equilibrium of Systems of Forces, Trusses**	**9 hr**

 Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium   of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses. Principle of virtual work with simple examples

Unit 3	**Centroid, Centre of Gravity, Moments of Inertia**	**9 hr**

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. **Centre of Gravity:** Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.
 Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.
Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

Unit 4	Rectilinear and Curvilinear motion of a particle	9 hr

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics – D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

Unit 5	Rigid body Motion	9 hr

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:

1.Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati, McGraw Hill Education 2017. 5th Edition.

2.Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.

3.Engineering Mechanics - Statics and Dynamics, Pearson Education India, 11th Edition.

Reference Books:

1.Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.

2.Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.

3.Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L.G. Kraige., John Wiley, 2008. 6th Edition.

Additional References:

1.Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition.

2.Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition.

Online Courses:

https://archive.nptel.ac.in/courses/112/106/112106286/

https://archive.nptel.ac.in/courses/112/106/112106180/

https://nptel.ac.in/courses/112103109

https://archive.nptel.ac.in/courses/122/104/122104014/

https://www.coursera.org/learn/engineering-mechanics-statics

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO-1	BL3	X				
CO-2	BL4		X			
CO-3	BL3			X		
CO-4	BL3				X	
CO-5	BL4					X
CO-6	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 LABORATORY** (Common to all branches of Engineering)		**L**	**T**	**P**	**C**
	Total Contact Hours	30 (P)				
	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

R23CIVL301	**ENGINEERING MECHANICS & BUILDING PRACTICES LAB**					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**3**	**1.5**

Course Objective

The students completing the course are expected to
● Verify the Law of Parallelogram of Forces and Lami's theorem.
● Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
● Understand the layout of a building, concepts of Non-Destructive Testing and different Alternative Materials.

Course Outcomes

1	Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
2	Prove the Law of Parallelogram of Forces and Law of Moment using a force polygon and bell crank lever.
3	Determine the Centre of gravity in different configurations
4	Categorize the Quality Testing and Assessment Procedures and principles of Non- Destructive Testing.
5	Explain safety practices in the construction industry.

List of Experiments

1	To study various types of tools used in construction.
2	Forces in Pin Jointed Trusses
3	Experimental Proof of Lami's Theorem
4	Verification of Law of Parallelogram of Forces.
5	Determination of Center of Gravity of different shaped Plane Lamina.
6	Determination of coefficient of Static and Rolling Friction.
7	Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever
8	Study of Alternative Materials like M-sand, Fly ash, Sea Sand etc.
9	Field-Visit to understand the Quality Testing - report.
10	Safety Practices in Construction industry
11	Demonstration of Non-Destructive Testing - using Rebound Hammer & UPV
12	Study of Plumbing in buildings.

LEARNING RESOURCES

TEXT BOOKS:

1	Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2	A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018. 4th Edition.
3	Concrete Technology: Theory and Practice by M S Shetty and A. K. Jain, S Chand Publishing 2019, 8th Edition

REFERENCE BOOKS:

1	Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
2	Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition
3	Properties of Concrete: Adam M. Neville, Wiley Publishings, 1996, 4Th Edition

		ENGINEERING WORKSHOP					
R23MECW201		(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) Godown lighting d) Tube light e) Three phase motor f) Soldering of wires
6	**Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7	**Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8	**Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

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	Demonstration 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, 2021-22.

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/

R23CSEW201	**IT WORKSHOP** (Common to all branches of Engineering)					
	Total Contact Hours	30 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**0**	**0**	**2**	**1**

Course Objective

● 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.

Course Outcomes

1	Students will be able to analyze Hardware troubleshooting.
2	Students will be able to identify Hardware components and inter dependencies.
3	Students will be able to choose safeguard computer systems from viruses/worms.
4	Students will be able to Create document and power point presentation.
5	Students will be able to develop calculations using spreadsheets.

List of Experiments

1	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.
2	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.
3	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.
4	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 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 downloadsto 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 oftoolbars, saving Excel files, Using helpand 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, PearsonEducation, 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

		HEALTH AND WELLNESS, YOGA & SPORTS					
R23HSSM801		(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
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

R23MCIVT003	FLUID MECHANICS						
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Prerequisite	Nil	**3**	**0**	**0**	**3**

Course Objective

This course aims to equip students with a comprehensive understanding of fluid mechanics enabling them to analyze fluid behavior, apply relevant principles, and design fluid flow systems.

Course Outcomes

After completing this course, the students will be able to

1	Distinguish fluid properties and determine forces on submerged surfaces using hydrostatic principles. **(BL4)**
2	Analyze fluid flow patterns and distinguish between different flow types using flow parameters and diagrams. **(BL4)**
3	Analyze the use of energy and momentum equations to determine flow rates through meters and openings. **(BL4)**
4	Analyze fluid behaviour in hydraulic systems using principles of jet flow and laminar movement. **(BL4)**
5	Determine head losses and Examine flow in pipe systems, including networks and water hammer effects. **(BL4)**.
6	Design fluid systems by combining fluid properties, flow principles, and energy concepts to solve practical civil engineering problems. **(BL6)**

SYLLABUS		
UNIT 1	**PRESSURE MEASUREMENT AND HYDROSTATICS**	**8 Hrs.**

Properties of fluids

Fluids vs. Solids – Concept of Continuum; Fluid Properties (Density, Viscosity, Surface Tension, Capillarity).

Fluid pressure and its measurement

Variation of Pressure in a fluid; Measurement of pressure – simple, differential manometers and mechanical gages.

Hydrostatics

Total Pressure and Centre of Pressure; Hydrostatic forces on submerged plane and curved surfaces; Practical applications of Total pressure – Dams, Gates and Tanks.

UNIT 2	**FLUID KINEMATICS**	**8 Hrs.**

Fundamentals of fluid flow

Classification of fluid flows; Description of flow pattern; Continuity Equation; Acceleration of a fluid particle; Rotational and Irrotational Motions; Circulation and Vorticity; Stream function – Velocity potential function; Flow Net analysis.

UNIT 3	**ENERGY EQUATION AND ITS APPLICATIONS**	**8 Hrs.**

Energy equation

Introduction to Fluid Dynamics and Forces acting on a fluid; Equation of motion; Energy equation; Momentum Equation.

Practical Application of energy equation – Measurement of flow in pipes and open channels

Venturi meter and Orifice meter; Pitot tube; Orifice and Mouthpiece; Notches/weirs.

UNIT 4	PRACTICAL APPLICATIONS OF MOMENTUM EQUATION AND LAMINAR FLOW	8 Hrs.

Application of Momentum equation

Force on pipe bend; Force exerted by a jet – Stationary Flat Plate, Moving Flat Plate, Flat Plates mounted on a wheel; Applications to Hydraulic Machines – Turbines and Pumps.

Laminar flow

Two types of flow - Reynold's Experiment - Characteristics of Laminar and turbulent flow; Laminar flow between parallel plates, Laminar flow through pipes, Hazen Poiseuille equation.

UNIT 5	FLOW THROUGH PIPES	8 Hrs.

Laws of fluid friction; Equation for head loss in pipes due to friction – Darcy – Weisbach equation; Minor losses in pipes. Hydraulic Grade Line and Energy Grade Line; Moody's chart; Pipes in series and Parallel; Water Hammer in Pipes; Water Distribution Networks.

<div align="center">LEARNING RESOURCES</div>

TEXTBOOKS:

1	A. K. Jain, *Fluid Mechanics including Hydraulic Machines,* Khanna Publishers
2	P. N. Modi, S. M. Seth, *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, Standard Book House Publishers.

REFERENCE BOOKS:

1	Yunus A. Cengel, John M. Cimbala, *Fluid Mechanics- Fundamentals and Applications*, McGraw-Hill Education (India) Publishers.
2	S. K. Som, G. Biswas, and S. Chakraborty, *Introduction to Fluid Mechanics and Fluid Machines*, McGraw-Hill Education (India) Publishers.
3	K. Subramanya, *Fluid Mechanics and Hydraulic Machines,* McGraw-Hill Education (India) Publishers.

ADDITIONAL REFERENCE MATERIAL:

1	https://nptel.ac.in/courses/112104118

ONLINE COURSES:

1	NPTEL:: Mechanical Engineering - NOC: Introduction to Fluid Mechanics

<div align="center">BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX</div>

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

R23MCIVT004	STRENGTH OF MATERIALS					
	Total Contact Hours	42(L)	L	T	P	C
	Prerequisite	Engineering Mechanics	3	0	0	3

Course Objective

To equip students with theoretical knowledge and analytical skills required to predict various stresses and failure modes developed in a material subjected to various types of loads.

Course Outcomes

After completing this course, the students will be able to

1	Ability to apply the fundamental concepts of stress and strain to determine the internal responses in deformable bodies. **(BL3)**
2	Ability to analyze the state of stress on an oblique plane to identify principal stresses and principal planes**. (BL4)**
3	Ability to analyze the distribution of shear force and bending moment in statically determinate beams. **(BL4)**
4	Ability to apply bending and shear stress formulas to evaluate stresses in simple beams. **(BL3)**
5	Ability to apply Euler's theory to determine the critical load for buckling in columns. **(BL3)**
6	Elaborate on various theories necessary for the prediction of various stresses and failure modes developed in a material subjected to various types of loadings. **(BL6)**

SYLLABUS		

UNIT 1	SIMPLE STRESSES AND STRAINS	8 Hrs.

Types of stresses and strains, Hooke's law; Stress, Strain variation of mild steel; Working stress, factor of safety, lateral strain, Poisson's ratio; Stresses in prismatic and homogeneous bars;

Stresses in bars of varying sections; Stresses in composite bars; Stresses due to temperature changes; Elastic moduli and the relationship between them, Volumetric strain.

UNIT 2	PRINCIPAL STRESSES AND PRINCIPAL PLANES	8 Hrs.

Introduction, Stresses on an inclined section of a bar under axial loading; Compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses; Normal and tangential stresses on an inclined plane for a state of pure shear; Two perpendicular normal stresses accompanied by a state of simple shear.

Introduction, Principal stresses and Principal planes; Analytical solution for Two-dimensional stress system (general case); Graphical methods, Mohr's circle construction for Principal stresses; Theories of failures.

UNIT 3	BENDING MOMENT AND SHEAR FORCE IN STATICALLY DETERMINATE BEAMS	8 Hrs.

Introduction to shear force and bending moment; Relation between SF, BM and rate of loading at a section of a beam; Shear Force and Bending Moment diagrams for a cantilever beam for different load cases;

Shear Force and Bending Moment diagrams for a simply supported beam with and without overhang for different load cases; Point of contraflexure and maximum bending moment in a Simply supported beam.

UNIT 4	FLEXURAL AND SHEAR STRESSES IN BEAMS	8 Hrs.

Bending Stress: Theory of simple bending, Assumptions, Derivation of pure bending equation; Position of Neutral axis, Modulus of rupture, Flexural rigidity

and Section modulus of rectangular, I, T and built-up sections of simple beams; Determination of bending stresses, Practical applications of Pure bending equation.

Shear Stress: Expression for transverse shear stress in beams, Assumptions and derivation; Shear stress distribution across rectangular (Hollow and Solid), I and built-up beams; Applications, Concept of shear centre.

UNIT 5	COLUMNS AND STRUTS	8 Hrs.

Introduction, Types of columns, Axially loaded compression members, Crushing load; Euler's theory for long columns, Assumptions and Limitations; Euler's critical load formulae for various end conditions; Equivalent length of a column, slenderness ratio, Euler's critical stress;

Rankine's Theory; Combined Direct and Bending Stresses; Core of a section; Stresses under the combined action of direct loading and Bending Moment.

LEARNING RESOURCES

TEXTBOOKS

1	R K Rajput, *A Textbook of Strength of Materials* 7/e, 2022, S Chand and Company Ltd.
2	Timoshenko S, *Strength of Materials*, 3rd Ed., 2002, CBS Publishers and Distributors. Part 1 Elementary Theory and Problems Part 2 Advanced Theory and Problems.

REFERENCE BOOKS

1	R C Hibbeler, *MECHANICS OF MATERIALS*, 10th Ed., 2022, Pearson Education.
2	H. J. Shah and S. B. Junnarkar, *Mechanics of Structures*, Vol. 1 and Vol. 2, Charotar Publishing House, 2008

ADDITIONAL REFERENCE MATERIAL

1.	NPTEL:: Mechanical Engineering - Strength of Materials https://archive.nptel.ac.in/courses/112/107/112107146/
2.	Strength of Materials - Civil Engineering Questions and Answers (indiabix.com) https://www.indiabix.com/civil-engineering/strength-of-materials/

ONLINE COURSES

1.	'Strength of Materials' Video Lectures from IIT Kharagpur by Prof. S.K. Bhattacharyya - Civil Engineering NPTEL Video Lectures (nptelvideos.com) https://nptelvideos.com/course.php?id=352

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	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

R23MCIVT005	CONSTRUCTION MATERIALS AND CONCRETE TECHNOLOGY						
	Total Contact Hours	42 (L)	L	T	P	C
	Prerequisite	Nil	3	0	0	3

Course Objective

This course aims to equip students with a comprehensive understanding of construction materials, their properties, testing methods, and applications in various construction scenarios, enhancing their employability through knowledge.

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

1	Select the right materials like stone, wood, metal and brick based on their basic properties. **(BL3)**
2	Compare the properties of cement, aggregates, and bitumen through tests to check if they are suitable for building work. **(BL4)**
3	Analyze the factors affecting the quality of fresh and hardened concrete, including the influence of admixtures and curing on its strength and durability. **(BL4)**
4	Develop concrete mix designs for different situations applying IS codes, based on strength and durability needs. **(BL3)**
5	Identify suitable materials for roads and other structures by understanding performance needs and usage conditions**. (BL3)**
6	Design concrete mix compositions by using the knowledge of material properties, durability aspects, and codal provisions to meet specific structural and environmental requirements. **(BL6)**

SYLLABUS		
UNIT 1	**PRINCIPAL PROPERTIES OF CONSTRUCTION MATERIALS**	**8 Hrs.**

Introduction to various construction materials and their uses (Rocks and stones, Wood and wood products, Metals, Plastics, Paints, Bricks, and Tiles) – Physical properties of the materials (Density, Specific gravity, Porosity, water absorption, weathering, heat conductivity, chemical resistance, Permeability and void ratio) Mechanical Properties of the materials (Strength, hardness, elasticity, plasticity, ductility)

UNIT 2	**AGGREGATES AND BINDING MATERIALS**	**8 Hrs.**

Aggregates: Types of aggregates – Coarse aggregate, Fine aggregates, and artificial aggregates – Physical properties and their testing

Cement: Types, Manufacturing, chemical composition, cement reaction, Tests on cement

Bitumen – Types, Physical properties – bitumen mix and its properties

UNIT 3	**FRESH CONCRETE AND ADMIXTURES**	**8 Hrs.**

Types of concrete; Workability; Manufacturing; Ready mix concrete; Bleeding and segregation; Curing of concrete; Chemical admixtures; Mineral Admixtures		
UNIT 4	**HARDENED CONCRETE**	**8 Hrs.**
W/C ratio; Gel/Space ratio; rate of Gain of strength and Maturity; Elasticity, shrinkage and creep; Strength of concrete; Compressive strength; Tensile strength; Flexural strength, NDT Tests on concrete.(Rebound hammer, UPV, Carbonation, RCPT)		
UNIT 5	**DURABILITY AND MIX DESIGN**	**8 Hrs.**
Strength and durability; Permeability and Chloride penetration; Sulphate attack and Acid attack; Carbonation and Alkali-Silica reaction; Nominal Mixes as per IS 456; Concept of Mix design; Mix design of Normal concrete as per IS 10262 – 2019; Mix design of special concrete as per IS 10262 - 2019		
LEARNING RESOURCES		
TEXTBOOKS		
1	Concrete Technology, M. S. Shetty – S. Chand & Co.: 2004	
2	Highway Engineering, Khanna S.K., and Justo – Nem Chand Bros	
REFERENCE BOOKS		
1	Properties of concrete, A. M. Neville – PEARSON – 4th edition	
2	Concrete: microstructure, properties and materials – PK Mehta – McGraw Hill – 4th Edition	
3	MORTH Publications- Specifications for roads and bridges	

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 4			X		
CO4	BL 3				X	
CO5	BL 3					X
CO6	BL 6	X	X	X	X	X

	ENVIRONMENTAL ENGINEERING					
R23MCIVT006	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**3**	**0**	**0**	**3**

Course Objective

- Comprehensive understanding of key terms, concepts, and principles in urban water systems and environmental engineering.
- Equip students with the ability to apply their knowledge in practical scenarios, emphasizing problem-solving skills related to water supply, treatment, and sewage disposal.
- Enhance students' analytical skills by breaking down and comprehending the design principles and functioning of urban water and sewage treatment components.
- Encourage students to apply their knowledge to formulate a holistic urban water and sewage management plan, necessitating the integration of diverse concepts and the synthesis of intricate solutions to address complex environmental engineering challenges.

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

1	A layout for drinking water treatment**. (BL4)**
2	Drinking water treatment unit operations/process. **(BL4)**
3	Water distribution and sewage collection systems. **(BL4)**
4	Sewage treatment unit operations/process. **(BL4)**
5	Sludge treatment and disposal systems. **(BL4)**
6	Design a water supply and sewage treatment systems. **(BL6)**

SYLLABUS		
UNIT 1	**URBAN WATER SUPPLY: SOURCES, QUALITY, AND DEMAND FORECASTING**	**8 hr**
Sources and impurities - Water Demand – Factors affecting water demand - Population Forecasting - Water conveyance – Physical characteristics - Chemical characteristics – Biological characteristics		
UNIT 2	**DRINKING WATER TREATMENT**	**8 hr**
Layout of water treatment plant - Screening - Aeration - Type 1 Settling – Type 2 settling - Filtration theory – Rapid sand Filter – Disinfection		
UNIT 3	**WATER DISTRIBUTION AND SEWAGE COLLECTION**	**8 hr**
Design (Turbid surface water) - Design (Turbid ground water) - Distribution Systems I - Distribution Systems II – Design of Distribution Systems - Sewerage systems - Sewer design I - Sewer design II		
UNIT 4	**URBAN SEWAGE TREATMENT – PROCESS COMPONENTS**	**8 hr**
Sewage characteristics I - Sewage characteristics II - Sewage treatment plant layout - Bar screens - Grit chambers – Secondary Treatment (Aerobic and anaerobic) - Activated sludge process I - Activated sludge process II -		
UNIT 5	**URBAN SEWAGE TREATMENT – DESIGN AND RESIDUALS MANAGEMENT**	**8 hr**
STP Design I – STP Design II - Sewage disposal – Septic tank - Soak pit - Sludge digestion I - Sludge digestion II - Sludge disposal		
LEARNING RESOURCES		
TEXTBOOKS:		

1	G. Peavy, D. Rowe, and G. Tchobanoglous, *Environmental Engineering*. New York, NY, USA: McGraw-Hill, 1985.
2	S. Goel, *Water and Wastewater Engineering*. Cambridge, UK: Cambridge University Press, 2019.
REFERENCE BOOKS:	
1	*Manual on Water Supply and Treatment*, CPHEEO, New Delhi, India, 2000.
2	*Manual on Sewerage and Sewage Treatment*, CPHEEO, New Delhi, India, 2000.
ADDITIONAL REFERENCE MATERIAL	
1	S. Arceivala and S. R. Asolekar, *Wastewater Treatment for Pollution Control and Reuse*. New Delhi, India: Tata McGraw-Hill.
ONLINE COURSES	
1	NPTEL course on "*Water Supply Engineering*" https://archive.nptel.ac.in/courses/105/105/105105201/
2	NPTEL course on "*Wastewater Treatment and Recycling*" https://archive.nptel.ac.in/courses/105/105/105105178/

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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	**INTRODUCTIONTOOSANDCONCEPTSOFPROCESSANDTHRE ADING**	**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,PAGEREPLACEMENTANDACCESS INGFILES 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,thiscoursecoversfundamentalconcepts and principles of operatingsystems. ● https://www.coursera.org/specializations/codio-introduction-operating-systems
2	**edX:"IntroductiontossOperatingSystems"** ● ProvidedbyGeorgiaInstituteofTechnology,thiscourseexploresthedesignandimplementation 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

R23MCIVL001	**SURVEYING FIELD WORK**		L	T	P	C
	Total Contact Hours	45 (P)	L	T	P	C
	Pre-requisite	Nil	0	0	3	2

Course Objective: To imbibe the expertise of various field relevant surveying techniques by using instruments like auto level, theodolite, total station and DGPS.

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

1	Measure linear distances, angles and levels using different surveying instruments (theodolite, auto level, total station) (**BL6**)
2	Plot longitudinal or transverse profile through profile levelling. (**BL6**)
3	Develop a contour map (**BL6**)
4	Stake out a given set of points/area. (**BL6**)
5	Prepare a plan/ map of a given area/ plot. (**BL6**)
6	Set out a given plan on the field. (**BL6**)

LIST OF EXPERIMENTS	
1	Linear measurements, measuring height of a remote point using theodolite.
2	Profile levelling and cross sectioning of a road using auto level
3	Preparation of Contour map of a given area by taking levels and linear measurements.
4	Taking direct and indirect measurements using total station (includes orientation, Remote elevation method, missing line method)
5	Measuring the area of a plot using total station.
6	Stake out a plan/map using total station.
7	Preparing a plan/map using total station.
8	Setting out a given plan on the field.

Demo Experiments	
1	Measuring an area, developing Digital Elevation Model using DGPS
2	Stake out map using the DGPS.
3	Preparing a plan/map using DGPS

LEARNING RESOURCES	

TEXT BOOKS:

1	Chandra A M, "Plane Surveying and Higher Surveying", New age International Pvt. Ltd., Publishers, New Delhi.
2	Duggal S K, "Surveying (Vol – 1 & 2), Tata McGraw Hill Publishing Co. Ltd. New Delhi.
3	Arthur R Benton and Philip J Taety, Elements of Plane Surveying, McGraw Hill.

REFERENCE BOOKS:

1	Surveying and levelling by R. Subramanian, Oxford university press, New Delhi
2	Arora K R "Surveying Vol 1, 2 & 3), Standard Book House, Delhi.
3	Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi.
4	IS 1200 (Part 1) : 1992, Methods of Measurement of Building And Civil Engineering Works, Part 1: Earthwork
5	IS code SP:27-1987, Handbook of Method of Measurement of Building Works

R23MCIVL002	**CONSTRUCTION MATERIAL TESTING LABORATORY**					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**0**	**0**	**3**	**2**

Course Objective: To enable the students to have hands-on experience in testing the materials like Cement, Fine aggregate, Coarse aggregate, and bitumen used in building and road construction

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

1	Evaluate the construction materials like Cement, Fine aggregate, Coarse aggregate, and bitumen for their suitability for the construction
2	Assess the quality of construction materials
3	Assess the quality of fresh concrete for workability, hardened concrete for its strength, and bituminous mixes for their stability

<div align="center">LIST OF EXPERIMENTS</div>

1	Determination of Standard Consistency value and specific gravity of given cement sample
2	Determination of Initial and final setting times of given cement sample
3	Determination of Crushing strength and Impact strength of given coarse aggregate sample
4	Determination of Los-Angeles Abrasion value of given coarse aggregate sample as per the gradation chart
5	Determination of Specific gravity of given fine aggregate and coarse aggregate samples
6	Sieve analysis and determination of Flakiness index and elongation index of given coarse aggregate sample
7	Determination of Penetration value and Softening point value of given bitumen sample
8	Determination of Ductility value and Specific gravity of the given bitumen sample
9	Determination of Tensile strength and shear strength of given steel specimens
10	Determination of elastic modulus value of a material using the Deflection test on beams – (a) Simply supported and (b) cantilever
11	Determination of Workability of freshly prepared concrete mix using the– (a) Slump cone test and (b) Compaction factor test
12	Determination of Compressive strength of concrete specimens– (a) Cylinder and (b) Cube

<div align="center">Demo Experiments</div>

1	Determination of the viscosity of given bitumen sample at a specified temperature
2	Determination of Split tensile strength of concrete
3	Determination of Flexure strength of concrete beam on Loading frame setup
4	Concrete Mix design

LEARNING RESOURCES

TEXT BOOKS:

1	Concrete Technology, M. S. Shetty – S. Chand & Co.: 2004
2	Highway Engineering, Khanna S.K., and Justo – Nem Chand Bros

REFERENCE BOOKS:	
1	Properties of concrete, A. M. Neville – PEARSON – 4th edition
2	Relevant IS Codes
3	MORT&H, Specifications for Road and Bridge Works, 2013 (Fifth Revision), IRC, New Delhi
ADDITIONAL REFERENCE MATERIAL	
1	https://www.vlab.co.in/broad-area-civil-engineering

R23MCSCL001	**DATA STRUCTURES & ALGORITHMS LAB** **(for MEC, ECE, EEE, CIV and CHE)**					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Programming	**0**	**0**	**3**	**2**

Course Objective

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

Course Outcomes

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

LIST OF EXPERIMENTS

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

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

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

	STRUCTURAL ANALYSIS					
R23MCIVT007	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	Engineering Mechanics, Strength of materials	**3**	**0**	**0**	**3**

Course Objective

To equip students with theoretical concepts and analytical skills necessary to analyze different types of structures like beams, frames, and trusses using Force and displacement methods.

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

1	Analyse simply supported and cantilever beams for slope and deflection. (BL4)
2	Analyze statically indeterminate beams using slope deflection method. (BL4)
3	Analyze statically indeterminate beams using moment distribution method. (BL4)
4	Analyze the indeterminate plane truss using stiffness method (BL4)
5	Develop Influence Line Diagrams and analyze simply supported beams subjected to moving loads. (BL4)
6	Design different types of structures like beams, frames, and trusses using Force and displacement methods (BL6)

SYLLABUS

UNIT 1	INTRODUCTION AND DISPLACEMENTS OF DETERMINATE STRUCTURES	8 Hrs.

Introduction to Structural Analysis, Definition and classification of structure, element/member and joint/support; Degree of static - kinematic indeterminacy.
Slope and deflection using Macaulay's method and moment Area method for Simply supported and Cantilever beams subjected to Point Load and uniformly distributed loads.

UNIT 2	SLOPE DEFLECTION METHOD	8 Hrs.

Introduction to Slope deflection method, development of Slope – deflection equations; Analysis of propped cantilever; Continuous beams with extreme ends fixed, one extreme end fixed and other simply supported, extreme ends simply supported, One end with overhang, continuous beams with and without sinking of supports.

UNIT 3	MOMENT DISTRIBUTION AND SUBSTITUTE FRAME METHOD	8 Hrs.

Introduction to moment distribution, Analysis of propped cantilever, Continuous beams with extreme ends fixed, one extreme end fixed and other simply supported, extreme ends simply supported, One end with overhang, Non-sway Portal Frame; Approximate methods, Substitute frame method for vertical loads, Loading condition, maximum Bending Moment and Maximum Shear Force.

UNIT 4	STIFFNESS METHOD FOR ANALYSIS OF PIN-JOINTED TRUSSES	8 Hrs.

Introduction to Stiffness matrix methods, formulation of element Stiffness matrix of axial loaded element in Local and global coordinate systems, Analysis of two dimensional trusses with kinematic indeterminacy up to 3, Development of total stiffness matrix, Joint displacements, Support reactions and Internal forces

UNIT 5	MOVING LOADS AND INFLUENCE LINES	8 Hrs.

Introduction to moving loads, Concepts of influence lines, ILD for reactions, Shear Force and bending moment - Absolute SF and BM - Point load – UDL larger than

span - UDL shorter than span - Two Point loads - Several Loads are moving	
LEARNING RESOURCES	
TEXTBOOKS:	
1	Structural Analysis", by R.C. Hibbler, Pearson, New Delhi.
2	Structural Analysis", by Vazrani and Ratwani
REFERENCE BOOKS:	
1	Theory of Structures", by R S Khurmi, S Chand Publication Company Ltd.
2	Analysis of Structures", by Thandava Murthy, Oxford University Press, Edition2011
3	Theory of Structures Vol. 1 and 2", by S.P. Gupta, G.S. Pandit and R. Gupta, Tata McGraw Hill Publication Company Ltd.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

		SOIL MECHANICS				
R23MCIVT008	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Strength of Materials, Fluid Mechanics	**3**	**0**	**0**	**3**

Course Objective

To make the student understand the soil characteristics by estimating various index and engineering properties of the soil

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

1	Illustrate the formation processes, structure, and properties of different types of soils (BL3)
2	Interpret the soil index properties and classify soils based on index tests and permeability behaviour. (BL3)
3	Analyze effective stress conditions and seepage flow to assess soil stability. (BL4)
4	Examine the stress distribution and compressibility behaviour of soils under vertical loads. (BL4)
5	Examine the shear strength of soils using various theoretical and empirical methods. (BL4)
6	Develop a deep understanding of soil behavior or soil characteristics from the index and engineering properties. (BL6)

SYLLABUS		
UNIT 1	**INTRODUCTION TO SOIL FORMATION**	**8 Hrs.**
Formation of soil; Types of soil; Phase system; Phase relationships; Soil structure; Clay minerology; Types of clay minerals; Soil water		
UNIT 2	**INDEX PROPERTIES, SOIL CLASSIFICATION AND PERMEABILITY**	**8 Hrs.**
Index properties of soil – Particle size distribution analysis; Consistency of soil; Unified soil classification system; Indian standard soil classification system; Permeability - One dimensional flow Darcy's law; Measurement of permeability; Factors affecting permeability; Permeability through stratified soils		
UNIT 3	**EFFECTIVE STRESSES AND SEEPAGE THROUGH SOILS**	**8 Hrs.**
Types of stresses; Types of heads; Principle of effective stress; Capillarity; Quicksand condition; Seepage through soils; Two-dimensional seepage flow; Flow nets		
UNIT 4	**VERTICAL STRESSES AND COMPRESSIBILITY OF SOILS**	**8 Hrs.**
Stress distribution in soils – Boussinesq's theory, Pressure bulbs; Compaction of soils – Factors affecting; Mechanical properties affected by compaction; Field compaction; Consolidation – One-dimensional consolidation theory; Stress history; Consolidation settlement; Time rate of consolidation		
UNIT 5	**SHEAR STRENGTH OF SOILS**	**8 Hrs.**
Shear Strength importance; Mohr-Coulomb failure theory; Shear strength tests; Effective and total shear strength parameters; Stress-Strain characteristics of clays and sand.		

LEARNING RESOURCES	
TEXTBOOKS:	
1	K. R. Arora, "*Soil Mechanics and Foundation Engineering*," Standard Publishers Distributors, Delhi, 2008.

2	Gopal Ranjan & ASR Rao, "*Basic and Applied Soil Mechanics*", New Age. International Publishers, Delhi, 2000.
REFERENCE BOOKS:	
1	Taylor, Donald W. "*Fundamentals of soil mechanics*". Vol. 66, no. 2. John Willey and Sons, London, 1948
2	Lambe, T.W. and Whitman, R.V. "Soil Mechanics. John Wiley & Sons", New York, 1969.

BLOOM'S LEVEL – UNITS CATCHMENT ARTICULATION MATRIX

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

	OPEN CHANNEL HYDRAULICS					
R23MCIVT009	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Fluid Mechanics	**3**	**0**	**0**	**3**

Course Objective

This course aims to help students understand the principles of open channel flows and enable them to design water conveyance systems through open channels predominantly used in water resources management.

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

1	Determine uniform flow velocity in open channels **(BL3)**
2	Determine the most economical sections and specific energy for various flow conditions **(BL3)**
3	Analyze the channel sections provided with transitions (horizontal & vertical) using the concept of specific energy **(BL4)**
4	Sketch GVF profiles and analyze RVF in open channel flows. **(BL3)**
5	Identify various components of hydropower plant/hydraulic structures. **(BL3)**
6	Design water conveyance systems through open channels for various conditions using open channel flow principles. **(BL6)**

	SYLLABUS	
UNIT 1	**INTRODUCTION TO OPEN CHANNELS AND UNIFORM FLOW**	**8 Hrs.**

Introduction to Open Channel flow

Pipe flow Vs Open channel flow – Types of channels & flows; Geometrical properties; Velocity distribution; Energy and Momentum Correction factors.

Uniform flow

Uniform flow equations – Chezy's equation, Manning's formula.

UNIT 2	**MOST ECONOMICAL SECTIONS AND SPECIFIC ENERGY**	**8 Hrs.**

Most economical sections

Conditions for Rectangular, Triangular, Trapezoidal, and Circular sections

Specific Energy

Concept of Specific energy; Specific energy-depth curve; Characteristics of critical state of flow - Critical depth & discharge; Computation of critical depths.

UNIT 3	**APPLICATIONS OF SPECIFIC ENERGY AND GVF**	**8 Hrs.**

Applications of Specific Energy

Applications of Specific energy; Channel transitions – Reduction in width and Hump analysis; Brief introduction to Venturi-flume.

GVF

Introduction; Dynamic equation of GVF; Other forms of GVF equation.

UNIT 4	**GVF SURFACE PROFILES AND RVF GOVERNING EQUATION**	**8 Hrs.**

Channel slopes, Surface profiles; Characteristics of surface profiles; Direct Step Method; Surface profiles for practical problems.

Introduction to Hydraulic Jump, Concept of specific force and specific force curve – Governing equation for RVF; Hydraulic jump in rectangular channels – Sequent depth ratio – Energy loss; Introduction to Surges.

UNIT 5	**INTRODUCTION TO HYDRAULIC STRUCTURES**	**8 Hrs.**

Hydropower plant – layout and classification; Dams – types – site and type selection; Reservoir – types- classification; Weirs and Barrages – Layout of a barrage; Spillways – types – applications for energy dissipation.

LEARNING RESOURCES	
TEXTBOOKS:	
1	K. Subramanya, *Flow in Open Channels,* McGraw-Hill Education (India) Publishers.
2	P. N. Modi, S. M. Seth, *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, Standard Book House Publishers.
3	A. K. Jain, *Fluid Mechanics including Hydraulic Machines,* Khanna Publishers
REFERENCE BOOKS:	
1	V. T. Chow, *Open Channel flow,* McGraw-Hill Education (India) Publishers.
2	Yunus A. Cengel, John M. Cimbala, *Fluid Mechanics-Fundamentals and Applications*, McGraw-Hill Education (India) Publishers.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

	BUILDING PLANNING & DRAWING					
R23MCIVT010	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Computer Aided Engineering Drawing	**3**	**0**	**0**	**3**

Course Objective

The course aims to equip the students with comprehensive knowledge about building bye-laws, residential and public building planning, and the drafting of building drawings.

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

1	Apply appropriate building bye-laws and classification standards to different types of buildings. (BL3)
2	Apply standard spatial requirements to develop functional residential building layouts. (BL3)
3	Analyze planning principles and design criteria for public building layouts.(BL4)
4	Analyze residential building drawings to verify spatial organization, circulation, and compliance with regulations.(BL4)
5	Evaluate public building drawings based on building codes, user requirements, and functional performance.(BL5)
6	Create drawings for residential and public buildings by integrating building regulations, planning standards, and spatial requirements. (BL6)

SYLLABUS		
UNIT 1	**BUILDING BYE-LAWS & REGULATIONS**	**8 Hrs.**

Objectives of building bye-laws; Principles underlying building bye-laws; Building Classification; Development Control Rules of buildings; General Building Requirements as per NBC; Open space, Lighting, and ventilation requirements; Floor area ratio & Floor space index; Built up area and Height of Buildings limitations

UNIT 2	**PLANNING OF RESIDENTIAL BUILDINGS**	**8 Hrs.**

Types of Residential buildings; Minimum standards for various parts of Sub-structure; Minimum standards for various parts of Super-structure; Requirements of different rooms; Standards for different rooms and their grouping; Standards for Doors; Standards for Windows; Standards for Ventilators

UNIT 3	**PLANNING OF PUBLIC BUILDINGS**	**8 Hrs.**

Types of Public buildings; Minimum standards for various parts of Sub-structure; Minimum standards for various parts of Super-structure; Requirements of different rooms; Standards for different rooms and their grouping; Standards for Doors; Standards for Windows; Standards for Ventilators

UNIT 4	**RESIDENTIAL BUILDING DRAWING**	**8 Hrs.**

Drawing of residential building; Making line diagram; Site plan; Floor plan; Elevation; Sectional view; Conventional signs and Special signs; Specifications

UNIT 5	PUBLIC BUILDING DRAWING	8 Hrs.

Drawing of public building; Making line diagram; Site plan; Floor plan; Elevation; Sectional view; Conventional signs and Special signs; Specifications

LEARNING RESOURCES

TEXTBOOKS:

1	"Building Planning and Drawing", by N. Kumaraswamy and A. Kameswararao, Charotar Publishing House Pvt. Ltd.
2	"Building Planning Designing and Scheduling", by Gurcharan Singh & Jagdish Singh, Standard Publishers Distributors.

REFERENCE BOOKS:

1	Drawing and Design of Residential and commercial Building", by Zaidi S. Kaleem A. Label Book Publisher: New Delhi Standard Pub.
2	"Civil engineering drawing and design", by Ghose, CBS Publisher.

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

SYLLABUS

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

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

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

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

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

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

Unit IV	**FILES AND PANDAS**	**8 hr**

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

Unit V	**TKINTER GUI, EVENT DRIVEN PROGRAMMING, WIDGETS**	**8 hr**

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

LEARNING RESOURCES

TEXTBOOKS:

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

REFERENCE BOOKS:

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

ONLINE COURSES

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

Bloom's level – Units catchment articulation matrix

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

R23MSCST010	**DATABASE MANAGEMENT SYSTEMS** **(Common to all branches)**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**3**	**0**	**0**	**3**

Course Objective

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

Course Outcomes

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

SYLLABUS

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

Need for DBMS, Advantages of DBMS over File Systems, Database applications; Database Users, Different Data Models; 3 Levels of Abstraction in DBMS (External, Conceptual & Physical Schema) and data independence, Database Management System Structure.; Introduction to ER Model, Entity, Entity Set, Attribute – Entity Vs Attribute;

Relationship & Relationship Set – Entity Vs Relationship – Binary Relationship, Ternary Relationship; Introduction to Keys (Candidate Key, Primary Key, Super Key, Unique Key, Not Null Key) – Modeling Key Constraints; Modeling Weak Entities – Mapping concept of Weak Entities to Composite, Primary Key Concept, Referential Integrity Constraint (include cascaded operations of Delete & Update) ; Modeling Participation Constraints – Cardinality, Full participation & Partial, Modeling Class Hierarchies – Mapping concept of class Hierarchies to covering constraints, Modeling Aggregation – Ternary Vs Aggregation;

Unit II	**RELATIONAL ALGEBRA & RELATIONAL CALCULUS**	**8 hr**

Introduction to Relational Model (Translating Entity Set & Relationship set into Tables) ; Introducing Basic operations on Relations: Selection and Projection , Cartesian product, examples;   Introducing Basic operations on Relations : Joins, Set Operations and examples ; Introducing Basic operations on relations: Division

& Renaming and example;
Syntax & Semantics of Tuple Relational Calculus (notations used to represent a query using DRC); Syntax & Semantics of Domain Relational Calculus (notations used to represent a query using DRC); TRC, DRC Query representations using AND, OR, NOT OPERATORS; IMPLIES operator , Comparison between TRC and DRC;

Unit III	SQL (STRUCTURED QUERY LANGUAGE)	8 hr

Basic Structure of SQL queries(Basic format of select query, DDL,DML commands) ; Integrity and Referential constraints (Includes syntax for all key constraints, Translating Constraints associated with ER into Tables); Additional Basic Operations(Arithmetic, logical, relational, pattern matching); Functions(String, Date, Numeric);
Aggregate Functions, Clauses and Set Operations; Join Expressions; Nested Queries, Correlated Queries; Introduction to Views, Destroying/Altering/Updating of views, Handling Null values;

Unit IV	NORMALIZATION	8 hr

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

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

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

LEARNING RESOURCES	
TEXTBOOKS:	
1	Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition. McGrawHill.
2	Data base Management Systems, Raghurama Krishnan, Johannes Gehrke
REFERENCE BOOKS:	
1	Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
2	An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III.

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

BLOOM'S LEVEL – UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVL003	CAD AND GIS LABORATORY						
	Total Contact Hours	45(P)		**L**	**T**	**P**	**C**
	Pre-requisite	Structural Analysis		**0**	**0**	**3**	**2**

Course Objective

The students shall get exposure to a computer aided design software and geographical Information system

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

1	Model and analyse idealized pin and rigid jointed plane or space structures in civil engineering using STAAD Pro.
2	Interpret the analysis results from the idealized structure and design as per relevant standard codes using STAAD Pro.
3	Digitize and create thematic map and extract important features
4	Develop digital elevation model and watershed boundaries

LIST OF EXPERIMENTS

Computer Aided Design

1	Analysis and Design of Continuous beam for different types of static loading
2	Analysis and Design of rigid jointed plane frame for different types of static loading
3	Analysis and Design of plane truss
4	Analysis and Design of Multi storey RC framed structure for Dead and Live loads as per IS 875
5	Analysis and Design of Space truss for Dead and Wind load

Geographical Information System

6	Digitization of Map/ Topo sheet
7	Creation of thematic maps.
8	Study of features estimation
9	Developing Digital Elevation model
10	Simple applications of GIS in water Resources Engineering

Additional experiments

1	Analysis and design of pin-jointed plane trusses subjected to moving loads
2	Simple applications of GIS in Transportation Engineering

LEARNING RESOURCES

TEXTBOOKS:

1	STAAD Pro V8I For Beginners: With Indian Examples by T S Sarma, Notion Press
2	Exploring Bentley'S STAAD. Pro Connect Edition. by Prof. Sham Tickoo/TIET, BPB Publications
3	Concepts & Techniques of GIS by C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.

REFERENCE BOOKS:

1	STAAD. Pro Connect edition - Technical Reference Manual.

	SOIL MECHANICS LABORATORY		**L**	**T**	**P**	**C**
R23MCIVL004	Total Contact Hours	45 (P)	0	0	3	2
	Pre-requisite	Soil Mechanics				

Course Objective

To make students perform various tests for determining the index and engineering properties of the soil as well as make them to analyze and interpret the test results

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

1	Identify and classify soil based on particle size distribution analysis and consistency limits of soil
2	Perform laboratory compaction and in-situ density tests useful for quality control
3	Estimate permeability characteristics and swelling nature of soil
4	Perform shear tests, interpret the results and estimate shear strength parameters

List of Experiments

1	Determination of grading characteristics of coarse-grained soil and classify the soil by conducting dry mechanical analysis
2	Determination of liquid limit of soil
3	Determination of plastic limit and shrinkage limit of soil
4	Determination of field dry density of soil by core cutter and sand replacement method
5	Determination of hydraulic conductivity of soil (permeability) by constant head method
6	Determination of hydraulic conductivity of soil (permeability) by variable head method
7	Determination of OMC and MDD values of soil by IS light weight compaction method and specific gravity of soil solids by density bottle method
8	Determination of undrained shear strength of soil by conducting unconfined compressive strength test
9	Determination of shear strength of soil by direct shear test
10	Determination of CBR value of soil by performing CBR Test

Additional experiments

1	Determination of shear strength of soil by Vane shear test
2	Determination of liquid limit of soil by cone penetration test
3	Classify the fine-grained soil by conducting wet mechanical analysis – Hydrometer method

Demonstration experiments

1	Determination of compressibility parameters by Consolidometer test apparatus
2	Determination of shear strength of soil by Tri-axial test

LEARNING RESOURCES

TEXTBOOKS:

1	K. R. Arora, "Soil Mechanics and Foundation Engineering," Standard Publishers Distributors, Delhi, 2008.
2	IS1498-1970,"IS code of Practice for classification and identification of soils for general engineering purposes" Bureau of Indian Standards, NewDelhi

REFERENCE BOOKS:

| 1 | IS 2720, "IS code of Practice for methods of test for soils. (Latest Edition)". Bureau of Indian Standards, New Delhi. |

R23MSCSL005	**PYTHON PROGRAMMING LAB** **(Common to all branches)**					
	Total Contact Hours	42 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	C Programming	**0**	**0**	**3**	**2**

Course Objective

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

Course Outcomes

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

List of Experiments

1	**Week – 1: DATA TYPES, OPERATORS, BUILT-IN FUNCTIONS** 1. Write a python script to illustrate data types (int, char, float, string). 2. Write a python program to perform the following expressions using operator precedence (1) 5+3*2 (2) 2*3**2 (3) 2**3**2 (4) (2**3)**2 3. Write a python program to illustrate type conversion functions 4. Write a python program to illustrate pi, sqrt, cos, sin functions of math module
2	**Week – 2: PROGRAMS WITHOUT CONTROL STATEMENTS** 1. Write a program to calculate simple interest 2. Write a python program to calculate compound interest 3. Write a python program to print ASCII value of a character 4. Write a python program to find the area of a circle 5. Write a python program to find the area of a triangle 6. Write a program to perform string concatenation
3	**Week – 3: PROGRAMS ON NUMPY MODULE** 1. Write a program to work with 1D array operations including indexing and slicing. 2. Write a program to work with 2D array operations
4	**Week – 4: PROGRAMS ON CONTROL STATEMENTS**

	1. Write a python program find the power of a number without built-in functions. 2. Write a python program to count the number of even and odd numbers upto the given range. 3. Write a python program to print the multiplication table for a given number. 4. Write a python program to display minimum and maximum among three numbers.
5	**Week – 5: PROGRAMS ON FUNCTIONS** 1. Write a python program to find if a number is prime or not with and without recursion. 2. Write a python program to display Fibonacci series using iteration and recursion. 3. Write a python program to find the factorial of a number with and without recursion.
6	**Week – 6: PROGRAMS ON STRINGS** 1. Write a program to work with string built-in functions 2. Write a python program to determine number of times a given letter occurs in a string 3. Write a python program to check if a string is a palindrome or not. 4. Illustrate in operator and write a python program to count number of lowercase characters in a string. 5. Write a program to replace all the occurrences of letter 'a' with letter 'x' in a string.
7	**Week – 7: PROGRAMS ON LISTS** 1. Write a program to implement the following list functions a)len() b)extend() c)sort() d) append() e)insert() f)remove() 2. Write a program to pass list as an argument to a function 3. Write a python program to find the largest and smallest number in a list. 4. Write a python program to merge two lists and sort it. 5. Write a python program to remove the duplicate items from a list. 6. Write a python program to find sum of elements in a list
8	**Week – 8: PROGRAMS ON TUPLES , DICTIONARIES** 1. Write a program to create a list of tuples with the first element as the number and the second element as the square of the first element. 2. Write a python program that takes the list of tuples and

	sorts the list of tuples in increasing order by the last element in each tuple.
	3. Write a program to implement the following dictionary methods a) keys() b) values() c)items() d) pop() e)delete()
	4. Write a python program to add a key value pair to a dictionary and update the dictionary based on the key.
	5. Write a Program to do a reverse dictionary lookup in python.
9	**Week – 9: PROGRAMS ON FILES** 1. Write a program to implement read(), readline(), readlines(), write(), writelines() methods on files. 2. Write a program to implement seek(), tell() and flush() methods with different arguments in a file. 3. Write a program to generate 20 random numbers in the range of 1 to 100 and write to a file.
10	**Week – 10: PROGRAMS ON PANDAS MODULE** 1. Write a program to import data from CSV to DataFrame and inspect data in DataFrame using head(), tail (), info() and describe() functions in pandas. 2. Write a program to perform sorting and slicing operations in pandas. 3. Write a program to perform dataframe modification and data cleaning in pandas.
11	**Week – 11: PROGRAMS ON GUI** 1. Design and develop a GUI application to display -Hello World. 2. Design and develop a GUI application using Label, Entry and Button widgets. 3. Design and develop a GUI application using Tkinter Geometry methods pack(),grid(), place(). 4. Design and develop a GUI application using CheckButton and Radiobutton widgets.
12	**Week – 12: PROGRAM ON GUI CONTI...** 1. Design and develop a GUI application using Menu and Menubutton widgets. 2. Design and develop a GUI application using Listbox and Scrollbar widgets. 3. Design and develop a GUI application using Messagebox and File Dialog widget
Demonstration experiments	
1	Demonstration of Python IDLE to implement solutions.
2	Demonstration on Colab notebook to read, access and display data from google drive.

3	Demonstration on jupyter notebook to link and access data.

LEARNING RESOURCES

TEXTBOOKS:

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

REFERENCE BOOKS:

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

ADDITIONAL REFERENCE MATERIAL

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

	ETHICS & HUMAN VALUES					
R23MENGAT01	Total Contact Hours	28 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	…..	**2**	**0**	**0**	**-**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

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

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

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

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

Unit III	**ETHICAL THEORIES**	**5 hrs**

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

Unit IV	**ETHICS AND ENGINEERING**	**5 hrs**

Engineering ethics - Social Experimentation; Safety Responsibility and Rights: Engineers as responsible Experimenters, Concept of Safety and Risk: Engineer's Responsibility for Safety, Risk – Benefit Analysis.

Case Studies: The challenger disaster, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy, The Titan submersible disaster.

Unit V	ETHICS AND GLOBAL ISSUES	5 hrs

Ethics and Global Issues: Environmental ethics; computer ethics; Business Ethics; Corporate
Social responsibility; Code of ethics.

LEARNING RESOURCES

TEXTBOOKS:

1	R R Gaur, R Sangal, G P Bagaria, "*A Foundation Course in Human Values and Professional Ethics*" Excel Books, New Delhi, 2010.

REFERENCE BOOKS:

1	A.N. Tripathi, "*Human Values*", 2nd Edition, New Age International Publishers, 2004.
2	Charles D. Fleddermann, "*Engineering Ethics*", Pearson Education / Prentice Hall, New Jersey, 2004.

Bloom's level - Units catchment articulation matrix

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

R23MCIVT011	DESIGN OF REINFORCED CONCRETE STRUCTURES					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite	Strength of Materials, Structural Analysis, Construction Materials and Concrete Technology and Engineering Mechanics	3	0	0	3

Course Objective

Students will get exposure to the design principles of reinforced concrete elements such as beams, columns and footings.

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

1	Apply the limit state design philosophy to analyze and design singly reinforced concrete beams as per IS code provisions. (BL3)
2	Apply fundamental concepts and codal guidelines to design doubly reinforced beams and one-way slabs under specified loading conditions. (BL3)
3	Apply IS code procedures to design reinforced concrete beams for shear, torsion, bond, and anchorage. (BL3)
4	Analyze the behavior of short columns under axial and uniaxial bending loads and interpret results using IS code and SP16 charts. (BL4)
5	Analyze the structural requirements for isolated footings under axial and bending loads and develop appropriate design solutions. (BL4)
6	Design reinforced concrete structural members to meet functional requirements and ensure structural stability. (BL6)

SYLLABUS		
UNIT 1	**LIMIT STATE DESIGN PHILOSOPHY AND DESIGN OF SINGLY REINFORCED BEAMS**	8 Hrs.
	Philosophy of limit state method - Materials for reinforced concrete, Stress-strain curves, Stress blocks parameters, Balanced, under-reinforced and over-reinforced sections, Analysis and design of singly reinforced beam	
UNIT 2	**DESIGN OF DOUBLY REINFORCED AND DESIGN OF ONE-WAY SLAB**	8 Hrs.
	Analysis and design of doubly reinforced beam Fundamental concepts of One-way slabs, IS codal provisions, Design of one-way slab	
UNIT 3	**DESIGN OF BEAMS FOR SHEAR, TORSION AND BOND**	8 Hrs.
	Design of RC beams for shear, torsion, bond and anchorage	
UNIT 4	**DESIGN OF SHORT COLUMNS**	8 Hrs.
	Effective length of a column- analysis, design and detailing of short under axial loads and uniaxial bending using IS Code provisions and SP16 Charts**.**	
UNIT 5	**DESIGN OF ISOLATED FOOTINGS**	8 Hrs.
	Different types of footings – Design and Detailing of rectangular and square isolated footings for column subjected to axial loads and uniaxial bending moments	

LEARNING RESOURCES		
TEXTBOOKS:		
1	Limit State Design of Reinforced Concrete, Varghese, P.C., Prentice Hall of India, Pvt. Ltd., New Delhi, E2, 2008	
2	Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press, 2013	
3	Reinforced Concrete: Limit State design, A. K. Jain, Nem Chand & Brothers Publishers, 2007	
REFERENCE BOOKS:		
1	Reinforced concrete design by S. Unnikrishnan Pillai & Devdas Menon, Tata Mc.Graw Hill, New Delhi, E3, 2009	
2	Reinforced Concrete Structures by Park and Pauley, John Wiley and Sons, 2000	
3	IS 456-2000, IS 875 Part 1 and 2, SP 16-1978	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

		ENGINEERING HYDROLOGY				
R23MCIVT012	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Fluid Mechanics, Open Channel Hydraulics	**3**	**0**	**0**	**3**

Course Objective

This course provides foundational knowledge in hydrological processes, rainfall analysis, runoff processes, and essential methods for measuring precipitation, evaporation, infiltration, flood estimation, flood routing, and irrigation water requirements.

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

1	Identify the key components of the hydrologic cycle and Apply various techniques to determine precipitation over a catchment. (BL3)
2	Distinguish DAD and IDF curves and Determine evaporation and evapotranspiration components over a catchment. (BL4)
3	Determine Infiltration, Streamflow and Runoff volumes for a catchment. (BL3)
4	Examine hydrograph analysis methods for estimating flood runoff. (BL4)
5	Distinguish between different routing techniques and Examine irrigation systems based on their application. (BL4)
6	Propose effective water resources management solutions by utilizing the knowledge of hydrologic components. (BL6)

	SYLLABUS	
UNIT 1	**PRECIPITATION**	**8 Hrs.**

Hydrologic cycle, Water-budget equation; Precipitation – forms and weather systems; Measurement of precipitation – gauges and rain gauge network; Optimum number of rain gauges.
Representation of rainfall data – rainfall mass curve, hyetograph; Computation of mean precipitation; Estimation of missing data; Test for consistency.

UNIT 2	**ABSTRACTIONS FROM PRECIPITATION – EVAPORATION, TRANSPIRATION AND EVAPO-TRANSPIRATION**	**8 Hrs.**

Frequency of point rainfall; Depth-Area-Duration Curves, Maximum Intensity-Duration-Frequency (IDF) curves; Probable Maximum Precipitation.
Abstractions from Precipitation
Evaporation process, Measurement of evaporation - Evaporimeters, Empirical evaporation equations; Reservoir evaporation and methods for reduction.
Transpiration & Evapotranspiration processes; Reference ET, Potential ET, Actual ET; Measurement and Estimation of Evapotranspiration – Lysimeters, Analytical and Empirical equations.

UNIT 3	**INFILTRATION, STREAMFLOW, AND RUNOFF**	**8 Hrs.**

Infiltration process; Measurement of infiltration – Infiltrometers, Modelling Infiltration capacity - Horton's Equation; Infiltration Indices.
Streamflow process, Measurement of streamflow.
Runoff – Definition, process, types; Runoff characteristics, catchment characteristics; SCS-CN Method of estimating runoff volume.

UNIT 4	**HYDROGRAPHS**	**8 Hrs.**

Hydrograph – Definition, process, components, factors affecting hydrograph.

Flood hydrograph; Base flow separation; Direct Runoff Hydrograph; Effective Rainfall Hyetograph - Derivation of DRH and ERH.
Unit Hydrograph – Concept, Derivation of Unit hydrographs.
Unit Hydrographs of different durations – Method of superposition and S-curve Method.

UNIT 5	FLOOD ROUTING AND INTRODUCTION TO IRRIGATION ENGINEERING	8 Hrs.

Flood estimation – Rational Method, Gumbel's Method.
Flood routing – Hydrologic and Hydraulic routing - Muskingham method of hydrologic routing.
Irrigation Engineering – Introduction, types of irrigation systems; Water requirement of a crop – Base period, Duty, and Delta; Soil water plant relationship – soil moisture constants – field capacity, wilting point, available moisture, depth, and frequency of irrigation.

LEARNING RESOURCES	

TEXTBOOKS:

1	K. Subramanya, *Engineering Hydrology,* McGraw-Hill Education (India) Publishers.
2	H. M. Raghunath, *Hydrology: Principles, Analysis and Design*, New Age International Publishers.
3	C. S. P. Ojha, P. Bhunya, and R. Berndtsson, *Engineering Hydrology*, Oxford University Press

REFERENCE BOOKS:

1	L. W. Mays, *Water Resources Engineering*, Wiley
2	V. T. Chow, D. R. Maidment, and L. W. Mays, *Applied Hydrology*, McGraw-Hill Education (India) Publishers.

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	BL4					X
CO6	BL6	X	X	X	X	X

R23MCIVT013	CONSTRUCTION TECHNOLOGY AND PROJECT MANAGEMENT					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**3**	**0**	**0**	**3**

Course Objective

To equip students with the knowledge, skills, and techniques necessary for effective construction project management, equipment utilization, and application in order to successfully plan, execute, and monitor construction projects while optimizing resources and costs.

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

1	Apply knowledge of construction types, equipment, and technological innovations to select appropriate construction methods and machinery considering project and economic requirements. **(BL3)**
2	Apply knowledge of construction equipment to select and use appropriate machinery for various construction operations effectively. **(BL3)**
3	Analyze construction project data to develop effective schedules and coordination plans using basic project management tools. **(BL4)**
4	Analyze project activities using scheduling techniques to determine critical paths and optimize project timelines. **(BL4)**
5	Analyze project performance and resource plans to identify factors affecting cost, time, and resource utilization in construction projects **(BL4)**
6	Design and develop an integrated construction project plan by selecting appropriate technologies, equipment, scheduling methods, and resource control strategies to ensure efficient execution and management. **(BL6)**

SYLLABUS

UNIT 1	**CONSTRUCTION TECHNOLOGY**	**8 Hrs.**

Types of constructions – Role of technology in the construction industry – Types of common activities in construction – Types of construction equipment – Selection and economic considerations – Identification of equipment related to earthwork, concreting, and road laying.

UNIT 2	**CONSTRUCTION EQUIPMENT AND APPLICATIONS**	**8 Hrs.**

EARTHWORK EQUIPMENT: Excavator – Wheel loader – Backhoe – Scraper.
HAULING EQUIPMENT: Dump trucks – Capacities of trucks – Calculation of truck production.
HOISTING EQUIPMENT: Chain hoists – Hoist cranes – Tower cranes – Draglines.
HANDLING EQUIPMENT: Hand trolleys – Conveyor belts – Forklift – Pallet truck – Skidder – Clamshell bucket.
COMPACTION EQUIPMENT: Factors affecting compaction – Types – Dynamic roller.
ROAD LAYING EQUIPMENT: Tractor – Bulldozer – Grader – Paver.
CRUSHERS: Jaw crushers – Gyratory crushers – Impact crushers.

CONCRETING EQUIPMENT: Concrete mixers – Ready mix concrete – Concrete pumps – Vibrators – Stages of concreting.		
UNIT 3	**CONSTRUCTION MANAGEMENT**	**8 Hrs.**
Construction management and its relevance – Qualities of a project manager – Project planning – Coordination – Scheduling – Monitoring – Bar charts – Milestone charts – Elements of network – Introduction to network diagram – Guidelines for the construction of the network diagram.		
UNIT 4	**PROJECT SCHEDULING TECHNIQUES: PERT AND CPM**	**8 Hrs.**
PERT NETWORK: Development of network – Numbering – Time estimates: Optimistic, most likely, Pessimistic – Earliest expected time – Latest allowable occurrence time. **CPM NETWORK**: Terminology – Construction of network – Earliest and latest start and finish times – Floats – Slack – Identification of critical path.		
UNIT 5	**PROJECT CONTROL AND RESOURCE MANAGEMENT**	**8 Hrs.**
Probability of project completion using PERT – Identification and management of buffer periods – Updating and revising network schedules – Cost-time trade-offs (introduction to crashing) – Resource allocation and leveling – Overview of Earned Value Management (EVM) – Case studies on real-world project planning and control.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	"Construction Project Management Theory and Practice' by Kumar Neeraj Jha (2011), Pearson.	
2	"Construction Technology", Subir K Sarkar, Subhajit Saraswati, Oxford University Press Publications.	
REFERENCE BOOKS:		
1	"Construction Project Management - An Integrated Approach' by Peter Fewings, Taylor and Francis	
2	"Construction Management Emerging Trends and Technologies' by Trefor Williams, Cengage 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	BL3		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

		HIGHWAY ENGINEERING				
R23MCIVT014	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**3**	**0**	**0**	**3**

Course Objective

 To introduce the concepts of highway planning, geometric design of highways, highway material requirements and pavements structural design methods

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

1	Distinguish the types of roads and surveys used for highway planning. (BL4)
2	Apply geometric design concepts to design highways. (BL3)
3	Examine the various design factors and methods for pavement structural design. (BL4)
4	Analyze different pavement constructions, rehabilitation and preservation strategies for better pavement performance. (BL4)
5	Examine different properties of bituminous mix for its suitability in highway construction and Discuss traffic studies. (BL4)
6	Develop an analysis of different surveys, properties, methods and materials used for pavements. (BL6)

SYLLABUS		

UNIT 1	HIGHWAY ALIGNMENT AND SURVEYS	8 Hrs.

Jayakar Committee recommendations, Twenty-year Road development plans, Classification of roads, Road network patterns, Planning Surveys – Economic, Financial, Traffic, Engineering studies,
Highway Alignment and requirements of alignment, factors affecting alignment, Engineering Surveys –Map, Reconnaissance, Preliminary & Detailed surveys, Pavement surface characteristics – Friction, Unevenness, light reflecting characteristics, Camber

UNIT 2	HIGHWAY GEOMETRIC DESIGN	8 Hrs.

Carriageway, Medians, Kerbs, Road margins, right of way, Width of formation, Sight Distance Elements-Stopping Sight Distance & Overtaking Sight Distance
Design of Horizontal Alignment - Super elevation, Extra widening, Transition Curves, Design of Vertical alignment - Gradients, Vertical curves.

UNIT 3	PAVEMENT STRUCTURAL DESIGN	8 Hrs.

Types of Pavements – Flexible, Rigid, semi rigid, Functions of pavement components, Design factors, Flexible Pavement Design Methods: CBR method, IRC method,
Differences between flexible and rigid pavements, Design factors, Design Considerations: wheel load stresses, temperature stresses, frictional stresses, combination of stresses

UNIT 4	PAVEMENT CONSTRUCTION METHODS AND PAVEMENT DISTRESSES	8 Hrs.

Flexible pavement materials and their properties, Construction of water bound macadam roads, Construction of bituminous pavements – Bituminous macadam, Penetration Macadam, Built up spray grout, Rigid pavement materials and their properties, Construction of cement concrete pavements – Slip form paver, Fixed form, Labor oriented methods
Distresses in flexible pavements, Maintenance measures for flexible pavements, Distresses in rigid pavements, Maintenance measures for rigid pavements

UNIT 5	BITUMINOUS MIX DESIGN AND TRAFFIC STUDIES	8 Hrs.

Desirable properties of bituminous mix, Properties of design mix, Marshall mix design, Marshall stability test

Road and Vehicular characteristics, Traffic Studies - Speed Studies, Volume Studies and Accident Studies

LEARNING RESOURCES

TEXTBOOKS:

1	Highway Engineering, SK Khanna, CEG Justo, A Veeraragavan, Nem Chand Bros. Publications.
2	Specifications for Roads and Bridges - Manual for Maintenance of roads, MORTH Publications.
3	Principles of Highway Engineering, Kadiyali LR, Khanna Publishers.

REFERENCE BOOKS:

1	Fundamentals of Transportation Engineering, CS Papacostas, Prentice Hall Publications.
2	Traffic and Highway Engineering, Nicholas J Garber, Lester A Hoel, Cengage Learning Publications.
3	IRC SP- 019: Manual for Survey, Investigation and Preparation of Road Projects.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVT019 DSC-E1	**BUILDING CONSTRUCTION AND SERVICES**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Building Materials, Building Planning	**3**	**0**	**0**	**3**

Course Objective

This course is designed to provide an in-depth understanding of building components, finishing techniques, and construction procedures, encompassing both sub-structure and super-structure elements. It aims to enhance awareness of building services, green building construction principles, and the use of sustainable materials in eco-friendly construction.

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

1	Examine and articulate the stages, standards, and requirements of residential building construction based on NBC guidelines and building classifications. **(BL4)**
2	Evaluate different masonry techniques and materials, including types of bonds and dressing methods, to determine suitable applications in construction. **(BL5)**
3	Analyze various finishing techniques like plastering, pointing, and flooring to identify appropriate methods for building construction. **(BL4)**
4	Evaluate building service systems including plumbing, HVAC, fire safety, and acoustics to ensure functionality and safety in building design. **(BL5)**
5	Examine the principles of green building design by evaluating sustainable practices in energy, water use, materials, and waste management. **(BL4)**
6	Combine the knowledge about construction stages, masonry, finishes, services, and sustainable practices and create a basic building plan. **(BL6)**

SYLLABUS		
UNIT 1	**INTRODUCTION TO BUILDING CONSTRUCTION**	8 Hrs.

Introduction to Building construction– Classification of buildings – Development Control Rules and General Building Requirements as per NBC-Types of Building construction – Stages of Building construction – Minimum standards for various parts of residential buildings – Characteristics of various types of residential buildings – Activities required for Building construction.

UNIT 2	**MASONRY IN BUILDING CONSTRUCTION**	8 Hrs.

Stone Masonry-Introduction &Types – Methodology – Dressing of stones – General principles of Stone masonry.
Brick Masonry-Introduction and Types of Brick bonds – Methodology – General principles of Brick masonry – Latest advances in masonry blocks.

UNIT 3	**FINSHINGS, AND FLOORING**	8 Hrs.

Plastering-Introduction and Terminology – Types of Plastering and Methodology – Defects in Plastering and general principles.
Pointing-Introduction and Terminology – Types of Pointing and methodology – General principles of Pointing.
Flooring-Introduction and types of Flooring-Methodology and General principles

of Flooring.		
UNIT 4	**BUILDING SERVICES**	**8 Hrs.**

Building Services-Introduction and Importance – Plumbing and water supply systems-Electrical systems-HVAC-Fire safety and protection systems-Mechanical systems-Accoustics and sound insulation-BIM for building services.

UNIT 5	**GREEN BUILDINGS**	**8 Hrs.**

Green buildings- Introduction and importance–Sustainable site planning and design-Energy efficiency-Water efficiency-Sustainable materials-Indoor environmental quality-Construction practices and technologies-waste management.

LEARNING RESOURCES		
TEXTBOOKS:		
1	"Building Construction", PC Varghese, PHI Publications.	
2	"Construction Technology", Subir K Sarkar, SubhajitSaraswati, Oxford University Press Publications.	
REFERENCE BOOKS:		
1	"Building Construction Vol. 1,2 and 3" , WB McKay, Pearson Publications.	
2	"Green building A to Z: Understanding the Language of Green Building", Jerry Yudelson, New Society Publications.	
ADDITIONAL REFERENCE MATERIAL		
1	https://www.bis.gov.in/standards/technical-department/national-building-code/	

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

R23MCIVT028 DSC-E1	**EARTH SCIENCES**				
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	None	**3**	**0**	**0**	**3**

Course Objective

To equip students with a fundamental understanding of Earth Sciences, enabling them to analyze geological processes, assess geohazards, and apply mineralogical and petrological principles for designing safe and sustainable civil engineering structures.

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

1	Analyze the significance of Earth Sciences in Civil Engineering by examining case studies of structural failures and the impact of weathering processes on construction materials. (BL4)
2	Differentiate and classify rock-forming and ore-forming minerals and rocks based on their physical properties, and assess their suitability for civil engineering applications. (BL4)
3	Identify and classify geological structures (folds, faults, joints, unconformities) and formations, and examine their impact on construction projects and groundwater resources. (BL3)
4	Analyze the effects of seismic activity, landslides, and tsunamis on civil engineering structures, and examine the effectiveness of preventive measures to mitigate associated risks. (BL4)
5	Analyze geological factors and construction feasibility to critique potential dam and tunnel sites, and formulate geologically sound solutions for site selection. (BL4)
6	Develop innovative and sustainable civil engineering solutions by integrating geological principles, analyzing geohazards, and applying rock and mineral properties to design safe and resilient infrastructure. (BL6)

	SYLLABUS	
UNIT 1	**IMPORTANCE OF EARTH SCIENCES AND WEATHERING**	**8 Hrs.**

Introduction

Introduction to Earth Sciences; scope and importance of Earth Sciences from Civil Engg. point of view; case studies on failures of Civil Engineering structures-1; case studies on failures of Civil Engineering structures-2

Weathering – Geological agents; Weathering Process of rocks-physical; Weathering Process of rocks-chemical and biological; River Process and its Development

UNIT 2	**MINERALOGY AND PETROLOGY**	**8 Hrs.**

Mineralogy – Mineral definition and classification; Methods of identifications of minerals;
 Physical properties of Rock-forming minerals and their uses from civil engineering point of view; physical properties of ore forming minerals and their uses from civil engineering point of view

Petrology – Classification of rocks; physical properties of igneous rocks and their suitability; physical properties of sedimentary rocks and their suitability; physical properties of metamorphic rocks and their suitability

UNIT 3	**STRUCTURAL GEOLOGY AND GEOLOGICAL FORMATIONS**	**8 Hrs.**

Structural Geology - Study of folds, faults, joints, and unconformities; Significance of study of structures in Civil Engg; Active faults and its related hazard in India; Active faults Mapping and Applications	
Geological formations - Zone of aeration and saturation; different types of Geological formations; Aquifer types and properties; wells	

UNIT 4	SEISMOLOGY, LANDSLIDE AND TSUNAMI	8 Hrs.

Seismology - Basic Terminology in Seismology; the internal Structure of the Earth; Plate Tectonics and Continental Drift; Precautions for building construction

Landslide & Tsunami– Classification; Causes and Effects; Preventive measures; case studies from civil engg point of view

UNIT 5	APPLICATIONS OF EARTH SCIENCES IN CIVIL ENGG.	8 Hrs.

Geology of Dams and Reservoirs - Selection of dam site; type of dam Considerations for successful reservoirs-1; type of dam Considerations for successful reservoirs-2; Life of reservoirs

Geology of Tunnels – concept of Over break and under break; Purposes and effects of tunnelling; Lining of Tunnels; Influence of geology for Successful tunnelling

LEARNING RESOURCES

TEXTBOOKS:

1	"Engineering Geology", N Chenna Kesavulu, Trinity Press.
2	"Engineering and General Geology", Parbin Singh, Katson Educational Series Publicaitions.

REFERENCE BOOKS:

1	"Principles of Engineering Geology", K V G K Gokhale, BS Publications.
2	"A textbook of Applied Engineering Geology", M T Maruthesha Reddy, New Age International (P) Ltd Publications.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVT0 37	TRAFFIC ENGINEERING AND TRANSPORT PLANNING				
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite(s)	None	3	0	0	3

Course Objective

Developing analytical and comprehensive approach to traffic management and plan transportation systems and network.

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

1	Apply traffic stream characteristics to interpret fundamental relationships and different traffic studies. (BL3)
2	Analyze various traffic control devices and characteristics of different types of intersection. (BL4)
3	Analyze factors affecting four stages of transport Planning Process and trip generation process. (BL4)
4	Evaluate different modelling techniques of trip distribution (BL5)
5	Evaluate modelling techniques of Modal Split and Traffic Assignment. (BL5)
6	Propose innovative solutions for improving traffic flow, safety, and efficiency including comprehensive transportation planning. (BL6)

SYLLABUS

UNIT 1	TRAFFIC CHARACTERISTICS AND SURVEYS	8 Hrs.

Road user characteristics, Traffic Characteristics, Speed, flow and density relationships, Fundamental diagrams.

Speed studies, Volume studies, Parking studies, accident studies, Origin & Destination studies

UNIT 2	TRAFFIC CONTROL DEVICES	8 Hrs.

Traffic Control devices- Traffic Signs, Traffic Signals, Road markings, Traffic Islands, Capacity and Level of Service

Types of Intersection- At grade and Grade separated Intersection, Layout of Rotary, Design parameters of Traffic Signal, Webster method of signal design

UNIT 3	URBAN TRANSPORTATION PLANNING	8 Hrs.

Urban transit problems, Need for planning and Transportation planning process, stages of transport planning, Components of travel demand: Independent variables & Travel Attributes

Zoning, cordon lines and screen lines, Data requirements for demand estimation: Socio Economic surveys, Land use Surveys, Traffic and Transport surveys, factors influencing trip production and attraction, Zonal regression models, Category analysis.

UNIT 4	TRIP DISTRIBUTION	8 Hrs.

Origin and destination matrix, Growth Models: Average Growth factor method, Furness method, Detroit method.

Singly and doubly constrained Gravity model derivation, singly constrained gravity model, doubly constrained gravity model

UNIT 5	MODAL SPLIT AND TRAFFIC ASSIGNMENT	8 Hrs.

Factors influencing mode choice, Zonal regression models, Binary and multinomial logit models, nested logit model.

Need for assignment, Objectives, Assignment techniques: all or nothing assignment technique, capacity restraint assignment technique, User Equilibrium method.

LEARNING RESOURCES

TEXTBOOKS:

1	Roess, RP., McShane, WR. and Prassas, ES "Traffic Engineering", Prentice Hall.
2	Introduction to Urban System Planning by Hutchinson, B.G., McGraw Hill.
3	Fundamentals of Transportation Planning by Papacostas, Tata McGraw Hill.

REFERENCE BOOKS:

1	May, A. D., Fundamentals of Traffic Flow, Prentice Hall.
2	Ortuzar, J.D.D. and Willumsen, L.G. "Modelling Transport", John Wiley & Sons.
3	Ben Akiva, M.E. and Lerman, S.R., "Discrete Choice Analysis: Theory and Application to Travel Demand", The MIT Press, Cambridge, Massachusetts.

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

	SOFTWARE ENGINEERING (Common to all Branches)					
R23MCSCT005	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

R23MCIVL005	**BUILDING INFORMATION MODELLING LABORATORY**					
	Total Contact Hours	15(T)+30(P)	**L**	**T**	**P**	**C**
	Pre-requisite	Understanding of CAD	**1**	**0**	**2**	**2**

Course Objective: To enable the students to learn various concepts, processes and tools of BIM

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

1	Model a Single storied residential block using BIM authoring software.
2	Take quantities of basic building material from the 3D model.
3	Create rendered views from 3D model.
4	Run Clash coordination between 3D models

<div align="center">SYLLABUS</div>

Module 1:
Overview of BIM:
Defining BIM, as a process and as a technology,
Module 2:
Introduction to BIM 3D model Authoring software:
3D Model setting up, creation and modification.
Module 3:
Introduction to BIM 3D model review software:
3D model viewing, Clash coordination, Report Extraction, Animations and rendering.
List of Exercises

1	Exploring User Interface, File types, Elements/Families, Sections, Drawing/modify tools
2	Linking CAD/ 3D models, Drawing Grids/Levels, working with Views, Elevations and Sections.
3	Modelling Walls, Curtain walls and working with Doors, windows.
4	Modelling Floors, ceilings/ roofs.
5	Creating Stairs/ ramps, Adding rooms.
6	Working with Annotations, Tags, Schedules
7	Creating Details and Sheets, working with Rendering
8	BIM review tool user Interface, File types, Navigation
9	Working with Selection Methods, View Points, Model Review
10	Clash Detection, Resolution, Report generation
11	Introduction to 4D modelling, Rendering

<div align="center">LEARNING RESOURCES</div>

TEXTBOOKS:

1	Dr. Adv. Harshul Savla, Dr. Chandrahauns Chavan, *Building Information Modeling : Global & Indian Perspective,* Notion Press Publishers.
2	Kuwarjeet Bava, Bipasha Sinha, *Building Information Modeling,* Bio-Green Books Publishers.

REFERENCE BOOKS:

1	
2	M.B.Shah and B.C. Rana, *Engineering Drawing*, Pearson Education Inc., 2009.

ADDITIONAL REFERENCE MATERIAL

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

R23MCSCL003	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

R23MCIVAT02	ENVIRONMENTAL STUDIES					
	Total Contact Hours	28(L)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**2**	**0**	**0**	**2**

Course Objective

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

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

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

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

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

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

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

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

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

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

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

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

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

LEARNING RESOURCES	
TEXTBOOKS:	
1	E. Bharucha, *Textbook of Environmental Studies for Undergraduate Courses*, 2nd ed. Hyderabad, India: Universities Press, 2012.

2	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	BL3	X				
CO2	BL3		X			
CO3	BL3			X		
CO4	BL3				X	
CO5	BL3					X

		FOUNDATION ENGINEERING				
R23MCIVT015	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	Soil Mechanics	**3**	**0**	**0**	**3**

Course objective

To equip students with fundamental knowledge and analytical skills for designing safe and economical foundations by understanding soil behavior, load carrying capacity and the site investigation techniques

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

1	Apply appropriate soil exploration methods and interpret field test results to assess subsurface conditions for civil engineering projects. (BL3)
2	Apply earth pressure theories to determine active, passive, and at-rest earth pressures and analyze the behaviour of cantilever sheet piles in different soil conditions. (BL3)
3	Analyze different types of slope failures and apply suitable analytical methods to assess the stability of infinite and finite slopes under various soil conditions. (BL4)
4	Analyze the bearing capacity of shallow foundations using theoretical and field methods by considering modes of failure and the influence of footing shape and groundwater conditions. (BL4)
5	Analyze the settlement of shallow foundations using analytical and field-based methods and design isolated footings based on settlement criteria. (BL4)
6	Design geotechnical solutions for soil-related engineering problems by integrating exploration data, analytical methods, and field test results in accordance with standard practices. (BL6)

SYLLABUS

UNIT 1	**SOIL EXPLORATION**	**8 Hrs.**

Significance of soil exploration; Methods of exploration - Types of boring - Types of samples and samplers; Field tests: standard penetration test, cone penetration tests, Plate load test; Geophysical investigations - Seismic refraction method, Electrical resistivity method

UNIT 2	**EARTH PRESSURE THEORIES**	**8 Hrs.**

Introduction; Types of earth pressures based on movement of wall; Earth pressure at rest; Rankine's theory for active and passive earth pressures for cohesion less and cohesive soils; Sheet piles : Introduction, Types of sheet piles - Cantilever sheet piles in cohesion less and cohesive soils

UNIT 3	**STABILITY OF SLOPES**	**8 Hrs.**

Significance of slope stability; Types of slopes and their failures; Causes of slope failures; Stability analysis of infinite slopes; Stability analysis of finite slopes; $\emptyset=0$ analysis; Method of slices, Friction circle method

UNIT 4	**SHALLOW FOUNDATIONS-BEARING CAPACITY**	**8 Hrs.**

Types of foundations - Basic terminology on bearing capacities; Modes of soil failures - Analytical methods to determine bearing capacity : Terzaghi's theory,

Meyerhof's theory ; IS code method; Corrections to consider Effect of shape of footing and water table - Bearing capacity from field tests	
UNIT 5	**SHALLOW FOUNDATIONS - SETTLEMENT** **8 Hrs.**

Settlement of shallow foundations - Analytical methods to calculate the settlements - Settlement based on Plate load test - Settlement based on SPT, SCPT, Semi - empirical Method (Buisman) - Design of Isolated footing

LEARNING RESOURCES

TEXT BOOKS:

1	Soil Mechanics & Foundation Engineering, K.R. Arora, Standard Publisher Distributors
2	Principles of Foundation Engineering by B. M. Das, Global Engineering Publications

REFERENCE BOOKS:

1	Foundation design and construction by M.J. Tomlinson, Pearson Education Limited
2	Soil mechanics, Foundations and Earth structures by G. Tschebotarioff, McGraw Hill book company

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVT016	**ESTIMATION AND COSTING**						
	Total Contact Hours	42(L)		**L**	**T**	**P**	**C**
	Pre-requisite(s)	None		**3**	**0**	**0**	**3**

Course Objective

To equip students with a comprehensive understanding and practical application of estimation techniques and quantity surveying principles like specifications, contracts, and analysis methods in construction.

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

1	Apply the basic principles and scope of quantity surveying and prepare different types of estimates based on project requirements. (BL3)
2	Analyze the purpose, structure, and components of specifications and contract documents relevant to building construction. (BL4)
3	Analyze and interpret rate analysis data to determine accurate cost estimates for construction activities. (BL4)
4	Apply the Long Wall–Short Wall method to compute quantities for a complete building estimate. (BL3)
5	Apply the Centre Line method to prepare detailed estimates for building components. (BL3)
6	Create a comprehensive and professional construction estimate incorporating quantity surveying, specifications, bar bending schedules, rate analysis, and estimation methods. (BL6)

SYLLABUS

UNIT 1	**QUANTITY SURVEYING AND ESTIMATE**	**8 Hrs.**

Quantity Surveying

Introduction to Quantity Surveying – Importance and its relevance – The role of Quantity Surveying in Construction industry – Scope and Principles – Qualities of a Quantity surveyor.

Estimate

Purpose of estimates – Preliminary estimates – Types of estimates – Various items to be included in estimates – principles in selecting units of measurements for items.

UNIT 2	**SPECIFICATION AND CONTRACTS**	**8 Hrs.**

Specifications

Introduction to specifications – Purpose and Importance – General specifications – Principles of detailed specifications – Standard specifications for different items of building construction.

Contracts

Introduction to Tender and types – Tendering Procedure – Types of contracts – Contract Documents – Conditions of contracts and Contractor.

UNIT 3	**BAR BENDING SCHEDULE AND RATE ANALYSIS**	**8 Hrs.**

Bar Bending Schedule

Introduction to BBS – Advantages & Requirements – BBS for footing – BBS for Beam and Column – BBS for Slab.

Rate Analysis

Introduction to Rate analysis and SSR – Purpose and Requirements – Factors effecting the rate analysis – Discussion on Direct and Indirect cost – Analyse the rates for different Activities/Items.

UNIT 4	**LONG WALL – SHORT WALL METHOD**	**8 Hrs.**

Complete Estimation of Building using Long Wall - Short Wall Method.

UNIT 5	CENTRE LINE METHOD	8 Hrs.
Complete Estimation of Building using Centre Line Method.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	"Estimating, Costing, Specification and Valuation in Civil Engineering", M. Chakraborti, MK Publications.	
2	"Estimating and Costing in Civil Engineering", BN Dutta, CBS Publications.	
REFERENCE BOOKS:		
1	Standard Schedule of Rates and Standard Data Book" Public Works Department and National Building Code of India.	
2	IS 1200 (Parts I to XXV-1974/ Method of Measurement of Building & Civil Engg Works).	

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	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	DESIGN OF STEEL STRUCTURES					
R23MCIVT017	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	Engineering Mechanics, Structural Analysis	**3**	**0**	**0**	**3**

Course objective

To equip students with fundamental knowledge and analytical skills for designing key steel structural components of typical steel structures and their connections

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

1	Analyze different types of bolted and welded connections for their suitability under various loading conditions. (BL4)
2	Analyze failure modes in laterally supported and unsupported steel beams. (BL4)
3	Analyze axial behavior of short and long columns using slenderness ratio and effective length and design laced and batten columns considering load transfer and stability. (BL4)
4	Analyze tension members for various failure modes such as yielding, rupture, and block shear design slab base and gusseted base foundations for columns under axial loads. (BL4)
5	Compare Pre-Engineered Buildings with conventional steel buildings based on cost, time, material efficiency, and design. (BL4)
6	Design and develop complete steel structural systems including connections, beams, columns, tension member, column bases and PEB for real-world building applications. (BL6)

SYLLABUS

UNIT 1	**STEEL CONNECTIONS**	**8 Hrs.**

Introduction to Steel Connections; Bolted Connections, Design of bolted connections (shear, bearing); Design of welded Connections, Moment Connections, Eccentric connections;

UNIT 2	**BEAMS**	**8 Hrs.**

Introduction to beams; Design of laterally supported beams, Different failure modes, Check for deflection, Web buckling, Web crippling; Design of laterally unsupported beams;

UNIT 3	**COLUMNS**	**8 Hrs.**

Design of Axially loaded columns (short and long columns), Slenderness ratio and effective length, Design of Laced column; Design of Batten Column; Design of compression members using IS 800

UNIT 4	**TENSION MEMBERS AND COLUMN BASES**	**8 Hrs.**

Various failure modes, Design of tension members for axial load; Slab base and gusseted base foundation, Column bases subjected to axial force and moment;

UNIT 5	**INTRODUCTION TO PRE-ENGINEERED BUILDINGS**	**8 Hrs.**

Introduction; Advantages of PEB - Applications of PEB - Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal, Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases

LEARNING RESOURCES	
TEXT BOOKS:	
1	Limit State Design of Steel Structures, S K Duggal, Tata Mc Graw Hill Publishers, 2019, 3rd Edition.
2	"Limit State Design of Steel Structures" by V. L. Shah & S. R. Karve
REFERENCE BOOKS:	
1	"Steel Structures: Design and Behavior" by Charles G. Salmon & John E. Johnson
2	Steel Structures: Design and Practice, N.Subramanian, Oxford Publishers, 2018.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit I	Unit II	Unit III	Unit IV	Unit V
CO1	BL4	X				
CO2	BL 4		X			
CO3	BL 4			X		
CO4	BL 4				X	
CO5	BL 4					X
CO6	BL 6	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	Data Structures	**3**	**0**	**0**	**3**

Course Objective

Students will have the ability to understand, design, integrate, and evaluate complex Java systems by combining object-oriented principles, multithreading, GUIs, exception handling, and collections to create efficient, scalable, and robust applications.

Course Outcomes

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

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

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

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

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

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

		hr
Inheritance Basics – Base class, sub class, types of inheritance; Member Access, Method overriding; super keyword, Using final with inheritance; Abstract classes, Multiple inheritance issues; Interfaces – Defining an interface, implementing interfaces; Packages - Defining a Package, Finding Package with CLASSPATH, importing packages, Access Protection; Exploring java.util Package (Random, String Tokenizer, Scanner); Exploring java.io package (Byte and Character streams, File class);		
Unit IV	**EXCEPTION HANDLING AND MULTITHREADING**	**8 hr**
Exception Handling Fundamentals, Exception Types, Uncaught Exceptions; Using Try and Catch, Multiple Catch Clauses, Nested Try Statements; Throw, Throws and Finally; Handling of User Defined Exceptions; The Java Thread Model, Thread Life Cycle, Comparison of Thread and Process. The Main Thread; Creating a Thread: Implementing Runnable Interface, Extending Thread class; Creating Multiple Threads, isAlive () and join(); Synchronization (Keyword and Block), Thread Priorities;		
Unit V	**EVENT HANDLING, AWT, SWING**	**8 hr**
Delegation Event Model: Events, Event sources, Event Listeners; Event Classes, Event Listeners (Action Listener, Window Listener); Key Listener, keyboard events; Mouse Listeners, mouse events; AWT classes, AWT Controls (Button, Text Field, Label, Checkbox); Layout manager: BorderLayout, GridLayout, FlowLayout; Swings: JLabel, JButton, JTextField, JCheckbox; Collections: Array List, iterator;		

LEARNING RESOURCES	
TEXTBOOKS:	
1	Herbert Schildt, "Java The Complete Reference" 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

R23MCIVT020 DSE-E2	CONTRACTS AND LEGAL ISSUES					
	Total Contact Hours	42 (L)	L	T	P	C
	Pre-requisite(s)	None	3	0	0	3

Course Objective

To provide students with a comprehensive understanding of construction contracts, legalities, labour legislation, and welfare measures, enabling them to effectively manage construction projects and labor-related issues.

Course Outcomes: After completion of this course student able to

1	Analyze how public works are carried out directly by the department or through contractors, and compare different types of work agreements and contracts. **(BL4)**
2	Evaluate the main parts of a contract and methods to solve disputes like arbitration in construction projects. **(BL5)**
3	Analyze why specifications and account procedures are important in public works and how they are used. **(BL4)**
4	Evaluate how labour laws affect construction work and help manage workers and safety. **(BL5)**
5	Analyze worker welfare plans by examining safety rules, insurance schemes, and incentive measures to ensure better workplace conditions. (**BL4**)
6	Estimate the overall requirements of a construction project by integrating knowledge about contract types, work methods, specifications, accounts, and labour rules. **(BL6)**

SYLLABUS		
UNIT 1	**INTRODUCTION AND CONTRACTS**	**8 Hrs.**

Execution of Works – Direct execution by department – Muster roll (form 21) – Piece work agreement – Work order. Execution through contractor – Definitions – Types of contracts – Lump sum contract, Item rate contract, cost plus fixed fee contract, Cost plus percentage contract, Special contracts.

UNIT 2	**CONTRACT DOCUMENT AND DISPUTES**	**8 Hrs.**

Contract document – Conditions of Contract – Tender notice – Bidding procedure – Scrutiny and acceptance of tender, award of contract – Earnest money deposit and Security deposit - Termination of contract. Disputes – Settlement through arbitration – Indian Arbitration Act 1940 – Clauses and advantages of arbitration.

UNIT 3	**SPECIFICATIONS AND ACCOUNTS**	**8 Hrs.**

Specifications – Importance, Design and Writing of Specifications – Types of Specifications – General, Detailed, Standard, Special, Restricted and Manufacturer's specifications. Accounts – Advances, Earnest money and Security deposits, First and final bills, Fines, Recovery, Closing of accounts.

UNIT 4	LABOUR LEGISLATION	8 Hrs.
Labour legislation – Factory Act 1948, Contract Labour Act 1970, Trade Union Act, Minimum Wages Act 1948, Workmen Compensation Act 1923, Industrial Disputes Act 1947.		
UNIT 5	LABOUR WELFARE	8 Hrs.
Labour Welfare – Labour welfare fund act 1965, Employees State Insurance act 1948, Incentives, Labour welfare measures.		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Construction Management and Accounts – BL Gupta and Amit Gupta	
2	Construction Management and Projects – B Sengupta and H Guha	
REFERENCE BOOKS:		
1	Construction Planning and Management – PS Gelhot and BM Dhir.	

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	**BL5**				X	
CO5	**BL4**					X
C06	**BL6**	X	X	X	X	X

R23MCIVT029	**Environmental Impact Assessment**				
DSC-E2	Total Contact Hours	45 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Environmental Science	**3**	**0**	**0**	**3**

Course Objective

Students will learn how to evaluate the potential environmental, social, and economic impacts of proposed projects, considering both positive and negative effects on society, culture, and health. Environmental Impact Assessment (EIA) is a tool used to predict and address these impacts during the planning stage to reduce harm.

This course will cover the basics of EIA, including its history, purpose, process, methods, and challenges. Students will also learn how to choose suitable assessment methods, involve the public, and prepare clear and effective reports.

Course Outcomes	
1	Able to identify the ecological factors and principles. (BL3)
2	Able to analyze the impacts of various activities on environmental attributes. (BL4)
3	Able to choose the suitable assessment methodology for analysis (BL3)
4	Able to produce an assessment report on environmental issues. (BL3)
5	Able to relate the knowledge of acts and legislation in taking the environmental auditing. (BL3)
6	Able to develop a systematic evaluation of the potential environmental effects of industrial or developmental projects and a sustainable approach for processing the environmental base maps, impact mitigation, and urban planning principles. (BL6)

SYLLABUS

Unit 1	Ecological Foundations for Environmental Impact Assessment	**8 hr**
	Introduction to Ecology & Its Role in EIA; Climatic Factors & Their Environmental Influence; Topographical & Edaphic Factors in Environmental Assessment, Ecosystem Structure & Function in EIA; Biogeochemical Cycles & Their Role in Impact Assessment; Ecosystem Types & Their Environmental Significance; Urban & Regional Planning Based on Ecological Principles; Ecological Risk Assessment in Development Projects.	
Unit 2	Fundamentals of EIA & Environmental Impact Studies	**8 hr**
	Introduction to EIA & Environmental Impact Statement (EIS); Key Components of EIA; Factors Affecting EIA Outcomes; Environmental Baseline Mapping & Data Collection; Classification of Environmental Attributes; Identification & Measurement of Environmental Impacts; Environmental Indices & Their Applications; Case Study – Successful EIA Implementation.	
Unit 3	EIA Methodologies & Assessment Techniques	**8 hr**

		Overview of EIA Methodologies; Ad-hoc & Matrix Methods; Network Method for EIA; Environmental Media Quality Index Method; Overlay Methods & GIS in EIA; Cost-Benefit Analysis in EIA; Comparing EIA Methodologies for Different Sectors; Limitations & Challenges in EIA Methodologies.	
Unit 4	Environmental Impact Assessment of Key Environmental Components	**8 hr**
	Soil & Groundwater Assessment in EIA; Study Area Delineation & Impact Identification; Assessment of Impacts on Surface Water & Mitigation Strategies; Generalized Approach for Air Pollution Impact Assessment; Impact of Development on Vegetation & Wildlife; Deforestation & Its Environmental Impact; EIA for Industrial & Infrastructure Projects; Mitigation & Remediation Strategies in EIA.	
Unit 5	Environmental Audit & Legislative Framework	**8 hr**
	Introduction to Environmental Audits; Stages of Environmental Audits; Audit Protocol & Data Collection Techniques; Evaluation of Audit Data & Report Preparation; Regulatory Framework for Environmental Compliance; Case Studies on Industrial & Developmental Project Audits; Environmental Regulations for Major Projects; Post-Audit Impact Mitigation & Sustainable Management	

LEARNING RESOURCES	
TEXT BOOKS:	
1	Environmental Impact Assessment, Canter, Tata McGraw Hill Publications.
2	Environmental Impact Assessment, Y Anjaneyulu, BS Publications.
3	Ecology and Environment P D Sarma, Rastogi Publications
REFERENCE BOOKS:	
1	Concepts in Environmental Impact Analysis, SK Shukla SK, PR Srivastava PR, Common Wealth Publishers.
2	Environmental Impact Assessment, David P Lawrence, Wiley Publications.

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	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	RAILWAYS, AIRPORTS AND HARBOURS					
R23MCIVT038 DSE-E2	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	Highway Engineering	**3**	**0**	**0**	**3**

Course Objective

Develop a comprehensive understanding of the design, planning, and management principles for railways, airports, and harbours

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

1	Identify components of permanent way and different Creep theories (BL3)
2	Analyze different geometric design factors of railway track. (BL4)
3	Analyze the different elements of a track layout and signaling system (BL4)
4	Appraise the different elements of airport planning and design (BL5)
5	Appraise the different elements of Harbour (BL5)
6	Propose techniques and methods to design and maintain railway tracks, airports and harbours. (BL6)

SYLLABUS

UNIT 1	**INTRODUCTION TO RAILWAY ENGINEERING**	**8 Hrs.**

Permanent way cross-section and components, Functions of various components like Rails, Sleepers, Ballast, Rail fastenings
Gauge – Uni-gauge policy of India, Creep of rails and theories of creep, Coning of wheels, Alignment of rail track

UNIT 2	**RAILWAY GEOMETRIC DESIGN**	**8 Hrs.**

Gradients and grade compensation, Cant and negative superelevation, Degree of curve and safe speed on curves,
Types of curves - transition curves, compound curves, reverse curves –Extra clearance and widening of gauge on curves, Vertical curves

UNIT 3	**RAILWAY TRACK LAYOUT AND SIGNALLING SYSTEM**	**8 Hrs.**

Track layouts and turnouts (double turnout, left turnout, right turnout), Crossings (diamond crossing, scissors crossing)
Railway signals: objectives and classification, Introduction to signaling systems – mechanical signaling systems, electrical signaling systems, Introduction to Interlocking.

UNIT 4	**INTRODUCTION TO AIRPORT ENGINEERING**	**8 Hrs.**

Airport site selection, Aircraft characteristics, Terminal and airport layout, Wind rose diagram and runway orientation, Runway length, Visual aids

UNIT 5	**INTRODUCTION TO HARBOUR ENGINEERING**	**8 Hrs.**

Classification of ports & harbours, Requirements of good port and site selection criteria, Docks: dry and wet docks, Navigational aids in ports and harbours.

Transition sheds & warehouses, Quays, wharves, jetties, dolphins and moorings, Break waters, Dredging

LEARNING RESOURCES	
TEXT BOOKS:	
1	A Course in Railway Engineering, Saxena Subhash C and Satyapal Arora, Dhanpat Rai and Sons, Delhi, 2003
2	Railway Engineering, Satish Chandra and Agarwal M.M, , 2nd Edition, Oxford University Press, New Delhi, 2013.
3	Airport Planning and Design, Khanna S K, Arora M G and Jain S S, Nemchand and Brothers, Roorkee, 2012.
REFERENCE BOOKS:	
1	Indian Railway Tracks, MM Agrawal, Prabhakar & Co Publications.
2	A course in Docks & Harbour Engineering, Oza.H.P. and Oza.G.H., Charotar Publishing Co.
3	A Course in Docks and Harbour Engineering, Bindra S P, Dhanpat Rai and Sons, New Delhi, 2013.

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

R23MCIVT021	**PROJECT ADMINISTRATION AND SAFETY MANAGEMENT**						
	Total Contact Hours	42 (L)		**L**	**T**	**P**	**C**
	Pre-requisite(s)	None		**3**	**0**	**0**	**3**

Course Objective

To provide students with the knowledge and skills to effectively manage construction projects and ensure safety in construction operations.

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

1	Implement procedures and legal provisions during preconstruction operations in infrastructure projects (BL3)
2	Analyze the organizational structure, roles, and responsibilities within construction projects to ensure effective coordination, monitoring, and compliance throughout the construction process. (BL4)
3	Analyze construction project risks to determine their sources and impacts, using techniques such as decision trees and sensitivity analysis (BL4)
4	Analyze safety management systems and regulatory standards to identify key factors influencing accident prevention and regulatory compliance in construction projects. (BL4)
5	Examine advanced safety analysis techniques, to understand their role in identifying and preventing accidents in construction projects. (BL4)
6	Develop a comprehensive construction project plan by integrating key management techniques to ensure successful project execution and control. (BL6)

SYLLABUS

UNIT 1	**PRECONSTRUCTION OPERATIONS**	**8 Hrs.**

Constructability analysis - Preparation and issuance of bidding documents - Prequalification of bidders - Types of bonds (bid, performance, and payment bonds) - Procedures for bid opening, evaluation, acceptance, and documentation - Familiarization with construction documents - Overview of design-build contracts with roles and responsibilities.

UNIT 2	**CONSTRUCTION ADMINISTRATION**	**8 Hrs.**

Organizational structures in construction projects - Lines of authority and role distribution in construction projects - Staffing roles and workforce allocation - Responsibilities for coordinv ation among trades - Project monitoring and reporting mechanisms - Legal and contractual obligations and compliance management during construction administration.

UNIT 3	**RISK MANAGEMENT IN CONSTRUCTION**	**8 Hrs.**

Certainty, risk, and uncertainty in construction projects - Identification and nature of construction risks - Contractual allocation of risks - Types of risks - Strategies for

minimizing risks and mitigating losses - Use of expected values and utility in investment decisions - Decision trees and sensitivity analysis.

UNIT 4	SAFETY MANAGEMENT IN CONSTRUCTION	8 Hrs.

Safety management functions in the construction industry - Line versus staff authority in safety - Safety responsibility and accountability - Causes and costs of accidents - General safety programs and solution - OSHA (Occupational Safety and Health Administration) Standards - . IS 18001:2007 / ISO 45001:2018 (Occupational Health & Safety Management Standards),
National Building Code of India (NBC 2016) - Safety Provisions.

UNIT 5	ADVANCED SAFETY ANALYSIS	8 Hrs.

Case-based reasoning for accident prevention - Indexing and retrieval methods for safety data - Accident forecasting using CBR methods - System safety analysis - Fault tree analysis (FTA) - Failure modes and effects analysis (FMEA) in the construction industry.

LEARNING RESOURCES

TEXTBOOKS:

1	Construction Project Administration by E.R.Fisk, (2000) Prentice hall International, London.
2	Construction Project Administration by A.A.Kwakye, (1977) Adission Wesley Longman,

REFERENCE BOOKS:

1	Safety Management by John V. Grimaldi, (1996). AITBS Publishers & Distributors, New Delhi, India.

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	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R23MCIVT 030	**IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES**					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	Fluid Mechanics, Hydraulics and Hydraulic Machinery, Water Resources Engineering	**3**	**0**	**0**	**3**

Course Objective

This course will enable students to develop a comprehensive understanding of the principles of Irrigation Engineering and the hydraulic structures associated such as Diversion and Storage headworks, Canal regulation structures and canal system.

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

1	Determine uplift pressures at key points along a barrage profile using Bligh's and Khosla's theories. (BL4)
2	Classify canal regulation structures such as falls, cross drainage works, regulators, and escapes, and examine their functions in irrigation systems. (BL4)
3	Distinguish between different types of reservoir storage and yield and examine the roles of spillways and energy dissipators. (BL4)
4	Distinguish different modes of failure in gravity dams and determine their overall stability using standard design principles. (BL4)
5	Determine suitable canal sections by applying silt theories of erodible canals. (BL4)
6	Design hydraulic structures such as Diversion Headworks, Canal Systems, and Dams by applying key theories and principles of Irrigation Engineering. (BL6)

SYLLABUS		
UNIT 1	**DIVERSION HEADWORKS AND KHOSLA'S THEORY**	**8 Hrs.**

Diversion head works - Typical layout, Components and functions; Effect of construction of a weir on the regime of a river, causes of failure of weirs and their remedies; Theories of seepage, Failure of hydraulic structures founded on pervious foundations; Bligh's creep theory – safety against piping and undermining, exit gradient.

Khosla's theory and concept of flow nets; Khosla's method of independent variables for determination of pressures and exit gradient for seepage below a weir or a barrage; Determination of uplift pressures, exit gradient, corrections to uplift pressures.

UNIT 2	**CANAL REGULATION STRUCTURES**	**8 Hrs.**

Introduction to Canal Regulation Structures - Canal falls – Scope and importance, classification; design principles of canal falls – Sarda type fall; Cross Drainage works – Scope and importance, classification – aqueduct and syphon aqueduct, super passage and canal syphon, inlets and outlets and level crossing.

Canal Escapes and Outlets - Scope and Importance, Functions and requirements, Classification; Gibbs outlet;

Canal regulators – Scope and importance; cross and distributary head regulators.

River training works - Scope and Importance, Objectives and Classification; Methods of River training – Levees, Guide banks, Groynes, Cut-offs, Pitched banks & Islands.

UNIT 3	RESERVOIRS, DAMS AND SPILLWAYS	8 Hrs.

Reservoirs - Purpose and Scope, Classification; Investigations for reservoir planning, Selection of site for reservoir; Storage zones of a reservoir, Catchment and Reservoir Yield; Fixation of reservoir capacity – Determining reservoir capacity for a given demand, Fixing demand for a reservoir capacity for the computed value of yield.

Dam – Classification, Factors affecting selection of site for a dam, Factors affecting selection of type of a dam

Spillways and Energy dissipators - Classification of spillways; Spillway Gates. Energy dissipation below overflow spillways – Jump Height Curve (JHC) – Tail Water Curve (TWC) – Energy dissipators for different cases; USBR stilling basins.

UNIT 4	EARTHEN DAMS AND STABILITY ANALYSIS OF GRAVUTY DAMS	8 Hrs.

Earthen dams – Comparative advantages and disadvantages; Classification of earthen dams; Methods of construction; Causes of failure of earthen dams – Hydraulic, Seepage and Structural.

Gravity Dams – Forces acting on gravity dam, Modes of failures of gravity dams; Stability analysis of gravity dams –Determination of Vertical, principal and shear stresses and Factors of safety.

UNIT 5	CANAL DESIGN	8 Hrs.

Canals – Classification; Sediment transport – Sediment load, bed load, suspended load; Tractive force approach – Shield's equation; Design of erodible canals – Silt theories, Kennedy's silt theory; Lacey's regime theory.

LEARNING RESOURCES	
TEXT BOOKS:	
1	"Irrigation Engineering and Hydraulic Structures" by Santosh Kumar Garg, Khanna Publishers.
2	"Irrigation and Water Power Engineering" by Dr. BC Punmia, Dr. Pande, BB Lal, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications.
REFERENCE BOOKS:	
1	"Irrigation, Water Resources & Water Power Engineering" by Dr. PN Modi, Standard Book House
2	"Theory and Design of Irrigation Structures: Vol1 & Vol2" by RS Varshney, SC Gupta, RL Gupta, Nemchand and Bros.
3	"Irrigation and Water Resources Engineering" by GL Asawa, New

	Age International Publishers.
4	"Water Resources Engineering" by Larry W Mays, Wiley.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIV T039	**HIGHWAY CONSTRUCTION PRACTICES**					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Highway Engineering	**3**	**0**	**0**	**3**

Course Objective

To provide foundational knowledge of highway construction materials, equipment, and techniques for effective execution and quality control of all pavement layers.

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

1	Apply knowledge to evaluate different highway construction materials and assess their suitability for various conditions (BL3)
2	Analyze the function and working mechanisms of various highway construction equipment for effective operation. (BL4)
3	Apply subgrade construction techniques and soil stabilization methods to enhance pavement performance. (BL3)
4	Execute the construction processes for sub-base and base layers while ensuring compliance with relevant standards and specifications. (BL3)
5	Oversee the construction processes for surface layer while ensuring compliance with relevant standards and specifications. (BL3)
6	Design innovative pavement layers and construction techniques, including mix preparation, laying, and compaction, incorporating advanced quality control measures. (BL6)

SYLLABUS

UNIT 1	**HIGHWAY CONSTRUCTION MATERIALS AND THEIR QUALITY CONTROL PARAMETERS**	8 Hrs.

Types of soils used in highway construction; Granular materials and their properties; Stabilization techniques for soils and granular materials; Wet Mix Macadam (WMM) and Water Bound Macadam (WBM); Compaction methods and determination of Optimum Moisture Content (OMC) & density; Bitumen and bituminous mixes: properties and requirements; Stone Matrix Asphalt (SMA), Bituminous Concrete (BC), Dense Bituminous Macadam (DBM), and Bituminous Macadam (BM); Cement concrete mixes for highways: strength and strain parameters.

UNIT 2	**HIGHWAY CONSTRUCTION EQUIPMENT**	8 Hrs.

Types of excavators and their applications in highway construction; Graders: working mechanism and applications; Loaders: types and working principles; Rollers: types, functions, and compaction mechanisms; Pavers: types and working principles; Operation and maintenance of highway construction equipment; Productivity analysis and efficiency of equipment; Selection criteria of construction equipment for different highway projects

UNIT 3	**CONSTRUCTION OF SUBGRADE**	8 Hrs.

Properties of embankment soil and selection criteria; Slope stability and need for retaining walls; Characteristics of subgrade soil and its significance; Soil stabilization techniques for subgrade improvement; Volume estimation for subgrade preparation; Field compaction methods and equipment; Compaction requirements as per Ministry of Road Transport and Highways (MoRTH); Construction methods, safety measures, and precautions in subgrade development

UNIT 4	**CONSTRUCTION OF SUB-BASE AND BASE LAYERS**	8 Hrs.

Types and properties of granular materials for sub-base and base layers; Stabilization methods for granular materials; Compaction specifications and

methods for sub-base layers; Construction sequence and quality control measures; Equipment used for sub-base and base layer construction; Mixing plant requirements for Cement Treated Base (CTB), Cement Treated Sub-Base (CTSB), and Dry Lean Concrete (DLC) layers; Curing requirements and methods for CTB, CTSB, and DLC layers; Quantity estimation for sub-base and base layer construction

UNIT 5	CONSTRUCTION OF SURFACE LAYER	8 Hrs.

Preparation methods for bituminous mixes; Preparation methods for cement concrete mixes; Requirements for batch plants and continuous plants; Mix transport requirements and quality control measures; Laying methods and equipment for bituminous and concrete pavements; Compaction methods and specification requirements; Curing methods and recommended curing periods; Quantity estimation and impact of weather conditions on surface layer construction

LEARNING RESOURCES

TEXTBOOKS:

1	**"Concrete Pavement Design, Construction, and Performance"** *– Norbert J. Delatte*
2	**Bituminous road construction in India - Prithvi Singh Kandhal**
3	*"Highway Engineering"* - **Khanna, S.K. & Justo, C.E.G.** – (Nem Chand & Bros, Latest Edition)

REFERENCE BOOKS:

1	**MoRTH (2013), Specifications for Roads and Bridges (Fifth Rivision)**
2	**MoRD** (2014), Specifications for the Rual Roads (First Rivision)

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	BL3				X	
CO5	BL3					X
CO6	BL6	X	X	X	X	X

	APPLIED COMPUTATIONAL METHODS LABORATORY					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
R23MCIVL006	Pre-requisite	Highway Engineering, Open Channel Hydraulics, Water Resources Engineering	**0**	**0**	**3**	**2**

Course Objective
To make students able to perform various transportation and water resources engineering data analysis using various soft computing tools

Course Outcomes: After completing this course, the students will be able to	
1	Analyze and compute traffic flow and intersection delay analysis
2	Analyze pavement design, optimize highway alignment and model & optimize public transport systems
3	Analyze, conduct hydrologic data and flood frequency data and design an open channel
4	Model and simulate reservoir operation and groundwater flow

LIST OF EXPERIMENTS	
1	Traffic Flow Analysis - Analyze traffic flow data to calculate flow, density, and speed using Excel and R language
2	Highway Alignment Design - Optimize horizontal and vertical alignment of a highway using Excel and R language
3	Pavement Design Analysis - Analyze pavement thickness using the AASHTO method using Excel and R language
4	Public Transportation Optimization - Model and optimize bus schedules to minimize waiting times using Excel and R language
5	Intersection Delay Analysis - Compute delays at intersections using the HCM method using Excel and R language
6	Hydrologic Data Analysis - Analyze rainfall and runoff data using Excel and R language
7	Flood Frequency Analysis - Conduct frequency analysis using Gumbel's method using Excel and R language
8	Channel Flow Design - Design an open channel for a specified flow rate using Excel and R language
9	Reservoir Operation Simulation - Model reservoir inflows and outflows for flood control using Excel and R language
10	Groundwater Flow Modeling - Simulate steady state groundwater flow in a confined aquifer using Excel and R language

LEARNING RESOURCES

TEXT BOOKS:	
1	Highway Engineering, 10th Edition, Khanna S.K & Justo C.E.G, by Nem Chand & Bros
2	Engineering Hydrology, 4th Edition, K. Subramanya, by McGraw Hill Education

REFERENCE BOOKS:	
1	www.r-project.org

R23MCSCL004	**OOP WITH JAVA LAB** **(for MEC, ECE, EEE, CIV and CHE)**		L	T	P	C
	Total Contact Hours	42 (P)				
	Pre-requisite	-	0	0	3	2

Course Objective

Students will have the ability to apply object-oriented programming concepts in Java to develop and implement modular and reusable software solutions.

Course Outcomes

1	Students will be able to implement object-oriented programming concepts such as classes, inheritance, polymorphism, and exception handling to build modular Java applications.
2	Students will be able to examine and debug Java programs to identify and resolve logical errors, ensuring correctness and efficiency.
3	Students will be able to assess the design and performance of Java applications, optimizing for scalability, maintainability, and resource management.
4	Students will be able to design and develop advanced Java applications by integrating OOP principles, multithreading, GUIs, and data structures to solve real-world problems.

List of Experiments

1	**Week 1: Introduction to Java and Structured Programming** 1. Write a simple Java program that prints "Hello, World!" to the console. 2. Write a Java program that takes user input using the Scanner class. 3. Write a Java program to demonstrate all primitive data types. 4. Implement a Java program that converts a floating-point number to an integer. 5. Create a Java program that uses the final keyword to define constants.
2	**Week 2: Operators, Control Statements - Selection** 1. Implement a Java program that uses arithmetic, relational, and logical operators. 2. Write a Java program to find the largest of three numbers using if-else statements. 3. Use the ternary operator to implement a simple conditional check.
3	**Week 3: Control Statements - Iteration** 1. Write a Java program that prints all even numbers between 1 and 100 using a for loop. 2. Create a Java program that calculates the factorial of a given number using a while loop. 3. Write a JAVA program to display the Fibonacci sequence. 4. Implement a menu-driven program using a do-while loop.
4	**Week 4: Arrays** 1. Write a Java program to reverse a one-dimensional array of integers. 2. Write a Java program to search for an element in an array. 3. Implement a Java program to find matrix multiplication using

	two-dimensional arrays.
5	**Week 5: Classes and Methods** 1. Create a class with fields and methods, then instantiate and use it. 2. Implement a method to calculate the area of a rectangle (accepting length and width as parameters). 3. Create a program that returns the area of different shapes (circle, square, rectangle) using method overloading.
6	**Week 6: Constructors, this Keyword, and Garbage Collection** 1. Implement a class with parameterized constructors and demonstrate object initialization. 2. Use 'this' keyword to resolve variable shadowing within methods and constructors. 3. Write a program that simulates garbage collection using System.gc() and observe the results.
7	**Week 7: Inheritance and Polymorphism** 1. Create a superclass and subclass to demonstrate basic inheritance. 2. Override a method in the subclass and call it from the main method. 3. Use the super keyword to call the parent class constructor and method.
8	**Week 8: Abstract Classes and Interfaces** 1. Write an abstract class with an abstract method and a concrete method. 2. Implement an interface and demonstrate how to implement it in a class. 3. Create a scenario where interfaces solve the multiple inheritance problem.
9	**Week 9: Exception Handling** 1. Write a program that demonstrates basic exception handling using try-catch blocks. 2. Implement a program that handles multiple exceptions using multiple catch clauses. 3. Create a custom exception class and use it to handle a specific error in a program.
10	**Week 10: Multithreading** 1. Implement a thread by extending the Thread class and demonstrate thread execution. 2. Create a program that demonstrates thread life cycle and state transitions. 3. Implement thread synchronization to avoid race conditions in a multi-threaded environment.
11	**Week 11: Event Handling, AWT** 1. Create a simple AWT program that displays a window with a button, text field, and label. 2. Implement mouse and keyboard event listeners in an AWT program.
12	**Week 12: Swings** 1. Create a Swing-based GUI with a JFrame, JButton, and JLabel, demonstrating layout managers like FlowLayout or BorderLayout.

	2. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.

LEARNING RESOURCES

TEXTBOOKS:

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

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/
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

R23MTPCT001	QUANTITATIVE PROBLEM-SOLVING TECHNIQUES					
	Total Contact Hours	28 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	NIL	**2**	**0**	**0**	**2**

Course Objective

The course aims to equip the students with standard concepts and techniques of arithmetic and logical thinking to handle various real-world problems and their applications.

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

1	Enhance the aptitude and reasoning round clearing ability.
2	Solve real-time problems for performing job functions easily.
3	Improve individual decision–making abilities, how to think critically, and logically and analyze information as corporate company-based decisions.
4	Acquire satisfactory competency in the use of VERBAL REASONING as well as LOGICAL REASONING.
5	Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.

SYLLABUS

Unit I	ARITHMETIC ABILITY	5 hr

Number System and LCM & HCF; Ratio & Proportion; Percentages; Profit & Loss; Mixture and Allegation.

Unit II	ALGEBRAIC ANALYSIS	5 hr

Quadratic & Linear eq's; Inequalities; Speed, Time and Distance; Time and Work; Simple Interest & Compound Interest.

Unit III	ADVANCED MATHS	5 hr

Circles, lines, angles & Co-ordinate geometry; Triangles, quadrilaterals & polygons; Areas & perimeter-2D; Surface area & volumes-3D; Trigonometry.

Unit IV	MODERN MATHS	5 hr

Probability; Permutation and Combination; Surds, indices & set theory; Functions; Logarithms.

Unit V	DATA INTERPRETATION & ELEMENTARY STATISTICS	5 hr

Tables, charts & pie-diagrams; Venn diagrams; Data sufficiency; Mean, median & mode; Standard deviation ,variance & Case studies.

LEARNING RESOURCES

TEXTBOOKS:

1	ARIHANT Publications - RAJESH VERMA Fast Track Objective Arithmetic (Revised Edition)
2	MC GRAW HILL Education- ABHIJIT GUHA Quantitative aptitude (6th edition)
3	ARIHANT Publications - B.S. SIJWALI & INDU SIJWALI Verbal, Non-verbal & Analytical reasoning
4	ARIHANT SERIES - JAI KISHAN & PREM KISHAN Verbal, Non-verbal & Analytical reasoning
5	R. S. Aggarwal - S. Chand Publications Quantitative Aptitude for Competitive Examinations

REFERENCE BOOKS	
1	A SURE SHOT GUIDE TO CRACK SSB: YES, YOU HAVE IT IN YOU(MAJ GEN VPS BHAKUNI (Author), VSM (Author), KAVITA MODI (Author)) https://amzn.in/d/9QFY0oF
2	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC Tier I & II	Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author)) https://amzn.in/d/3OTZ5uI
3	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition)(Adda247 Publications (Author)) https://amzn.in/d/4aMMHvq
4	Ultimate Guide to SSC CGL - Combined Graduate Level - Tier I & Tier II Exam with Previous Year Questions & 5 Online Practice Sets 9th Edition	Combined Graduate Level Prelims & Mains	PYQs https://amzn.in/d/9IEwmYc (Disha Experts (Author))
5	Excel in Quantitative Aptitude: Chapter-wise Maths 10 Years Previous Solved Papers (PYQ) of SSC CGL, IBPS PO & Clerk, SBI PO, & RRB NTPC Tier I & II	Mathematics for SSC, Banking, Railways Exams 2024 (Arun Sharma (Author)) https://amzn.in/d/3OTZ5uI
6	Quantitative Aptitude for CAT 2025	11th Edition (Latest)	Quant	CAT Preparation Exam Book with Solved Previous Years Papers (PYQ)	McGraw Hill edge Access: Mock Tests, Expert Sessions & Strategies (Arun Sharma (Author)) https://amzn.in/d/9OQMQBX
7	Ace Reasoning Ability for Banking and Insurance Book 2024 (Third English Edition) (Adda247 Publications (Author)) https://amzn.in/d/4aMMHvq

R23MCIVT 018	GIS APPLICATIONS IN CIVIL ENGINEERING					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Prerequisite	Physics	**3**	**0**	**0**	**3**

Course Objective

This course provides foundational knowledge of remote sensing and GIS, enabling students to understand spatial and non-spatial data, explore data models, map projections, and spatial analysis techniques for geospatial applications.

Course Outcomes

After completing this course, the students will be able to

1	Explain remote sensing platforms and sensors based on spectral reflectance and EMR interactions. (BL3)
2	Compare and justify the use of vector, raster, and TIN data models for geospatial needs. (BL5)
3	Analyze spatial database systems and assess preprocessing techniques such as georeferencing. (BL4)
4	Determine the suitability of spatial interpolation techniques and map projections. (BL4)
5	Examine GIS operations such as overlay, buffer, and classification, and perform spatial analysis. (BL5)
6	Create a GIS project using remote sensing and spatial data to solve a civil engineering problem. (BL6)

SYLLABUS

Unit 1	REMOTE SENSING	8 hr
Introduction to Remote Sensing; EMR Interaction with Atmosphere and EMR Interaction with Atmosphere Earth features - Spectral Reflectance of Earth Features; RS Sensors and Platforms; Sensor Resolutions; Satellites and Orbits; Definition and Components of GIS; Vector and Raster Data Models;		
Unit 2	NON-SPATIAL AND SPATIAL DATA	8 hr
Non-spatial data and their type; Raster data compression techniques; Spatial database systems and their types; Pre-processing of spatial datasets; Geo-referencing		
Unit 3	MAP PROJECTIONS AND MODELS	8 hr
Different map projections; Spatial interpolation techniques; Digital Elevation models and different types of resolutions; Quality assessment of DEMs;		
Unit 4	SPATIAL ANALYSIS	8 hr
GIS Analysis-1; GIS Analysis – Overlay operations; GIS Analysis – Buffer operations; Classification Methods; Errors in GIS; Limitations of GIS; Key Elements of Maps.		
Unit 5	APPLICATIONS IN CIVIL ENGINEERING	8 hr
Agriculture and Soil; Forestry and Ecology; Geoscience and Geo-hazards; Marine and Atmospheric Sciences; Urban and Regional Studies and Water Resources; Urban Traffic Planning and Network Designs.		

LEARNING RESOURCES

TEXTBOOKS:

1	Basudeb Bhatta , *Remote Sensing and GIS*, Oxford University Press Publications.
2	Jhon R Jensen, *Remote Sensing of the Environment*, Pearson Publications.

REFERENCE BOOKS:

1	Peter A Burrough, *Principles of Geographical Information*

	System for Land Resources Assessment, Oxford University Press Publications.
2	M Anji Reddy, *Text Book of Remote Sensing and Geographical Information Systems*, BS Publications

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVT022	GROUND IMPROVEMENT TECHNIQUES					
	Total Contact Hours	42	L	T	P	C
	Pre-requisite(s)	Geotechnical Engineering	3	0	0	3

Course Objective

To make the student understand the concept of various ground improvement techniques and give exposure to various ground improvement techniques through case studies

Course Outcomes

After completing this course, the students will be able to

1	Classify the problems associated with weak soil deposits and apply suitable ground modification techniques to address them. (BL3)
2	Differentiate and analyze various in-situ soil densification methods. (BL4)
3	Analyze the various dewatering systems. (BL4)
4	Appraise the concept of soil stabilization and analyze the selection of suitable soil stabilization techniques for different field conditions. (BL4)
5	Analyze the properties and usage of geosynthetics in reinforcement of soil. (BL4)
6	Formulate and propose appropriate ground improvement techniques by evaluating the problems associated with existing ground conditions. (BL6)

SYLLABUS

Unit 1	INTRODUCTION TO GROUND IMPROVEMENT TECHNIQUES	8 Hrs

Problems associated with weak deposit; Need for engineered ground improvement; Classification of ground modification techniques; Suitability, Feasibility and Desirability of ground improvement techniques; Objectives of improving soil

Unit 2	IN SITU SOIL DENSIFICATION	8 Hrs

In-situ densification methods in granular soils – Introduction, Vibration and impact at ground and at depth, Case studies; In-situ densification methods in cohesive soils – Introduction, Pre-loading, Sand drains, Geo drains, Stone columns, Case studies

Unit 3	DEWATERING	8 Hrs

Methods of dewatering and pressure relief; Well point systems; Deep well drainage; Vacuum dewatering; Electro osmosis; Seepage control, Design steps for dewatering, Criteria for choice of filler material around drains, Drains and Filter requirements, Case studies

Unit 4	SOIL STABILIZATION	8 Hrs

Materials, Types, Factors affecting and Properties of mechanical, cement and chemical stabilization materials; Waste and recycle material stabilization of soil; Soil nailing - Components, Constructional sequence, Advantages and Applications

Unit 5	GROUTING AND GEOSYNTHETICS	8 Hrs

Grout materials; Objectives, Functions, Applications, Method and Procedure of grouting	
Types, functions, tests, properties and applications of geosynthetics	

LEARNING RESOURCES

TEXT BOOKS:

1	Engineering principles of ground modification, Manfred R. Hausmaan, Tata McGraw Hill Publications
2	Ground Improvement Techniques, P Purushothama Raj, Laxmi Publications

REFERENCE BOOKS:

1	Reinforced Soil and its Engineering Applications, Swami Saran, IK International Publications
2	Ground Improvement Techniques, Nihar Ranjan Patro, Vikas Publishing House

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

COs	BLs	Unit-1	Unit-2	Unit-3	Unit-4	Unit-5
CO1	BL3	X				
CO2	BL4		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R23MCIVT031	AVAILABILITY AND MANAGEMENT OF GROUNDWATER RESOURCES					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Water Resources Engineering	**3**	**0**	**0**	**3**

Course Objective

To emphasize/make them understand the need to find out the availability and management of the water resources of our country with natural perspective.

Course Outcomes

After completing this course, the students will be able to

1	Identify the various processes in hydrologic cycle , need for conservation of groundwater resources and geological formations as aquifers. BL3
2	Solve for finding aquifer parameters and apply Darcy's law for groundwater movement. BL3
3	Solve for finding rainfall, infiltration and subsurface runoff. BL3
4	Analyze groundwater resources management strategies, examine factors influencing sustainability, and critique the effectiveness of various planning techniques for optimal water use. BL4
5	Examine strategies for rainwater harvesting and artificial recharge of groundwater, evaluate the impact of climate change on water resources, and interpret the long-term effects of these factors on water sustainability. BL4
6	Design and develop a comprehensive groundwater resources management plan, integrating the understanding of the hydrologic cycle, aquifer parameters, and rainfall/runoff dynamics, while considering strategies for rainwater harvesting, artificial recharge, and the impact of climate change on water sustainability. Propose innovative solutions for optimal water use and conservation based on these integrated factors. BL6

SYLLABUS

Unit 1	**HYDROLOGIC CYCLE AND AQUIFERS**	**8 hr**

The Hydrological Cycle: Movement of Water on Earth;Groundwater in the Hydrological Cycle; Significance of Groundwater Resources; Need for Groundwater Conservation; Introduction to Aquifers;Vadose Zone: The Unsaturated Layer; Saturated Zone and the Water Table; Confined and Unconfined Aquifers

Unit 2	**AQUIFER PARAMETERS AND DARCY'S LAW**	**8 hr**

Aquifer Properties and Parameters: An Overview; Understanding Porosity in Aquifers; Permeability and Its Role in Groundwater Flow;Transmissivity: Measuring Aquifer Productivity; Storage Coefficient and Groundwater Storage Capacity; Fundamentals of Groundwater Movement; Darcy's Law: Principles and Interpretation;Applications of Darcy's Law in Groundwater Studies

Unit 3	**WELL HYDRAULICS AND MEASUEREMNT OF RAINFALL**	**8 hr**

Subsurface Runoff: Concepts and Estimation Methods; Types of Wells and Their Construction; Introduction to Well Hydraulics; Steady and Unsteady Flow Towards Wells; Measurement of Rainfall: Methods and Instruments;Rainfall Indices: Index

of Wetness and Related Terms;Infiltration: Process and Influencing Factors; Infiltration Rate Estimation Techniques		
Unit 4	**GROUBWATER RESOURCES PLANNING AND MANAGEMENT**	**8 hr**
Groundwater Recharge: Basic Concepts; Natural vs. Artificial Groundwater Recharge; Factors Affecting Groundwater Recharge; Methods for Estimating Groundwater Recharge; Estimation of Total Annual Replenishable Groundwater; Introduction to Groundwater Resources Planning; Principles of Groundwater Management; Sustainable Strategies for Groundwater Resource Development		
Unit 5	**GROUNDWATER RECHARGING AND IMPACT OF CLIMATE CHANGE ON WATER RESOURCES**	**8 hr**
Introduction to Rainwater Harvesting; Techniques and Systems for Rainwater Harvesting;Artificial Groundwater Recharge: Need and Importance;Methods of Artificial Recharge of Groundwater; Site Selection and Design Considerations for Recharge Structures; Monitoring and Maintenance of Recharge Systems; Impact of Climate Change on the Hydrological Cycle; Climate Change Effects on Surface and Groundwater Resources		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Textbook of Geology- P. K. Mukerjee.	
2	Textbook of Engineering & General Geology- Parbin Singh.	
REFERENCE BOOKS:		
1	Groundwater- H. M. Raghunath	
2	Hydrology and Water Resources Engineering – S.K. Garg	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23MCIVT040	SUSTAINABLE TRANSPORTATION SYSTEMS					
	Total Contact Hours	42	L	T	P	C
	Pre-requisite	Environmental Engineering, Highway Engineering	3	0	0	3

Course Objective

This course introduces the fundamentals of Environmental Impact Assessment (EIA) in transportation, focusing on its environmental implications, planning interrelations, assessment methods, decision-making tools, and sustainable development strategies.

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

1	Apply the concepts of Environmental Impact Assessment (EIA) and its relevance in transportation systems. (BL3)
2	Analyze the influence of land-use planning and zoning regulations on transportation systems. (BL4)
3	Evaluate environmental impacts of transportation projects using assessment techniques. (BL5)
4	Apply decision-support tools and modeling techniques for transportation impact analysis. (BL3)
5	Analyze and evaluate sustainable transportation strategies and case studies using life cycle assessment (OpenLCA) and material flow analysis (STAN). (BL4)
6	Design and propose integrated, sustainable transportation systems by synthesizing environmental assessment methods, decision-support tools, and policy frameworks to achieve long-term climate resilience and resource efficiency (BL6)

SYLLABUS

Unit I	Introduction to EIA and Transportation Systems	8 hr

Introduction to Environmental Impact Assessment (EIA) – Definition, Objectives, Importance in Transportation Planning; Overview of Transportation Systems – Modes of Transport, Environmental Impacts; Historical Perspective of EIA in Transportation Projects – Evolution, Regulations; Basics of Land-Use Planning – Relationship between Land Use and Transport; Zoning Schemes and Regulations – Principles, Impact on Transport Systems; Integration of Land-Use and Transport Planning – Case Studies; Fundamentals of Urban Transport Planning – Concepts, Challenges; Regional Transport Planning Frameworks – Urban-Regional Coordination

Unit II	Environmental Impacts of Transport Systems	8 hr

Impacts on Humans, Flora, and Fauna – Effects on Ecosystems, Communities; Impacts on Soil, Water, and Air Quality – Degradation due to Transport; Effects on Climate and Landscape – Contribution to Climate Change, Alteration of Natural Terrain; Baseline Conditions for Soil Quality – Assessment Methods, Indicators; Baseline Conditions for Water Quality – Sampling Techniques, Analysis; Baseline Conditions for Air Quality – Monitoring Tools, Parameters; Noise Pollution Modeling – Techniques for Predicting Transport Noise; Air Pollution Modeling – Dispersion Models, Emission Inventories

Unit III	Impact Modeling and Scenario-Based Analysis	8 hr

Water Pollution Modeling in Transportation Infrastructure – Impact Assessment on Water Bodies; Introduction to Impact Modeling – Frameworks, Applications in Transport; Scenario-Based Analysis – Evaluating Alternatives in Transportation Planning; Sensitivity Analysis in Transportation Impact Assessment – Identifying

Key Influencing Factors; Indirect Impacts of Transport Projects – Environmental and Economic Ripple Effects; Cumulative and Synergistic Impacts – Combined Impact Assessment of Multiple Projects; Strategic Environmental Assessment (SEA) – Policy-Level EIA Approaches

Unit IV	Decision Support Systems and Abatement Measures	8 hr

Overview of Decision Support Systems (DSS) – Role in Transportation EIA; Tools for Multi-Criteria Decision Analysis (MCDA) – Evaluation of Transport Alternatives; Case Studies on DSS Applications in EIA – Real-World Implementation Examples; Mitigation of Noise, Air, and Water Pollution – Strategies, Technologies; Biodiversity Conservation and Land Restoration – Protection of Affected Ecosystems; Climate-Resilient Transport Infrastructure – Designing for Climate Change Adaptation; Principles of Sustainable Transportation – Key Concepts,
Benefits

Unit V	Sustainable Transportation Strategies and Case Studies	8 hr

Policy Measures for Sustainable Urban Transport – Public Transit Prioritization, Non-Motorized Transport; Integration of Sustainability in Transportation Planning – Frameworks, Decision-Making Tools; Case Study: Highway Projects and Their Environmental Impacts – In-Depth EIA Analysis; Case Study: Railway Projects and Their Environmental Impacts – Assessment Methods; Case Study: Airport Projects and Their Environmental Impacts – Environmental Concerns in Aviation; OpenLCA for Life Cycle Assessment (LCA) – Application in Transport Sustainability; STAN for Material Flow Analysis – Resource Flow Assessment in Transport Planning

LEARNING RESOURCES

TEXTBOOKS:

1	Assessment & Decision Making for Sustainable Transport, European Conference of Ministers of Transport, OECD Publishing 2004.
2	Wood, C. and Wood, C., "Environmental Impact Assessment: A Comparative Review", Prentice Hall. 2002.
3	Petts, J., "Handbook of Environmental Impact Assessment", Blackwell Publishing. 1999.

REFERENCE BOOKS:

1	Sucharov, L.J. and Baldasano, J.M., "Urban Transport and the Environment, Vol. II", Computational Mechanics Publications. 1996.
2	Zannetti P. (Ed.), "Environmental Modeling, Vol. I", Computational Mechanics Publication, Elsevier Applied Science. 1993.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

		SOLID WASTE MANAGEMENT				
R23MCIVT023	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Prerequisite	Water Resources Engineering	**3**	**0**	**0**	**3**

Course Objective

To provide students with a comprehensive understanding of municipal solid waste (MSW) management, including generation, handling, processing, and disposal, with a focus on sustainable practices and specialized management of construction and demolition (C&D) waste.

Course Outcomes

After completing this course, the students will be able to

1	Illustrate comprehensive municipal solid waste management strategies that address waste generation, segregation, and legal compliance to minimize environmental and public health impacts. (BL3)
2	Use and optimize integrated systems for the efficient collection, segregation, storage, and transportation of municipal solid waste, considering economic, environmental, and social factors. (BL3)
3	Illustrate and evaluate sustainable waste processing and treatment systems (e.g., composting, bio-methanation, waste-to-energy) for effective resource recovery and environmental protection. (BL3)
4	Formulate advanced landfill designs and sustainable disposal methods that minimize environmental risks and support circular economy principles. (BL6)
5	Develop sustainable management plans for construction and demolition waste by integrating innovative recycling technologies and regulatory compliance to promote resource efficiency. (BL6)

SYLLABUS		
Unit 1	**Introduction to Municipal Solid Waste Management**	**8 hr**
Definition and Scope of Solid Waste Management - Sources and Classification of Municipal Solid Waste - Physical, Chemical, and Biological Characteristics of MSW -Functional Elements of Solid Waste Management - Overview of Waste Generation Rates and Factors - Environmental Impacts of Improper Waste Management - International and National Legislations on MSW Management - Introduction to Sustainable Waste Management Practices		
Unit 2	**Collection, Storage, and Transportation of MSW**	**8 hr**
Waste Storage at Source: Design and Types of Bins - Waste Segregation Practices and Their Importance - Waste Collection Systems: Primary and Secondary Collection - Route Optimization for Waste Collection - Transfer Stations: Functions and Design Considerations - Waste Transportation: Vehicles, Logistics, and Costs - Community Participation in Waste Collection Systems - Challenges and Innovations in Waste Collection and Transport		
Unit 3	**Waste Processing and Treatment**	**8 hr**
Composting: Aerobic and Anaerobic Techniques - Vermicomposting: Principles and Applications - Waste-to-Energy: Incineration and Refuse-Derived Fuel (RDF) -		

Biomethanation: Process and Applications - Mechanical-Biological Treatment (MBT) of Waste - Recycling and Material Recovery Facilities (MRFs) - Leachate and Gas Management in Waste Processing - Emerging Technologies in Waste Processing		
Unit 4	**Disposal of Municipal Solid Waste**	**8 hr**
Landfills: Design and Types (Sanitary, Open Dumps, Engineered Landfills) - Environmental Impacts of Landfilling - Landfill Gas Recovery and Utilization - Bioreactor Landfills: Principles and Benefits - Integrated Waste Management Hierarchy - Closure and Post-Closure of Landfills - Monitoring and Remediation of Closed Landfill Sites - Circular Economy Approach in Waste Disposal		
Unit 5	**Construction and Demolition (C&D) Waste Management**	**8 hr**
Definition and Sources of C&D Waste - Classification of C&D Waste: Recyclable and Non-Recyclable Components - Environmental and Economic Impacts of C&D Waste - Legal and Regulatory Framework for C&D Waste Management - Recycling of C&D Waste: Aggregate Recovery and Applications - Technologies for Crushing, Screening, and Separation of C&D Waste - Design and Operation of C&D Waste Processing Plants - Case Studies of Successful C&D Waste Management Practices		
LEARNING RESOURCES		
TEXTBOOKS:		
1	George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 2014	
REFERENCE BOOKS:		
1	CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2016.	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

	RURAL WATER RESOURCES MANAGEMENT					
R23MCIVT032	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	Water Resources Engineering	**3**	**0**	**0**	**3**

Course Objective

To sensitize the students on the actual issues and how to manage, adapt and mitigate rural water resources for attaining sustainable development goals, protecting a country against climate change extremes and for promoting industrial growth in India.

Course Outcomes

After completing this course, the students will be able to

1	Identify the processes of hydrologic cycle and key parameters**(BL3)**
2	Select the groundwater components**(BL3)**
3	Apply water mass balance equation**(BL3)**
4	Identify engineered and nature based rural water resource management infrastructure**(BL3)**
5	Analyze the requirements for rural water resources management and interpret the data necessary for developing effective databases to support water resource planning and decision-making. **(BL4)**
6	Design a rural water resource management plan by integrating the hydrologic cycle, groundwater components, and infrastructure, and develop a database to support water resource planning and decision-making. **(BL6)**

SYLLABUS		
Unit 1	**Hydrologic cycle and Importance of water resources**	**8 hr**

Water Resource Management: Importance in the Indian Context; Challenges in Water Resource Management in India; Introduction to the Hydrological Cycle; Components and Processes of the Hydrological Cycle;Graphical and Schematic Representations of the Hydrological Cycle; Precipitation and Evapotranspiration as Key Hydrological Inputs; Runoff, Infiltration, and Groundwater Flow Parameters; Measurement and Estimation of Key Hydrological Parameters

Unit 2	**Groundwater Hydrology**	**8 hr**

Introduction to Groundwater Hydrology; Occurrence and Origin of Groundwater; Zones of Subsurface Water: Vadose and Saturated Zones; Aquifers: Types and Characteristics; Groundwater Flow and Storage Mechanisms; Groundwater Recharge and Discharge Areas; Interaction Between Groundwater and Surface Water;Overview of Groundwater Balance and Budgeting

Unit 3	**Surface water Hydrology**	**8 hr**

Introduction to Surface Water Hydrology; Components of the Surface Water System; Watersheds and Drainage Basins; Hydrological Processes in Surface Water Flow; Concept of Water Mass Balance; Derivation of the Water Balance Equation; Applications of Water Balance in Hydrological Studies; Case Studies and Practical Examples of Water Balance Analysis

Unit 4	**Rural water management issues and infrastructure**	**8 hr**

Overview of Rural Water Management in India; Common Water Issues in Rural Areas: Quantity and Quality; Data Availability and Challenges in Rural Water Monitoring; Importance of Long-Term Observation Records; Introduction to Rural Water Infrastructure Systems; Engineered Solutions for Rural Water

Management; Nature-Based Solutions and Traditional Practices; Integrating Engineered and Nature-Based Infrastructure for Sustainability		
Unit 5	**Database for rural water resources**	**8 hr**
Introduction to Hydrological Databases in India;Key Rural Water Databases: Sources and Accessibility; Central and State Agencies Managing Hydrological Data; Data Collection Techniques in Rural Hydrology; Basics of Remote Sensing in Water Resource Management; Remote Sensing Data Sources Relevant to Rural Water; Application of Remote Sensing in Rural Water Monitoring; Integration of Ground-Based and Remote Sensing Data for Decision Making		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Freeze P.A., Cherry J. 1979 Groundwater. Prentice-Hall	
2	Ward, R.C and Robinson. M. 1967. Principles of Hydrology. Tata McGraw Hill	
REFERENCE BOOKS:		
1	Dingman, S.L. and Dingman, S.L. 2015. Physical hydrology (Vol. 575). Upper Saddle River, NJ: Prentice Hall.	
2	Viessman, W., Lewis, G.L. and Knapp, J.W. 2003. Introduction to hydrology (No. GB 661.2. V53 1972.). Upper Saddle River, NJ: Prentice Hall.	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R23CIVT041	**MULTIMODAL URBAN TRANSPORTATION SYSTEMS**					
	Total Contact Hours	42	**L**	**T**	**P**	**C**
	Pre-requisite	Highway Engineering	**3**	**0**	**0**	**3**

Course Objective

This course provides a foundation in urban transportation systems, covering public transport planning and evaluation, non-motorized transport design, sustainable strategies such as TDM and ITS, and the analysis of multimodal
systems and road safety for sustainable urban mobility.

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

1	Evaluate urban transportation systems, key challenges, and demand modeling concepts. (BL5)
2	Analyze public transportation operations, performance, and financing. (BL4)
3	Evaluate Non-Motorized Transportation (NMT) infrastructure and planning strategies. (BL5)
4	Apply principles of sustainable transportation planning, including TDM and ITS. (BL3)
5	Analyze multimodal transfer facilities and road safety measures using multimodal level of service (MMLOS) and predictive safety methods. (BL4)
6	Design and propose integrated multimodal urban transportation systems by synthesizing demand modeling, sustainable strategies, NMT, ITS, and safety frameworks for sustainable urban mobility. (BL6)

SYLLABUS

Unit I	**Overview of Urban Transportation**	**8 hr**

Urbanization and Transport – Growth Trends, Urban Transport Needs; Key Issues in Urban Transportation – Traffic Congestion, Pollution, Accessibility; Challenges in Urban Transportation – Equity, Affordability, Sustainability; Travel Demand Modeling Overview – Trip Generation, Distribution, Mode Choice; Vehicular Level of Service (LOS) Overview – Capacity Analysis, Performance Indicators; Travel Demand Management (TDM) Overview – Strategies, Implementation; Parking Studies – Demand Estimation, Pricing Policies; Transit-Oriented Development (TOD) – Principles, Case Studies

Unit II	**Public Transportation Systems**	**8 hr**

Introduction to Public Transportation – Role, Benefits, Challenges; Basic Operating Elements of Public Transport – Frequency, Headway, Fleet Size; Bus Transportation – Operations, Route Planning, Scheduling; Rail Transportation – Metro, Light Rail, Commuter Rail; Financing Public Transportation – Revenue Sources, Subsidies, PPP Models; Transit Marketing – Ridership Growth Strategies, Branding; Measuring Performance of Transit Systems – Key Performance Indicators (KPIs), Benchmarking; Bus & Rail Transit Capacity – Passenger Flow Analysis, Bottlenecks.

Unit III	**Non-Motorized Transportation (NMT) Planning**	**8 hr**

Introduction to NMT Systems – Role in Urban Transport, Benefits; Assessing Existing NMT Scenario – Infrastructure Audit, Demand Analysis; Data Collection and Analysis in NMT Planning – Surveys, Pedestrian & Bicycle Data; Pedestrian Flow Characteristics – Level of Service (PLOS), Flow Models; Bicycle Level of Service (BLOS) – Parameters, Bicycle Compatibility Index (BCI); NMT Design Principles – Pedestrian & Cycling Infrastructure Standards; Case Studies on NMT Implementation – Best Practices, Success Stories; Economic & Financial Analysis of NMT Interventions – Cost-Benefit Analysis, Funding Strategies.

Unit IV	Urban Transport & Sustainability	8 hr
Introduction to Sustainable Urban Transport – Environmental & Social Impacts; Travel Demand Management (TDM) Strategies – Push & Pull Measures; Intelligent Transportation Systems (ITS) – Applications, Communication Framework; ITS Components & Architecture – Data Collection, Real-Time Information; Electronic Toll Collection (ETC) – Technologies, Benefits; Public Bicycle Sharing (PBS) System – Planning, Implementation, Case Studies; Urban Freight & Logistics – Challenges, Solutions, Integration with Passenger Transport; Environmental Concerns of Urban Transport – Air Quality, Energy Consumption		
Unit V	Multimodal Transportation & Road Safety	8 hr
Multimodal Transportation (MMT) Environment – Need, Integration Strategies; Multimodal Level of Service (MMLOS) – Definitions, Assessment Methods; Design of Multimodal Transfer Facilities – Planning, Location Considerations; Park & Ride (P&R) Facility Planning – Design Criteria, Demand Estimation; Road Safety for Pedestrians & Cyclists – Risk Factors, Safe Infrastructure; Road Crash Estimation & Predictive Methods – Data Analysis, Safety Performance; Predicting Vehicle-Pedestrian and Vehicle-Bicycle Conflicts – Simulation Approaches; Sustainable Strategies for Urban Transportation – Policies, Best Practices		

LEARNING RESOURCES

TEXTBOOKS:

1	Travel Demand Management and Road User Pricing: Success, Failure and Feasibility, edited by Gerd Sammer & Wafaa Saleh (2009), AshGate
2	The Implementation and Effectiveness of Transport Demand Management Measures -An International Perspective, edited by Stephen Ison, Tom Rye, (2008), Ashgate

REFERENCE BOOKS:

1	IRC 103:2012, Design of Pedestrian Facilities. Indian Road Congress
2	IRC 11: 2015 Design & Layout of Cycle Tracks. Indian Road Congress
3	Indo-Highway Capacity Manual (HCM), CSIR-CRRI, 2018.

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

R23MCSCT007	COMPUTER NETWORKS (Common to all Branches)				
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisites	DLD,CAO	**3**	**0**	**0**	**3**

Course Objective

Students will gain an ability to identify and design network architecture and apply the essence of various protocols.

Course Outcomes

1	Students will be able to analyse and **apply** key concepts of data communication, including network topologies, layering, and protocols; the OSI and TCP/IP reference models in order to design and evaluate efficient communication systems. **(BL3)**
2	Students will be able to **describe**, **demonstrate**, and **analyse** various data link layer techniques and apply this knowledge to design and evaluate reliable data communication systems. **(BL4)**
3	Students will be able to **identify**, **explain**, and **apply** random access methods and assess their impact on the performance and evolution of network communication systems. **(BL3)**
4	Students will be able to **describe**, **compare**, and **apply** the roles of connecting devices (switches, hubs, routers, bridges, gateways), **analyze** and **evaluate** various routing algorithms and **assess** the effectiveness of flooding in network communication. **(BL5)**
5	Students will be able to **compare**, and **apply** the TCP and UDP datagram formats, congestion control techniques and flow control methods and their roles in Internet communication. **(BL4)**
6	Students will be able to design and evaluate efficient, reliable and effective network communication systems. **(BL6)**

SYLLABUS

Unit I	OVERVIEW OF DATACOMMUNICATION AND NETWORKING	8 hr

Introduction to Data Communication; Network Topologies, Layering and Protocols; Reference-Model: OSI & TCP/IP Reference Model, Addressing; Physical Layer-Different types of Transmission Media-Guided; Different types of Transmission Media-Unguided; Multiplexing-TDM,FDM,WDM; Line Encoding (NRZ,NRZI,Manchester,AMI,4B/5B); Switching and Taxonomy: Circuit Switched, Packet Switched.

Unit II	DATALINK LAYER : ERROR CONTROL & FLOW CONTROL	8 hr

Error Detection: CRC, Checksum; Error Correction: Hamming Distance, Linear Block Codes Framing: Bit and Byte Stuffing ; Flow Control: Noiseless-Simplest, Stop and Wait; Noisy: Stop and wait ARQ; Go Back N, Selective repeat; PPP, HDLC; Random Access: Aloha: Pure and Slotted;

Unit III	DATALINK LAYER	8 hr

Random Access: CSMA, CSMA/CD; Random Access: CSMA/CA; Controlled Access-Reservation, Polling and Token passing; Channelization-FDMA; TDMA and CDMA; Standard Ethernet-MAC; Standard Ethernet-Physical Layer; Changes in the Standard- Fast Ethernet; Gigabit Ethernet,10 Gigabit Ethernet.

Unit IV	NETWORK LAYER	8 hr

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 ,4thEdition,McGrawHill.

REFERENCE BOOKS:

1	Computer Networks –Andrew S Tanenbaum,4th Edition, Pearson Education/PHI.
2	Computer Networking: *A Top Down Approach-James F Kurose and Keith W Ross,* 6th Edition, Pearson Education.

ADDITIONAL REFERENCE MATERIAL

1	https://www.geeksforgeeks.org/computer-network-tutorials
2	https://www.javatpoint.com/computer-network-tutorial
3	https://www.tutorialspoint.com/data_communication_computer_network

ONLINE COURSES

1	https://onlinecourses.nptel.ac.in/noc22_cs19
2	https://www.coursera.org/learn/illinois-tech-computer-networking

Bloom's level - Units catchment articulation matrix

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

R23MCSCT008	**ARTIFICIAL INTELLIGENCE: PRINCIPLES AND TECHNIQUES** **(for MEC, ECE, EEE, CIV and CHE)**				
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Data Structures	**3**	**0**	**0**	**3**

Course Objective

This course aims to help students conversant with the theoretical concepts and algorithm approaches that can be applied to the design of AI applications and students will gain insights into foundational principles, algorithms, and theoretical frameworks underlying Machine Learning.

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**8 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: (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 hr**

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 hr**

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 hr**

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 hr**

Introduction, Decision Tree Representation and Appropriate Problems for Decision Tree Learning;ID3 Algorithm: An Illustrative Example; Hypothesis Space Search and Inductive Bias in Decision Tree Learning; Neural Network Representation, Appropriate Problems for Neural Network Learning; Perceptrons - Representational Power of Perceptrons, The Perceptron Training Rule; Gradient Descent and The Delta Rule, Stochastic Approximation to Gradient Descent; Multilayer Networks and The Back Propagation Algorithm - A Differentiable Threshold Unit; The Back Propagation Algorithm

LEARNING RESOURCES

TEXTBOOKS:

1	Tom M. Mitchell "Machine Learning", Indian Edition.
2	Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Third Edition.
3	Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence", Tata McGraw-Hill Education, 3rd Edition, 2010.

REFERENCE BOOKS:

1	Christopher M. Bishop, "Pattern recognition and machine learning", Springer,2007.
2	Ethem Alpaydin, "Introduction to Machine Learning", PHI, Third edition, 2015.

ADDITIONAL REFERENCE MATERIAL

1	https://www.javatpoint.com/artificial-intelligence-ai/
2	https://www.geeksforgeeks.org/machine-learning/

Bloom's level - Units catchment articulation matrix

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

	OOAD AND DESIGN PATTERNS (Common to all Branches)					
R23MCSCT009	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 hr**

	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

Bloom's level - Units catchment articulation matrix

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