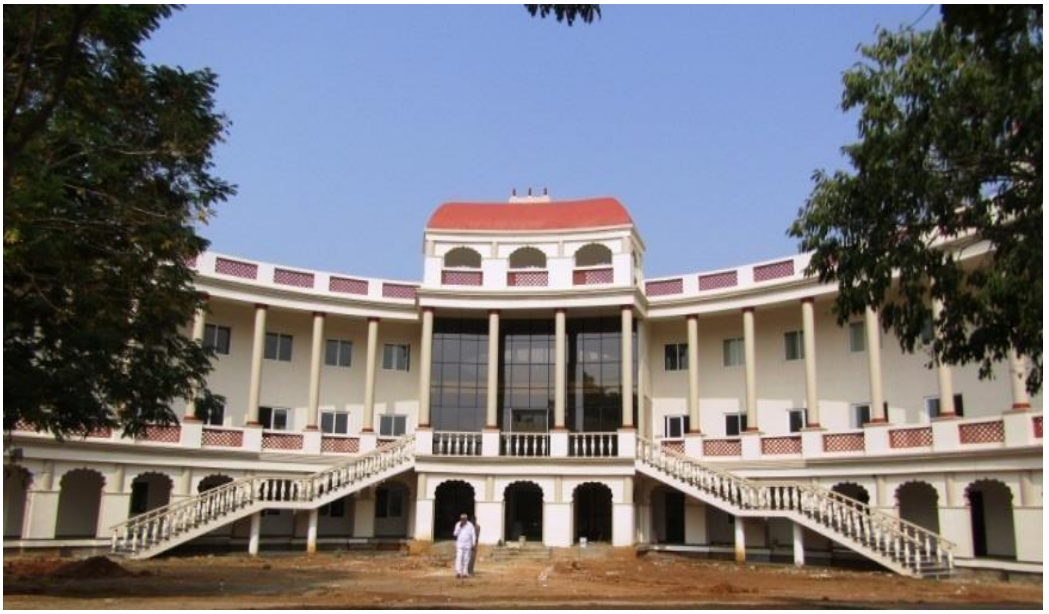
ACADEMIC REGULATIONS
&
CURRICULUM

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



CIVIL ENGINEERING
B. Tech. Program

MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING
(Autonomous)

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

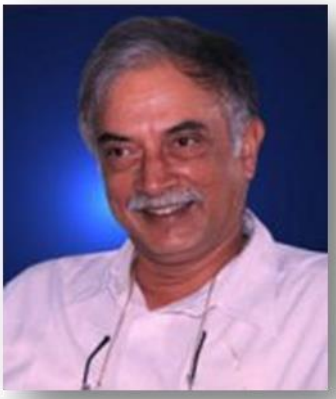
Listed u/s 2(f) & 12(B) of UGC Act 1956)

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

The visionaries

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

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



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

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

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

1. Award of the Degree

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

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

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

2. Award of B.Tech. degree with Honors

1. A student will be declared eligible for the award of the B.Tech degree with Honors if he/she fulfills the following:
   (i) Student secures additional **18** credits fulfilling all the requisites of B.Tech program i.e., **178** credits.
   (ii) Registering for Honors is optional.
   (iii) Honors is to be completed simultaneously with B.Tech. program.

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

3. Admissions

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

4. Program related terms

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

Credit definition:

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

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

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

5. Semester/Credits:

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

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

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

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

6. Structure of the Undergraduate Program:

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

S. No.	Category	Breakup of Credits (Total 160)	Percentage of total credits
1.	Engineering Major	81	50.625
2.	Extended Open Elective Cluster (EOEC)	29	18.125
3.	Generic Engineering Stream	20	12.5
4.	Ability Enhancement Courses (AEC)	6	3.75
5.	Value Added Courses (VAC)	6	3.75
6.	Skill Enhancement Courses (SEC)	8	5
7.	Projects	10	6.25
	Total	**160**	**100**

7. Course Classification:

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

Course Category	Course Modules	Total Credits
Professional Core	• 16 Professional Core Theory Mandatory of 3 credits each **16 * 3 credits = 48 credits** • 5 Professional Core Elective Theory of 3 credits each **5 * 3 credits = 15 credits** • 6 Professional Core Lab of 2 credits each **6 * 2 credits = 12 credits** • Projects (Mini & Major) **(2 + 8) credits = 10 credits** • Department specific module (SEC) = **2 credits**	**87**
Basic Sciences	• M-I and M-II **2 * 3 credits = 6 credits** • Physics + Lab **(3 + 1) credits = 4 credits** • Chemistry + Lab **(3 + 1)credits = 4 credits** • Department Specific Math oriented courses **2 * 3 credits = 6 credits**	**20**
Humanities	• **AEC** (Language Proficiency = 2 credits; Env. Studies = 2 credits; Community Project = 2 credits) • **VAC** (E & HV = 2 credits; Constitutional values/ Rights = 2 credits; Health & Wellness =2 credits) • **SEC** (Quantitative Problem Solving = 2 credits)	**14**
Engineering Sciences/Professional Sciences	**EOEC-Extended Open Elective Cluster** • 6 Theory Mandatory modules. **6 * 3 credits = 18** credits • 1 Theory Elective module. **1 * 3 credits = 3** credits • 4 Lab/practice modules. **4 * 2 credits = 8** credits, which is an elective cluster where students can choose from multiple clusters which they can opt for as secondary skill with total of **29 credits**. • Procedural Programming + Lab **(3 +1) credits = 4** credits • Computer Aided Engineering Drawing **= 2** credits • Engineering Workshop **= 2** credits • Office tools & Social Media Etiquette **= 2** credits	**39**
		160
Honors	Optional For Honors (In Professional Core Area as a deep dive into Professional Elective Cluster) **4 Modules * 4 credits = 16 credits**	**16**
	4 Year Honors Degree	**176**

8. Programme Pattern

i. Total duration of the B. Tech (Regular) Program is four academic years of 8 semesters.
ii. A semester comprises 90 working days and an academic year is divided into two semesters.
iii. There will be an Induction Program before the commencement of the First Semester for the newly admitted students in order to provide orientation and acclimatization to the college campus and professional learning environment. Several activities such as physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization to the departments, innovation activities etc., form part of the Induction Program.
v. Value Added Courses (VAC) like Health & Wellness, Constitutional Rights/Values, Ethics and Human Values are mandatory credit courses for all the undergraduate students.
vi. Ability Enhancement Courses (AEC) like Language Proficiency, Environmental Studies and Community Project are mandatory credit courses for all the undergraduate students.
vii. Skill Enhancement Courses (SEC) like Office Tools & Social Media Etiquette, Engineering Workshop, Quantitative Problem Solving Techniques and Departmental Specific Module are mandatory credit courses for all the undergraduate students.
viii. Undergraduate degree with Honors is offered as an option for the students having good academic record.
xvi. College shall assign a faculty advisor/mentor after admission to a group of students from same department to provide guidance in courses registration/ career growth / placements / opportunities for higher studies/ GATE/ other competitive exams etc.

9. Evaluation Process

- The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for 3 credit theory subjects, 50 Marks for 2 credit theory courses and 100 marks for practical subjects. Community Project and Mini Project shall be evaluated for 50 marks while Main Project work shall be evaluated for 200 marks.
- A student has to secure not less than 35% of marks in the semester end examination and a minimum of 40% of marks in the sum total of the Continuous Assessment (CA) and Summative Assessment (SA) marks taken together for the theory, practical, design, drawing subject or project etc.

THEORY COUSES

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

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

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

a) Continuous Assessment (5- unit/3 Credit courses)

i. Continuous Assessment, which is evaluated for 40 Marks is divided into 2 parts: Periodic Assessment (PA) examinations for 25 Marks and Teacher Assessment (TA) for 15 Marks. There shall be two Periodic Assessment (PA) examinations each of 25 marks during a semester. The weighted average in 80/20 ratio will be taken for 25 marks. The duration of exam is 90 minutes. The PA question paper contains 3 long answer questions with internal choice. Each Long answer question carries 7 marks. (3 * 7M = 21 marks). This will be scaled up to 25 marks)

ii. The first PA examination shall be conducted on Units I & II with either/or type question from each unit and the second PA examination shall be conducted on Units III, IV and V with either/or type question from each unit.

iii. The Teacher Assessment (TA) for 15 marks shall be based on assignments/projects/presentations /surprise tests/quizzes which the concerned course owner/subject teacher shall design. The TA methodology shall be approved upfront by the Board of Studies and the same shall be informed to the students at the beginning of the semester itself.

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

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

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

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

Final Continuous Assessment marks shall be evaluated as follows:

CA = Final PA + TA

b) Summative Assessment - Evaluation Pattern for 5-Unit/3-Credit courses

Summative Assessment examination of 3-credit theory subjects shall have the following pattern:

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

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

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

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

Summative Assessment examination of 2-credit theory courses shall have the following pattern:

- The Examination will be conducted for 30 Marks (5 * 6 Marks).
- Question Paper contains 5 questions (with either/or choice), one from each unit.
- The duration of exam is for **120 minutes**.

PRACTICAL COURSES

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

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

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

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

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

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

e) Computer Aided Engineering Drawing – Evaluation Pattern

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

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

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

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

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

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

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

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

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

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

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

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

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

11. Mini Project:

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

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

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

12. Skill Enhancement Course:

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

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

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

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

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

The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course (Minimum 30 hours) being offered by industries / Professional bodies or any other accredited bodies. If a student chooses to take a Certificate Course offered by external agencies, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency. A committee shall be formed at the level of the college to evaluate the grades/marks given for a course by external agencies and convert to the equivalent marks/grades.

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

If a student prefers to take a certificate course offered by external agency and approved by BoS, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate as approved by the BoS.

Evaluation pattern for Quantitative Problem Solving Techniques :

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

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

Continuous Internal Assessment : (40 Marks)

Continuous assessment	: 20 Marks
Internal test	: 20 Marks

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

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

13. Main Project Work:

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

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

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

14. Massive Open Online Courses (MOOCs):

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

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

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

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

15. Academic Bank of Credits (ABC)

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

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

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

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

16. Guidelines for offering Honors

The objective of introducing B.Tech.(Honors) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The program is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i. Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

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

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

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

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

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

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

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

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

Enrolment into Honors:

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

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

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

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

Registration for Honors:

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

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

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

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

17. Attendance Requirements:

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

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

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

iv. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester from the date of commencement of class work.

v. If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

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

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

18. Promotion Rules:

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

- Two regular and Two supplementary examinations of I semester
- Two regular and One supplementary examinations of II semester
- One regular examination and One supplementary examination of III semester
- One regular examination of IV semester.

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

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

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

19. Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:
After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

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

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

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

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

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

where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.
The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,

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

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

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

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

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

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

Award of Class:

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

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

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

CGPA to Percentage conversion Formula = CGPA x 10

20. With–holding of Results

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

21. Multiple Entry / Exit Option

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

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

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

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

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

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

(a) Exit Policy:

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

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

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

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

(b) Entry Policy:

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

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

22. Transitory Regulations

Discontinued, detained or failed candidates are eligible for readmission as and when the semester is offered after fulfillment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

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

23. Medium of Instruction:

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

24. Student Transfers:

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

25. General Instructions:

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

* * *

Regulations for MALPRACTICES during the conduct of examinations

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

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

		• To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs. • To keep the CC footage of the act as an evidence. • To obtain a statement from student, invigilator, subject expert and authorized by observer and Chief Superintendent.
4	If the candidate mishandles the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. Also, if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. In addition to the above punishment, a committee shall be constituted and recommends appropriate punishment for the improper conduct. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
5.	Uses objectionable, abusive or offensive language in the Examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject only. • To Obtain a statement from student and invigilator and get it authorized by Observer and Chief superintendent.
6.	Refuses to obey the orders of the Chief Superintendent/ACE/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.

7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action with documented proofs • To keep the CC footage of the act as an evidence. • To obtain a statement from student and invigilator and authorized by observer and Chief superintendent. • The candidate shall be handed over to Police and register a case.
9.	If a student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	If the student belongs to our college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.

		Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. • To constitute a committee comprising of Principal, Vice principal, Chief superintendent, Observer, Controller of Examinations and HoD to discuss and initiate the above action. • To keep the CC footage of the act as an evidence. • To Obtain a statement from student and invigilator and authorized by observer and Chief superintendent.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. • To keep the CC footage of the act as an evidence(If any). • To obtain a statement from invigilator and any others as witness authorized by observer and Chief superintendent.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations. • To Obtain a statement from Valuer / Chief Valuer authorized by Spot Coordinator and Controller of Examinations.

* * *

Ragging

Salient Features

- **Ragging within or outside any educational institution is prohibited.**
- **Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student**

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

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 – 1288

LET US MAKE MVGR A RAGGING FREE CAMPUS

ABSOLUTELY SAY NO TO RAGGING

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

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

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

1. Award of the Degree

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

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

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

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

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

(i) Student secures additional 18 credits fulfilling all the requisites of a B.Tech. program i.e., 120 credits.

(ii) Registering for Honors is optional.

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

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

3. Minimum Academic Requirements

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

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

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

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

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

4. Course Pattern

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

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

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

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R24-MVGR

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

I Semester						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R24MCHYT001	Chemistry	3	0	0	3
2	R24MMATT001	Linear Algebra and Differential Equations	3	1	0	3
3	R24MMATT002	Multi Variables and Vector Calculus	3	1	0	3
4	R24MCIVT001	Environmental Studies	2	0	0	2
5	R24MENGT001	Language Proficiency	2	0	0	2
6	R24MCHYL001	Chemistry Laboratory	0	0	2	1
7	R24MSCSL001	Office Tools and Social Media Etiquette	0	0	3	2
8	R24MENGT002	Constitutional Values	2	0	0	2
9	R24MMECW001	Engineering Workshop	1	0	2	2
	Total Credits					**20**

II Semester						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R24MPHYT001	Physics	3	0	0	3
2	R24MMATT003	Probability and Statistics and Numerical Methods	3	1	0	3
3	R24MCIVT002	Applied Mechanics	3	0	0	3
4	R24MSCST001	Procedural Programming	3	0	0	3
5	R24MPHYL001	Physics Laboratory	0	0	2	1
6	R24MSCSL002	Procedural Programming Laboratory	0	0	2	1
7	R24MMECD001	Computer Aided Engineering Drawing	1	0	2	2
8	R24MENGT003	Health and Wellness	2	0	0	2
9	R24MENGT004	Ethics and Human Values	2	0	0	2
	Total Credits					**20**

III Semester						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R24MCIVT003	Fluid Mechanics	3	0	0	3
2	R24MCIVT004	Strength of Materials	3	0	0	3
3	R24MCIVT005	Construction Materials and Concrete Technology	3	0	0	3
4	R24MCIVT006	Building Planning and Drawing	3	0	0	3
5	R24MCSCT001	Data Structures	3	0	0	3
6	R24MCSCT002	Operating Systems	3	0	0	3
7	R24MCIVL001	Surveying Field Work	0	0	3	2
8	R24MCIVL002	Construction Material Testing Laboratory	0	0	3	2
9	R24MCSCL001	Data Structures Lab	0	0	3	2
	Total Credits					**24**

IV Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCIVT007	Structural Analysis	3	0	0	3
2	R24MCIVT008	Soil Mechanics	3	0	0	3
3	R24MCIVT009	Open Channel Hydraulics	3	0	0	3
4	R24MCIVT010	Environmental Engineering	3	0	0	3
5	R24MCSCT003	Python Programming	3	0	0	3
6	R24MCSCT004	Database Management Systems	3	0	0	3
7	R24MCIVL003	CAD and GIS Laboratory	0	0	3	2
8	R24MCIVL004	Soil Mechanics Laboratory	0	0	3	2
9	R24MCSCL002	Python Programming Lab	0	0	3	2
Total Credits						**24**

V Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCIVT011	Design of Reinforced Concrete Structures	3	0	0	3
2	R24MCIVT012	Engineering Hydrology	3	0	0	3
3	R24MCIVT013	Construction Technology and Project Management	3	0	0	3
4	R24MCIVT014	Highway Engineering	3	0	0	3
5	R24MCIVTXXX	DSC-E1	3	0	0	3
6	R24MCSCT005	Software Engineering	3	0	0	3
7	R24MCIVL005	Building Information Modeling Laboratory	0	0	3	2
8	R24MCSCL003	Database Management Systems Lab	0	0	3	2
9	R24MCIVP001	Community Project	0	0	2	2
Total Credits						**24**

VI Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCIVT015	Foundation Engineering	3	0	0	3
2	R24MCIVT016	Estimation and Costing	3	0	0	3
3	R24MCIVT017	Design of Steel Structures	3	0	0	3
4	R24MCSCT006	OOP with JAVA	3	0	0	3
5	R24MCIVTXXX	DSC-E2	3	0	0	3
6	R24MCIVTXXX	DSC-E3	3	0	0	3
7	R24MCIVL006	Applied Computational Methods Laboratory	0	0	3	2
8	R24MCSCL004	OOP with JAVA Lab	0	0	3	2
9	R24MMATT007	Quantitative Problem Solving Techniques	2	0	0	2
Total Credits						**24**

VII Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCIVT018	GIS Applications in Civil Engineering (Self-Study/MOOCS)	3	0	0	3
2	R24MCIVTXXX	E4 (Self-Study/MOOCS)	3	0	0	3
3	R24MCIVTXXX	E5 (Self-Study/MOOCS)	3	0	0	3
4	R24MCIVP002	Mini Project	0	0	2	2
5	R24MCIVL007	Structural Detailing	0	0	3	2
Total Credits						**13**

VIII Semester						
Sl. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1	R24MCSCT007	Computer Networks	3	0	0	3
	R24MCSCT008	Artificial Intelligence: Principles and Techniques	3	0	0	
	R24MCSCT009	OOAD and Design Patterns	3	0	0	
2	R24MCIVP003	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	R24MCIVT019	Building Construction and Services	3	0	0	3
2	DSC-E2	R24MCIVT020	Contracts and Legal Issues	3	0	0	3
3	DSC-E3	R24MCIVT021	Project Administration and Safety Management	3	0	0	3
4	DSC-E4	R24MCIVT022	Ground Improvement Techniques (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R24MCIVT023	Solid Waste Management (Focus on C&D) (Self-study/MOOCS)	3	0	0	3
Water Resources and Environmental Engineering							
1	DSC-E1	R24MCIVT028	Earth Sciences	3	0	0	3
2	DSC-E2	R24MCIVT029	Environmental Impact Assessment	3	0	0	3
3	DSC-E3	R24MCIVT030	Irrigation Engineering and Hydraulic Structures	3	0	0	3
4	DSC-E4	R24MCIVT031	Availability and Management of Groundwater Resources (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R24MCIVT032	Rural Water Resources Management (Self-study/MOOCS)	3	0	0	3
Transportation and Geotechnical Engineering							
1	DSC-E1	R24MCIVT037	Traffic Engineering and Transport Planning	3	0	0	3
2	DSC-E2	R24MCIVT038	Railways, Airports and Harbours	3	0	0	3
3	DSC-E3	R24MCIVT039	Highway Construction Practices	3	0	0	3
4	DSC-E4	R24MCIVT040	Sustainable Transportation Systems (Self-study/MOOCS)	3	0	0	3
5	DSC-E5	R24MCIVT041	Multimodal Urban Transport Systems (Self-study/MOOCS)	3	0	0	3

HONOURS COURSES

Sl. No.	Course Code	Course Title	L	T	P	Credits
Structural Engineering						
1	R24MCIVH001	Advanced Reinforced Concrete Design	3	0	0	3
2	R24MCIVH002	Prestressed Concrete	3	0	0	3
3	R24MCIVH003	Structural Health Monitoring	3	0	0	3
4	R24MCIVH004	Structural Dynamics and Earthquake Resistant Design	3	0	0	3
5	R24MCIVH005	Advanced Structural Analysis	3	0	0	3
6	R24MCIVH006	Advanced Concrete Technology	3	0	0	3
Water Resources Engineering						
1	R24MCIVH007	Water Economics and Governance	3	0	0	3
2	R24MCIVH008	Watershed Management	3	0	0	3
3	R24MCIVH009	Groundwater Hydrology	3	0	0	3
4	R24MCIVH010	Hydraulic and Hydrologic Modelling	3	0	0	3
5	R24MCIVH011	Water Resource System Planning and Management	3	0	0	3
6	R24MCIVH012	GIS	3	0	0	3
Transportation and Geotechnical Engineering						
1	R24MCIVH013	Pavement Materials	3	0	0	3
2	R24MCIVH014	Pavement Analysis and Design	3	0	0	3
3	R24MCIVH015	Advanced Foundation Engineering	3	0	0	3
4	R24MCIVH016	Geo-Environmental Engineering	3	0	0	3
5	R24MCIVH017	Intelligent Transportation System	3	0	0	3
6	R24MCIVH018	Road Safety Audit	3	0	0	3

EXTENDED OPEN ELECTIVE CLUSTER

Business Management Cluster (BMC) (for CSE/IT/CSIT/AIML/DS/ICB)							
Type of Course	**Course Code**	**Course Title**	**Sem**	**Type of Course**	**Course Code**	**Course Title**	**Sem**
EOEC-T1	R24MBMCT001	Financial Management	III	EOEC-L1	R24MMECL001	Computer Aided Geometric Design and Assembly Lab	III
EOEC-T2	R24MMECT013	Leadership and Team Management	III	EOEC-L2	R24MBMCL001	Financial Accounting Lab	IV
EOEC-T3	R24MMECT020	Product Lifecycle Management	IV	EOEC-L3	R24MBMCL002	Digital Engineering Lab	V
EOEC-T4	R24MBMCT002	Quality Management	IV	EOEC-L4	R24MBMCL003	Business Analytics Lab	VI
EOEC-T5	R24MBMCT003	Entrepreneurship	V				
EOEC-T6	R24MMECT018	Business Analytics	VI				
EOEC-E1 (Self-study / MOOCs)	R24MBMCT004	Strategic Management	VIII				
	R24MBMCT005	Digital Marketing					
	R24MMECT017	Logistics and Supply Chain Management					

R24

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

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

Course Objective

This course aims to help students

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	HIGH POLYMERS	8 hr

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

Unit II	ELECTROCHEMISTRY AND ITS APPLICATIONS	8 hr

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

Unit III	SPECTROSCOPY AND MOLECULAR SWITCHES	8 hr

Introduction to spectroscopy - Electromagnetic radiation**;** Classification – Absorption and Emission spectroscopy**;** Laws of Absorption – Derivation of Beer – Lambert's law – Significance**;** UV – Visible Spectroscopy - 1 – Introduction – Principle**;** UV – Visible Spectroscopy – 2 - Instrumentation (block diagram) –

Applications**;** Infra – Red Spectroscopy - 1 – Introduction to Infra - Red Spectroscopy – Principle**;** Infra – Red Spectroscopy – 2 - Instrumentation (block diagram) – Applications**;** Molecular switches - NOR and NOT logic gate operators - Characteristics - Rotaxanes and Catenanes as artificial molecular machines.		
Unit IV	**Corrosion**	**8 hr**
Chemical Corrosion – Mechanism - Pilling Bed worth rule**;** Electrochemical Corrosion - Mechanism - Difference between dry and wet corrosion - Galvanic series**;** Types of Corrosion - Differential aeration corrosion, galvanic corrosion, pitting corrosion, waterline corrosion and stress corrosion**;** Factors influencing rate of corrosion - Metal-based factors and Environment based factors; Corrosion control Methods – Proper design, Use of Pure metal, Use of Alloy**;** Cathodic protection – Sacrificial Anodic protection method – Impressed current cathodic protection method- Use of Inhibitors**;** Protective coatings - Types - Metal Coatings – Anodic - Galvanizing and Cathodic Coating – Tinning**;** Passivation and Pourbaix diagram - Pourbaix diagram.		
Unit V	**Concepts of Green Chemistry, Nano Chemistry and Solar Energy**	**8 hr**
Green Chemistry - Introduction - Principles of Green Chemistry**;** Applications – Any green two reactions**;** Nanomaterials - Introduction – Classification**;** Synthesis of Nano material by Top down and bottom-up approach**;** CVD Method – Sol gel method – Synthesis of iron oxide nano particles**;** Carbon nano tubes – Introduction - Classification – Applications**;** Harnessing of Solar Energy – Construction and Working of PV Cell**;** Solar collectors – Concentrating		

LEARNING RESOURCES

TEXTBOOKS:

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

REFERENCE BOOKS:

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MMATT001	LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS (Common to all branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus and Matrices	**3**	**1**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

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

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

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

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

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

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

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

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

Unit V	**LAPLACE TRANSFORMS**	**8 hr**

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

LEARNING RESOURCES

TEXT BOOKS:

1	B.S.Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MMATT002	MULTI VARIABLES AND VECTOR CALCULUS (Common to all branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Calculus	**3**	**1**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

1	Test for maxima and minima for functions of several variables. (**BL6**)
2	Evaluate double and triple integrals of functions of several variables in two and three dimensions. (**BL5**)
3	Interpret the physical meaning of different operators such as gradient, curl and divergence. (**BL5**)
4	Estimate the work done against a field, circulation and flux using vector calculus. (**BL6**)
5	Solve the partial differential equations by various methods. (**BL3**)
6	Formulate Mathematical models and estimate appropriate physical quantities. (**BL6**)

SYLLABUS

Unit I	**MULTIVARIABLE CALCULUS**	**8 hr**

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

Unit II	**MULTIPLE INTEGRALS**	**8 hr**

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

Unit III	**VECTOR DIFFERENTIATION**	**8 hr**

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

Unit IV	**VECTOR INTEGRATION**	**8 hr**

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

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

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

LEARNING RESOURCES

TEXT BOOKS:

1	B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2	T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition

REFERENCE BOOKS:

1	Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

2	B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3	T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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

Course Objective

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

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

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

SYLLABUS

Unit I	**INTRODUCTION TO ENVIRONMENTAL STUDIES**	**5 hr**
Biodiversity and ecosystem functionality – Natural resources – Environmental pollution – Environmental episodes – Environmental legislation		
Unit II	**INTRODUCTION TO CLIMATE CHANGE**	**5 hr**
Carbon cycle – Earth's Climate System – Weather and Climate – Understanding Microclimate - Policy initiatives to Combat Climate Change		
Unit III	**SCIENCE BEHIND THE CLIMATE CHANGE – 1**	**5 hr**
Greenhouse gas effect - Paleoclimate - Energy Balance - Water Cycle – Atmospheric motion		
Unit IV	**SCIENCE BEHIND THE CLIMATE CHANGE – 2**	**5 hr**
Ocean changes - Cryosphere dynamics – Volcanoes - Biosphere and climate regulation - Mitigation strategies		
Unit V	**LIFESTYLE FOR ENVIRONMENT**	**5 hr**
Sustainability Challenges - Save Energy - Save Water - Reduce waste - Healthy Lifestyles		

LEARNING RESOURCES

TEXTBOOKS:

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

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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

Course Objective

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

Course Outcomes

1	Demonstrate the skill to comprehend, analyze and interpret information. (**BL3**)
2	Demonstrate the skill of structured thinking. (**BL3)**
3	Demonstrate Competency to summarize and paraphrase content in different materials. (**BL3)**
4	Demonstrate application of the skills of presentation in writing and speaking, meeting the requirement of the concept of constructive presentation. (**BL3**)
5	Demonstrate understanding of the nuances in group communication. (**BL3)**

SYLLABUS

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

REFERENCE BOOKS:	
1	Seely, John. *Oxford guide to effective Writing and Speaking*. Oxford Press. 2022.
2.	Atkins, Ros. *The art of explanation.* Wildfire publications. 2023.
WEB RESOURCES:	
1. www.purdueowl.com 2. www.voanews.com 3. www.learningenglish.vn 4. www.prowritingaid.com 5. www.eslcafe.com 6. www.5minutesenglish.com 7. www.livinglanguage.com 8. www.newsinlevels.com	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

<table>
<tr><td rowspan="3">R24MCHYL001</td><td colspan="6">CHEMISTRY LABORATORY
(Common to All Branches)</td></tr>
<tr><td>Total Contact Hours</td><td>28 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>Basics of 10 + 2 Chemistry</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="7">Course Objective: This course aims to help students</td></tr>
<tr><td colspan="7">• To verify the fundamental concepts with experiments</td></tr>
<tr><td colspan="7">Course Outcomes: After completing this course, the students will be able to</td></tr>
<tr><td>1</td><td colspan="6">Determine total hardness, dissolved oxygen, strength of acid in a lead acid battery, using volumetric analysis</td></tr>
<tr><td>2</td><td colspan="6">Explain conductometric, potentiometric, pH metric titrations and colorimetric determinations.</td></tr>
<tr><td>3</td><td colspan="6">Explain the synthesis of a polymer, nanomaterials.</td></tr>
<tr><td colspan="7">List of Experiments</td></tr>
<tr><td></td><td colspan="6">1. Determination of HCl using sodium carbonate.
2. Determination of Strength of an acid in Pb-Acid battery.
3. Determination of Iron (II) using potassium dichromate.
4. Determination of Hardness of a groundwater sample.
5. Determination of Dissolved oxygen in ground water sample.
6. Potentiometric titration of Fe (II) with potassium dichromate.
7. Condcutometric titration of Strong acid VS Strong base.
8. Condcutometric titration of Weak acid VS strong base.
9. pH metric titration of strong acid and strong base.
10. Determination of percentage of Iron in Cement sample by colorimetry.</td></tr>
<tr><td colspan="7">Additional Experiments</td></tr>
<tr><td></td><td colspan="6">1. Preparation of nanomaterials by precipitation method.
2. Preparation of Bakelite.
3. Determination of Cell constant of a conductivity cell.</td></tr>
<tr><td colspan="7">Advanced Design Experiments</td></tr>
<tr><td></td><td colspan="6">1. Determination of viscosity of polymer solution using survismeter.
2. Measurement of 10Dq by spectrophotometric method.</td></tr>
<tr><td colspan="7">TEXTBOOKS</td></tr>
<tr><td></td><td colspan="6">1. A.I. Vogel, "Quantitative Chemical Analysis," 6th ed. Boston, MA, USA: Cengage Learning, 2000.
2. D. A. Day and A. L. Underwood, Quantitative Chemical Analysis. Upper Saddle River, NJ, USA: Prentice Hall, 1991.
3. K. Mukkanti, Practical Engineering Chemistry. Hyderabad, India: B.S. Publications, 2009.</td></tr>
<tr><td colspan="7">REFERENCE BOOKS:</td></tr>
<tr><td></td><td colspan="6">1. J. Cherukui, Laboratory Manual of Engineering Chemistry-II, VGS Techno Series, 2012.
2. Department of Chemistry, MVGR College of Engineering, Laboratory Manual.</td></tr>
</table>

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

Course Objective

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

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

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

LIST OF EXPERIMENTS

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

LEARNING RESOURCES	
ONLINE COURSES	
1	https://books.libreoffice.org/en/
2	https://www.w3schools.com/googlesheets/
3	https://support.microsoft.com/en-us/training

4	https://www.office.com/
5	https://www.google.com/docs/about/
6	https://workspace.google.com/products/sheets/
7	https://in.linkedin.com/
8	https://www.rd.com/list/social-media-etiquette/

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

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

1	Demonstrate understanding of the principles of the Constitution of India. **(BL3)**
2	Demonstrate understanding of Constitutional values. **(BL3)**
3	Demonstrate understanding of Fundamental Rights and their relevance. **(BL3)**
4	Demonstrate understanding of the role of Judiciary in the interpretation and protection of Fundamental Rights. **(BL3)**
5	Develop understanding of the role of institutions like National Human Rights Commission in the protection of Fundamental Rights. **(BL3)**

SYLLABUS

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

LEARNING RESOURCES

REFERENCE BOOK:

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MMECW001	ENGINEERING WORKSHOP					
	Total Contact Hours	14 (L) + 28(P)	**L**	**T**	**P**	**C**
	Pre-requisite	Nil	**1**	**0**	**2**	**2**
Course Objective						
To familiarize students with different useful trades widely used in day- today practice.						
Course Outcomes After completing this course, the students will be able to						
1	Identify various trades and perform related work at a preliminary level.					
2	Select and use proper tools for the different tasks					
3	Address troubleshoots in real-life and get rid of dependency.					
4	Ability to design and model different prototypes using different trades					
5	Demonstrate the safety practices to be applied on different trades					
Module 1	**Carpentry shop** 1.1. Introduction to various types of wood such as Teak, Mango, Sheesham, etc. (Demonstration and their identification). 1.2. Demonstration, function and use of commonly used hand tools. Care, maintenance of tools and safety measures to be observed. Job I Marking, sawing, planning and chiselling & their practice 1.3. Introduction to various types of wooden joints, their relative advantages and uses. Preparation of half lap joint, Preparation of Mortise and Tenon Joint 1.4.Safety precautions in carpentry shop. 1.5 Hands on experience in carpentry for making duster. 1.6 Hands on experience in carpentry for making day-today used products and wood requirement.					
Module 2	**Plumbing:** 2.1. Introduction to plumbing tools, common materials used in plumbing. 2.2. Description and demonstration of simple operations in plumbing 2.3.Care, Safety precautions and maintenance of plumbing tools and setup. 2.4 Design a plumbing layout for domestic applications. 2.5 Address trouble shootings in basic plumbing emergencies.(Spindle replacement in taps, water tap replacement, leakage of a tap)					
Module 3	**House wiring – 3** 3.1 Study, demonstration and identification of common electrical materials such as wires, cables, switches, fuses, PVC Conduits. 3.2 Study of electrical safety measures and demonstration about use of protective devices such as fuses, and relays including earthing. 3.3 Selection of wires (color code) and identification of electrical components in house hold. 3.4 House wiring for specific requirement from main panel and usage of multimeter.					

	3.5 Load calculation given connected utilities and cost estimation
Module 4	**Fabrication – 4:** 4.1 Introduction to welding 4.2. Description about fabrication peripherals such as protection shield, welding machine types, electrode nomenclature. 4.3. Safety measures in welding practice 4.4 Fabrication of an useful component/ product using different weld joints.
Module 5	**Assembly and Disassembly:** 5.1 Introduction to machine parts, tools and accessories used for assembly and disassembly of a machine 5.2. Functions of all parts and their importance 5.3 Care and safety precautions during the work. 5.4 Assembly and disassembly of automobile (Replacement of vehicle tyre) 5.5 Assembly and disassembly of mechanical unit (machine).
LEARNING RESOURCES	
TEXT BOOKS:	
1	K.C. John, *Mechanical workshop practice*, second edition, PHI learning, 2010.
2	Bruce J. Black, *Workshop Processes, Practices and Materials*, Routledge publishers, 5th Edn. 2015.
3	B.S. Raghuwanshi, *A Course in Workshop Technology Vol I. & II,* , Dhanpath Rai & Co., 2015 & 2017.
REFERENCE BOOKS:	
1	S. K. Hajra Choudhury, Hajra Choudhury, A K, Roy, Nirjhar, Bhattacharya, S C. *Elements of Workshop Technology, Vol. I*, 14th edition, Media Promoters and Publishers, Mumbai. 2007.
2	H. S. Bawa, *Workshop Practice*, Tata-McGraw Hill, 2004.
3	Soni P.M. & Upadhyay P.A, *Wiring Estimating, Costing and Contracting;* Atul Prakashan, 2021.
ADDITIONAL REFERENCE MATERIAL	
1	https://mrcet.com/downloads/hs/EWS-ITWS%20%20LAB%20MANUAL.pdf
2	https://sjce.ac.in/wp-content/uploads/2018/04/Workshop-Laboratory-Manual.pdf
3	https://manavrachna.edu.in/latest/virtual-lab-workshop-for-first-year-engineering-students-mru/

II Semester

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

Course Objective

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

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

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

SYLLABUS

Unit I	**CRYSTAL PHYSICS**	**8 hr**

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

Unit II	**MAGNETIC AND DIELECTRIC MATERIALS**	**8 hr**

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

Unit III	**WAVE OPTICS**	**8 hr**

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

Unit IV	**PHOTONICS**	**8 hr**

Absorption, Spontaneous and Stimulated emission of radiation; Einstein coefficients- Relation between the coefficients; Laser- Characteristics- Applications; Population inversion (3-level)- Components of laser system; Ruby laser- Construction- Working- Advantages; Optic fiber- Principle- Components of fiber; Numerical aperture- Acceptance angle- Acceptance cone; Classification of optic fiber- Step Index- Graded Index fibers.

Unit V	QUANTUM PHYSICS AND SEMICONDUCTORS	8 hr
Matter Wave- de Broglie wavelength of matter wave; Uncertainty principle- Wave function- Physical significance; Schrodinger Time-independent wave equation; Particle in a 1D potential box- Energies and Wave functions; Fermi-Dirac distribution function- Distinction between metals, insulators and semiconductors; Intrinsic semiconductors- Carrier concentration- Fermi level; Extrinsic semiconductors- Carrier concentration; Hall effect		

LEARNING RESOURCES	
TEXT BOOKS:	
1	B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Second edition. Cengage Learning, 2021.
2	M. N. Avadhanulu, P.G.Kshirsagar and TVS Arun Murthy, *A Text book of Engineering Physics*, Eleventh edition. S.Chand Publications, 2019.
REFERENCE BOOKS:	
1	Hitendra K. Malik and A.K. Singh, *Engineering Physics*, Second edition. Mc. Graw Hill Publishers, 2017.
2	M.R. Srinivasan, *Engineering Physics,* Second edition. New Age International Publishers, 2021.
3	Shatendra Sharma and Jyotsna Sharma, *Engineering Physics*, First edition. Pearson Education, 2018.
ADDITIONAL REFERENCE MATERIAL:	
1	https://www.youtube.com/watch?v=GQ5XpeS3e3U&list=PLLy_2iUCG87B_Tmfs0y2tR8GNIkyRIKpW
2	https://archive.nptel.ac.in/courses/112/106/112106227/
3	https://archive.nptel.ac.in/courses/122/107/122107035/
4	https://archive.nptel.ac.in/courses/104/104/104104085/ https://archive.nptel.ac.in/courses/115/107/115107095/
5	https://archive.nptel.ac.in/courses/115/101/115101107/ https://archive.nptel.ac.in/courses/108/108/108108122/

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit 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

R24MMATT003	PROBABILITY & STATISTICS AND NUMERICAL METHODS (CIV, MEC & CHE)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic calculus and probability	**3**	**1**	**0**	**3**

Course Objective

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

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

1	Analyze and comprehend the properties of different statistical distributions. (**BL4**)
2	Utilize statistical techniques to analyze bivariate data. (**BL3**)
3	Test a hypothesis concerning means and proportions for large samples. (**BL6**)
4	Solve algebraic and transcendental equations and use numerical techniques for interpolation. (**BL3**)
5	Apply Numerical methods to solve initial value problems and do numerical integration. (**BL3**)
6	Formulate Mathematical models and estimate appropriate physical quantities. (**BL6**)

SYLLABUS

Unit I	**RANDOM VARIABLES & PROBABILITY DISTRIBUTIONS**	**8 hr**

Discrete Random Variable; Discrete Probability Distribution; Expectation of Discrete random variable; Continuous random variable; Continuous probability distribution; Normal distribution; Probabilities of normal variable; Parameters of normal variable.

Unit II	**STATISTICAL METHODS**	**8 hr**

Fitting of Linear Curve-1; Fitting of Linear Curve-2; Fitting of Parabola; Fitting of Exponential Curve; Fitting of Power Curve; Correlation-1; Correlation-2; Regression.

Unit III	**SAMPLING DISTRIBUTIONS AND TESTING OF HYPOTHESIS (LARGE SAMPLES)**	**8 hr**

Sampling Distribution of Means with replacement; Sampling Distribution of Means without replacement; Confidence interval for means; Confidence interval for proportions; Testing of Hypothesis for single mean; Testing of Hypothesis for two means; Testing of Hypothesis for single proportion; Testing of Hypothesis for two proportions.

Unit IV	**NUMERICAL METHODS-1**	**8 hr**

Bisection Method; Regula-Falsi Method; Newton-Raphson Method; Finite Differences and Symbolic operations; Newton Forward interpolation-1; Newton Forward interpolation-2; Newton Backward interpolation; Lagrange's interpolation.

Unit V	**NUMERICAL METHODS-2**	**8 hr**

Trapezoidal rule-1; Trapezoidal rule-2; Simpson's 1/3 rule; Simpson's 3/8 rule; Taylor's Series method; Euler's method; Runge-Kutta method of 2^{nd} order; RK method of 4^{th} order.

LEARNING RESOURCES

TEXT BOOKS:

1	RE Walpole, SL Mayeres & K May, Probability and Statistics for Engineers & Scientists, 3/e, Pearson Publishers
2	T.K.V. Iyengar et al, Probability and Statistics, S. Chand Publications, Revised edition.

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MCIVT002	APPLIED MECHANICS					
	Total Contact Hours	45 (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: After completing this course, the students will be able to

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	**FORCES AND KINETICS**	**8 Hrs.**

Introduction to Applied Mechanics– Basic Concepts. Scope and Applications

Systems of Forces: Free body diagrams, Equilibrium of forces

Friction: Introduction, Terminology, Types and laws of friction, Sliding friction

Kinetics: D-Alembert's principle, Concept of work energy equation

Loads: Types of loads, Types of supports, Types of beams

UNIT 2	**INTRODUCTION TO SHEAR FORCE AND BENDING MOMENT DIAGRAMS**	**8 Hrs.**

Definition of Structure, Classification of structures based on materials, load transfer mechanism etc., Types of Supports, Types of loads, Types of beams; Definition, understanding shear force and bending moment as internal forces; Shear Force and Bending Moment diagrams for cantilever beams and simply supported beams under Point loads, Uniformly distributed loads, uniformly varying loads and Couple;

UNIT 3	**CENTROID**	**8 Hrs.**

Introduction- Terminology, Significance of Centroid, Pappu's Theorem-I and II, Centroid of linear elements, Centroid of regular areas, Centroid of Composite areas, Centroid of built-up sections

UNIT 4	**MOMENT OF INERTIA**	**8 Hrs.**

Moment of Inertia, Polar Moment of inertia and radius of gyration, Parallel axis theorem, Perpendicular theorem, Moment of Inertia of regular areas, Moment of Inertia of composite areas.

UNIT 5	ANALYSIS OF PLANE TRUSSES	8 Hrs.
Introduction, types of trusses, assumptions, Indeterminacy and types, Static indeterminacy of plane and space trusses, Analysis of statically determinate plane trusses using method of joints and method of sections, zero force members		
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:		
1	https://archive.nptel.ac.in/courses/112/106/112106286/	
2	https://archive.nptel.ac.in/courses/112/106/112106180/	
3	https://nptel.ac.in/courses/112103109	
4	https://archive.nptel.ac.in/courses/122/104/122104014/	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

CO	Blooms Level	Unit-1	Unit-2	Unit-3	Unit-4	Unit-5
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**

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

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	**INTRODUCTION TO PROGRAMMING**	**8 hr**

Software, hardware, Number Systems (Binary, Hexadecimal, Octal, Decimal); Algorithms, pseudo code; Flowcharts, Program development steps; Structure of c program with example;

Tokens, Basic data types; Operators Arithmetic, logical, relational, bitwise; ternary, increment /decrement, special operators, assignment; Built-in Input/output Functions, Expressions, type casting.

Unit II	**SELECTION AND CONTROL STATEMENTS**	**8 hr**

Two way selection statements if, if-else with examples; Nested if with examples; Multiway selection statements - switch with examples; Nested switch with examples, else if ladders with examples;

Iterative statements while, do-while with examples; for loop with examples; Nested loops with examples; Un conditional statements; break, continue, goto with examples

Unit III	**INTRODUCTION TO ARRAYS AND STRINGS, MODULAR PROGRAMMING THROUGH FUNCTIONS**	**8 hr**

Array Definition, Declaration and accessing of 1D array; Declaration and accessing of integer 2D array; 2D array applications: matrix addition, multiplication; String definition, declaration and accessing of strings with examples;

Function Definition, prototype, declaration and accessing with examples; Parameter passing mechanisms with examples, Scope and Extent of Variables; Storage classes auto, static, Register and extern with examples; Definition of recursion, types of recursion (direct and indirect) Solving problems using recursive approach like finding factorial, Fibonacci series, Towers of Hanoi.

Unit IV	**POINTERS AND DYNAMIC MEMORY ALLOCATION**	**8 hr**

Definition of pointers, declaration, initialization, Pointer arithmetic; Representing 1D array using pointers with examples; Representing 2D arrays using pointers

with examples; Pointer to pointer, constant pointers with examples, Pointer to constant variable, void pointer, generic pointer with examples; Pointers to Functions; Difference between static and dynamic memory allocation, Dynamic memory allocation using built-in functions (malloc (), calloc ()) ; Dynamic memory allocation using built-in functions (realloc (), free ()) ; Dangling pointer and unreferenced memory problem		
Unit V	**STRUCTURES, UNIONS AND FILE HANDLING**	**8 hr**
Structure definition, declaration, initialization and accessing structure members; Nested structures with examples, arrays of structures; Pointer to structures with examples, Self-Referential structures; Unions, Bitfields, typedef with examples; Concept of a file and file modes, Formatted I/O; File handling functions; fopen (), fclose (), fscanf (), fprintf (); Random access files handling functions, command line arguments ; Text files, Binary files, Differences between text and Binary files, fread (), fwrite ()		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Brian W Kernighan and Dennis M Ritchie, *The C programming Language*, Second Edition, Pearson, 2015.	
2	Pradip Dey, Manas Ghosh, *Programming In C*, 2nd Edition, Oxford Higher Education, 2011.	
REFERENCE BOOKS:		
1	Dr Reema Thareja, *Programming in C*, Third Edition, Oxford Press, 2023.	
2	Byron Gottfried, *Programming with C*, Third Edition. Schaums Outlines Series, 2017.	
3	Ajay Mittal, *Programming in C - A Practical Approach*, Pearson, 2010.	
ONLINE COURSES		
1	https://mvgrce.codetantra.com	
2	www.netacad.com	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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

Course objectives

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

Course outcomes

After completion of course, the students will be able to

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

LIST OF EXPERIMENTS

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

ADDITIONAL EXPERIMENTS

1	Determination of dielectric constant of solid dielectric.
2	Determination of rigidity modulus of the of the material of the wire- Torsional pendulum

3	Determination of frequency of the electrical vibrator- Melde's experiment
LEARNING RESOURCES	
TEXT BOOK:	
1	C.S. Robinson and Dr. Ruby Das, *A Textbook of Engineering Physics Practical*, First edition. Laxmi Publications Pvt. Ltd., 2016.
REFERENCE BOOK:	
1	S. Balasubramanian and M.N. Srinivasan, *A Textbook of Practical Physics*, First edition. S. Chand Publishers, 2017
ADDITIONAL REFERENCE:	
1	www.vlab.co.in

<table>
<tr><td rowspan="3">R24MSCSL002</td><td colspan="6">PROCEDURAL PROGRAMMING LABORATORY</td></tr>
<tr><td>Total Contact Hours</td><td>28 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>-</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">To get practical exposure to the Structured Programming with hands-on experience in laboratory for solving real world problems using C</td></tr>
<tr><td colspan="7">Course Outcomes
After completing this course, the students will be able to</td></tr>
<tr><td>1</td><td colspan="6">Students will write and execute simple C programs, demonstrating understanding of basic input/output operations and program structure.</td></tr>
<tr><td>2</td><td colspan="6">Students will use various operators and control structures to perform decision-making and repetitive tasks.</td></tr>
<tr><td>3</td><td colspan="6">Students will declare, initialize, and perform operations on one-dimensional and multi-dimensional arrays, as well as handle string operations.</td></tr>
<tr><td>4</td><td colspan="6">Students will define, call, and pass parameters to functions, including recursive functions, to solve problems in a modular and efficient manner.</td></tr>
<tr><td>5</td><td colspan="6">Students will use pointers for dynamic memory allocation, manipulate structures and unions, and perform file operations for reading and writing data in text and binary formats.</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS</td></tr>
<tr><td>1</td><td colspan="6">Week-1: Introduction to Programming with operators
1. Write a C program to print "Hello, World!" and understand the structure of a basic C program.
2. Write a C program to demonstrate the use of basic I/O statements (printf, scanf)
3. Write a C program for calculating the sum of two numbers.</td></tr>
<tr><td>2</td><td colspan="6">Week-2: Expressions and Operators
1. Write a C program to finding the maximum of three numbers using conditional operator.
2. Write a C Program to convert temperature from Celsius to Fahrenheat and vice versa
3. Write a C Program to to calculate simple and compound interest</td></tr>
<tr><td>3</td><td colspan="6">Week 3: Selection Statements
1. Write a C program to find the largest of three numbers using if-else statements.
2. Write a program to demonstrate the use of switch-case statements to perform arithmetic operations based on user choice.
3. Write a program to demonstrate the use of else-if ladder to grade student marks.</td></tr>
<tr><td>4</td><td colspan="6">Week-4: Loops
1. Write a C program to print sum of the digits of the given number.
2. Write a C program to print the Fibonacci series up to n terms using a for loop.
3. Write a C program to check the given number is a palindrome or not.
4. Write a C program to calculate the factorial of a number using a while loop.</td></tr>
</table>

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

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

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

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

Course Outcomes

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

SYLLABUS:

Module 1:

Overview of CAD Software:

Computer technologies that impact graphical communication, Demonstrating knowledge of CAD software such as The Menu System, Toolbars, Command window, and Status Bar.

Set up the drawing page and the printer, Scale settings, setting up of units and drawing limits, standards for annotations, and 3D Modelling.

Module 2:

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

Module 3:

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

List of Exercises

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

LEARNING RESOURCES

TEXT BOOKS:

1	N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 2016.
2	Dhananjay Jolhe, *Engineering Drawing with an Introduction to AutoCAD*, Tata McGraw Hill, 2017

REFERENCE BOOKS:

1	K.L. Narayana and P. Kannaiah, *Engineering Drawing*, Tata McGraw Hill, Third Edition, 2013.
2	M.B.Shah and B.C. Rana, *Engineering Drawing*, Pearson Education Inc., 2009.
ADDITIONAL REFERENCE MATERIAL	
1	https://nitc.ac.in/imgserver/uploads/attachments/Ed__5c3343c5-c3f9-468a-b114-8f33556810b4_.pdf

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

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	**INTRODUCTION TO HEALTH AND WELLNESS AND WELLNESS PLANNING**	**5 hr**

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

Unit II	**HEALTHY LIFESTYLE CHOICE**	**5 hr**

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

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

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

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

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

Unit V	**SELF-CARE**	**5 hr**

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

LEARNING RESOURCES

TEXTBOOKS:

1	B.K.S. Iyengar, *Yoga The Path to Holistic: The Definitive Step-by-step Guide,* DK Publishers, 2021.
2	C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian, *Nutritive value of Indian foods (NVIF),* National Institute of Nutrition, India, 2023.
3	ICMR-*National Institute of Nutrition, Short summary report of*

	nutrient requirements for Indians, 2020.
4	Emily Attached & Marzia Fernandez*, Mental Health Workbook,* 2021.
REFERENCE BOOKS:	
1	C. Nyambichu & Jeff Lumiri, *Lifestyle Diseases: Lifestyle Disease Management*, 2018.
2	Nashay Lorick, *Mental Health Workbook for Women: Exercises to Transform Negative Thoughts and Improve Well-Being,* 2022.
3	Angela Clow & Sarah Edmunds, *Physical Activity and Mental Health*, 2013.
ADDITIONAL REFERENCE MATERIAL	
1	B.K.S. Iyengar, *Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority*, 2006.
2	Claude Bouchard, Steven N. Blair, William L. Haskell, *Physical Activity and Health*, Human Kinetics*,* 2012.
ONLINE COURSES	
1	http://vikaspedia.in/health/nutrition
2	https://yoga.ayush.gov.in/Yoga-Course/

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	**UNDERSTANDING THE SELF**	**5 hr**

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

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

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

Unit III	**ETHICAL THEORIES**	**5 hr**

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

Unit IV	**ETHICS AND ENGINEERING**	**5 hr**

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

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

Unit V	**ETHICS AND GLOBAL CONTEXTS**	**5 hr**

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

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

III Semester

R24MCIVT003	FLUID MECHANICS					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite	-	**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.		
LEARNING RESOURCES		
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	

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

R24MCIVT004	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

R24MCIVT005	CONSTRUCTION MATERIALS AND CONCRETE TECHNOLOGY					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	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. **(BL 4)**
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. **(BL 3)**
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

R24MCIVT006	BUILDING PLANNING & DRAWING					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	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	Examine public building drawings to determine how they reflect compliance with codes, user requirements, and functional needs. **(BL4)**
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	BL4					X
CO6	BL6	X	X	X	X	X

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

Course Objective

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

Course Outcomes

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

SYLLABUS

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

Data Structures- Introduction, need for a data structure, Types of Data Structures; Overview of time and space complexity analysis, asymptotic notations; Recursion-Introduction, Types of recursions; Searching-Linear Search algorithm, Binary Search algorithm

Sorting techniques- Bubble Sort, Selection Sort; Insertion Sort; Quick Sort; Merge Sort.

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

Introduction to Linked List, Variations/Types of Linked Lists, Applications; Single Linked List Operations: creation, insertion; Deletion, Traversal/Search; Circular Linked Lists-Insertion, Deletion, Traversal/Search.

Double Linked Lists and Operations- Creation, Insertion; Deletion, Traversal/Search; Applications of Linked List-Representation of Sparse Matrix using Single Linked List, Representation of Polynomials using Single Linked List; Polynomial Operations (Addition) using Linked List.

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

Introduction to Stack data structures, basic operation, implementation of Stack using array; Stack implementation using Linked Lists, advantages &

disadvantages; Applications of Stack: Infix to postfix conversion; postfix expression evaluation, Factorial using Stack. Introduction to Queue data structures, basic operation, implementation of Queue using array; Queue operations implementation using Linked Lists; Circular Queues using Arrays; Double Ended Queues.		
Unit IV	**TREE- BINARY TREE, BINARY SEARCH TREE, BALANCED TREE**	**8 hr**
Tree – Introduction, Types of Trees; Binary Tree – Introduction, Properties, Various ways of representing Binary Tree in memory; Recursive Binary tree traversals, Construction of Binary tree given tree traversals (In-order, Pre-order & In-order, Post-order); Tree applications-Heap(Min/Max) Binary Search tree operations- Creation, Insertion; Deletion, Traversal/Search; Balanced Binary trees – Introduction, Operations on AVL Trees –Insertion; AVL Tree Deletion, Search.		
Unit V	**GRAPHS AND HASHING**	**8 hr**
Basic concepts, Representation of Graph using Adjacency Matrix and Adjacency List; Graph Traversals (BFS, DFS); minimum spanning tree using Prim's Algorithm; minimum spanning tree using Kruskal's algorithm Single Source Shortest Distance- Dijkstra's algorithm, transitive closure; Introduction to Hashing, Hash Functions; Collision Resolution Techniques: Open hashing -chaining, Open Addressing- linear probing; quadratic probing, double hashing.		

LEARNING RESOURCES

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

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

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

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

Course Objective

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

Course Outcomes

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

SYLLABUS

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

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

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

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

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

Process Synchronization-Background, The Critical section problem;

Software-Based Solution (Peterson's Solution), Synchronization Hardware; Semaphores- Usage, Implementation; Classical Problems Synchronization-Bounded Buffer, Readers Writer's problem; Deadlock-System model, Deadlock Characterization; Methods of handling deadlocks, Deadlock Prevention; Deadlock Avoidance; Deadlock Detection, Recovery from Deadlock.		
Unit IV	**MEMORY MANAGEMENT**	**8 hr**
Background-Basic Hardware, Address Binding, Logical vs Physical; Swapping, Contiguous Memory Allocation; Paging- Basic Method, Hardware; Structure of page tables; Segmentation -Basic Methods, Hardware; Virtual Memory-Background, Demand Paging- Basic Concepts; Page Replacement Algorithm-Basic Page replacement, FIFO, Optimal; Page Replacement Algorithm-LRU, Thrashing-Causes of Thrashing.		
Unit V	**FILE & STORAGE MANAGEMENT, PROTECTION AND SECURITY**	**8 hr**
File Concept-File Attributes, File Operations, File Types; Directory Structure- Overview, Single level, Two level, Tree Structure; File Allocation Methods- Contiguous, Linked, Indexed; Mass Storage-Magnetic Disk, Magnetic Tape, Disk Structure; Disk Scheduling; Goals of Protection, Principals of Protection, Access Matrix, ACL; The Security Problems, Program threats- Trojan, Trap Door, Ransomware; User Authentication-Passwords, Password Vulnerabilities, Encrypted Password, OTP, Bio-Metric.		

LEARNING RESOURCES

TEXTBOOKS:	
1	Operating systems concepts by Abraham Silberschatz, peter B. Galvin, and Greg Gagne.
2	Operating systems: Internals and design principles by William Stallings.
REFERENCE BOOKS:	
1	Modern operating systems by Andrew S. Tanenbaum
ADDITIONAL REFERENCE MATERIAL	
1	"Operating Systems: Three Easy Pieces" by Remzi H. Arpaci-Dusseau and Andrea C. ArpaciDusseau (Free online book available at: http://pages.cs.wisc.edu/~remzi/OSTEP/)
2	"Linux Kernel Development" by Robert Love.
3	"File System Forensic Analysis" by Brian Carrier.

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MCIVL001	SURVEYING FIELD WORK					
	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, the student 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

R24MCIVL002	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, the student 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

LIST OF EXPERIMENTS

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

Demo Experiments

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

<table>
<tr><td rowspan="3">R24MCSCL001</td><td colspan="6">DATA STRUCTURES LAB
(Common to all Branches)</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>Basic Programming</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">To get hands-on exposure to linear and non-linear data structures and to identify and apply the suitable data structures for the given real-world problem.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Student will be able to implement recursive algorithms and will be able to understand the role of linear data structures in organizing and accessing data efficiently using searching and sorting techniques.</td></tr>
<tr><td>2</td><td colspan="6">Student will be able to implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation.</td></tr>
<tr><td>3</td><td colspan="6">Student will be able to develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.</td></tr>
<tr><td>4</td><td colspan="6">Student will be able to apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between linear queues and circular queues, and apply them appropriately.</td></tr>
<tr><td>5</td><td colspan="6">Student will be able to devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, trees, graphs.</td></tr>
<tr><td>6</td><td colspan="6">Student will be able to recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems.</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS</td></tr>
<tr><td>1</td><td colspan="6">WEEK 1(SEARCH TECHNIQUES)
• Write a C Program to search an element in the given list using Linear Search Technique. (using recursive and non-recursive functions)
Write a C Program to search an element in the given sorted list using Binary Search Technique. (using recursive and non-recursive functions)</td></tr>
<tr><td>2</td><td colspan="6">WEEK 2(SORTING TECHNIQUES)
• Write a C Program using recursive function to sort a given list of integers in ascending order using Bubble Sort Technique.
• Write a C Program using recursive function to sort a given list of integers in ascending order using Quick Sort Technique.
• Write a C Program using recursive function to sort a given</td></tr>
</table>

	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

IV Semester

R24MCIVT007	STRUCTURAL ANALYSIS					
	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	Ability to analyse simply supported and cantilever beams for slope and deflection. (BL4)
2	Ability to analyze statically indeterminate beams using slope deflection method. (BL4)
3	Ability to analyze statically indeterminate beams using moment distribution method. (BL4)
4	Ability to analyze the indeterminate plane truss using stiffness method (BL4)
5	Ability to develop Influence Line Diagrams and analyze simply supported beams subjected to moving loads. (BL4)
6	Ability to analyze 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		
TEXT BOOKS:		
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

R24MCIVT008	SOIL MECHANICS					
	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 behaviour 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

R24MCIVT009	OPEN CHANNEL HYDRAULICS					
	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

R24MCIVT010	ENVIRONMENTAL ENGINEERING					
	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

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

Course Objective

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

Course Outcomes

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

SYLLABUS

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

Data Types, Escape Sequences, Variables and Basic Input/Output; Assignment Statements, Operators; Arithmetic Expressions, Operator precedence, Type Casting, Program Comments and Docstrings; Program Format and Structure, REPL, IDLE, Running a Script from a Terminal Command Prompt;

Built-In Functions and Modules; User Defined modules creation and importing a user defined module; NumPy – Functions on 1D arrays, Functions on 2D arrays; Pandas Module-Creation of Series, DataFrames, indexing objects;

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

Conditional Statements; While loop, for loop; range () function, nested loops; While-else, For- else, break, continue, pass;

Functions: Syntax and basics of function and usage; Passing Parameters, arguments in a function – Default, keyword, positional and Variable - length arguments; local and global scope of variable; return statement, recursive function, recursion vs iteration;

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

Strings- A String is a sequence, Strings are immutable, String slice, String methods; Membership and Identity operators, String search; List-

Lists are mutable, List operations; Lambda functions, Map, filter and reduce; Tuples- Tuples are immutable, Tuple operations; Tuple as return values, List Comprehension, Comparison of Lists and tuples; Dictionaries – Dictionary Creation, operations, Looping through dictionaries; Dictionary Comprehension, Applying dictionary methods to counter objects, Reverse Lookup dictionary;		
Unit IV	**FILES AND PANDAS**	**8 hr**
Introduction to Files, modes, types of files, File handling functions: open(), close(), read(), readline(), readlines(); write(), writeline(), append(); seek(), tell(), flush(); file copy using shutil (), delete a file (os.remove ()); Pandas-DataFrame creation with dictionaries, list of dictionaries, dictionary of series, renaming columns and rows labels; Importing data from CSV to DataFrame (Pandas), Inspecting data in DataFrame (head (), tail (), info()), Statistical summary (describe ()); Slicing and Sorting in Pandas; Modifying DataFrames, Data Cleaning in Pandas;		
Unit V	**TKINTER GUI, EVENT DRIVEN PROGRAMMING, WIDGETS**	**8 hr**
The Behavior of Terminal-Based Programs and GUI-Based Programs, Label, Entry and Button widget; Tkinter Geometry methods (pack(), grid(), place()); Event-Driven Programming, Command Buttons and Responding to Events; CheckButton and Radiobutton widgets; Menu and Menu button widgets; Listbox and Scrollbar widgets; Messagebox and Toplevel widget; File Dialog widget;		
LEARNING RESOURCES		
TEXTBOOKS:		
1	Kenneth A. Lambert. -Fundamentals of Python: First Programs‖, 2nd Edition, Publisher: Cengage Learning	
2	Reema Thareja.-Python Programming using Problem Solving Approach	
3	R. Nageswara Rao, -Core Python Programming	
REFERENCE BOOKS:		
1	Wesley J. Chun. -Core Python Programming - Second Edition‖, Prentice Hall	
2	John V Guttag. -Introduction to Computation and Programming Using Python‖, Prentice Hall of India	
ONLINE COURSES		
1	https://www.w3schools.com/python/	
2	https://www.tutorialspoint.com/python/index.htm	
3	https://docs.python.org/3/tutorial/	
4	https://www.pythontutorial.net/tkinter	
5	https://www.python-course.eu/python3_course.php	
6	https://www.geeksforgeeks.org/python-tkinter-tutorial/	
7	https://www.tutorialspoint.com/python/python_gui_programming.htm	
8	https://www.programiz.com/python-programming	

Bloom's level – Units catchment articulation matrix

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

R24MCSCT004	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
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	

R24MCIVL003	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

TEXT BOOKS:	
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.

R24MCIVL004	SOIL MECHANICS LABORATORY					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Soil Mechanics	**0**	**0**	**3**	**2**

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	
TEXT BOOKS:	
1	K. R. Arora, "Soil Mechanics and Foundation Engineering," Standard Publishers Distributors, Delhi, 2008.
2	IS 1498-1970, "IS code of Practice for classification and identification of soils for general engineering purposes", BIS, New Delhi.
REFERENCE BOOKS:	
1	IS 2720, "IS code of Practice for methods of test for soils. (Latest Edition)". Bureau of Indian Standards, New Delhi.

<table>
<tr><td rowspan="3">R24MCSCL002</td><td colspan="6">PYTHON PROGRAMMING LAB
(Common to all branches)</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>C Programming</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">Students will implement python programming constructs which are used to develop both desktop and graphical user applications.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Students will be able to apply the basic building blocks of python language like variables, operators and modules.</td></tr>
<tr><td>2</td><td colspan="6">Students will be able to apply conditional control statements and functions.</td></tr>
<tr><td>3</td><td colspan="6">Students will be able to apply various file operations and analyze the data using pandas library.</td></tr>
<tr><td>4</td><td colspan="6">Students will be able to choose and decide the suitable widgets to design and develop Graphical User Interface (GUI) applications.</td></tr>
<tr><td colspan="7">List of Experiments</td></tr>
<tr><td>1</td><td colspan="6">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</td></tr>
<tr><td>2</td><td colspan="6">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</td></tr>
<tr><td>3</td><td colspan="6">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</td></tr>
<tr><td>4</td><td colspan="6">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.</td></tr>
<tr><td>5</td><td colspan="6">Week – 5: PROGRAMS ON FUNCTIONS</td></tr>
</table>

	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

V Semester

R24MCIVT011	**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

R24MCIVT012	ENGINEERING HYDROLOGY					
	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

R24MCIVT013	CONSTRUCTION TECHNOLOGY AND PROJECT MANAGEMENT					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Pre-requisite(s)	None	**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

R24MCIVT014	HIGHWAY ENGINEERING					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	None	**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	BL 6	X	X	X	X	X

R24MCIVT019	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

R24MCIVT028	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. **(BL3)**
3	Identify and classify geological structures (folds, faults, joints, unconformities) and formations, and examine their impact on construction projects and groundwater resources. **(BL4)**
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	BL4	**X**				
CO2	BL3		**X**			
CO3	BL4			**X**		
CO4	BL4				**X**	
CO5	BL4					**X**
CO6	BL6	**X**	**X**	**X**	**X**	**X**

R24MCIVT037	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	
TEXT BOOKS:	
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

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

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

Unit I	**INTRODUCTION TO SOFTWARE ENGINEERING**	**8 hr**

The Nature Of Software; Software Engineering - A Layered Technology; Software Engineering Practice; Software Myths; A Generic Process Model, Software Process Framework; Process flow, Identifying Task set, Process pattern; Process Assessment and Improvement (SCAMPI, CMM-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 hr**
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

R24MCIVL005	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

SYLLABUS

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

LEARNING RESOURCES

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.

R24MCSCL003	DATABASE MANAGEMENT SYSTEMS LAB					
	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 ofdata 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

VI Semester

R24MCIVT015	FOUNDATION ENGINEERING					
	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; ø=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

R24MCIVT017	DESIGN OF STEEL STRUCTURES					
	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	BL4		X			
CO3	BL4			X		
CO4	BL4				X	
CO5	BL4					X
CO6	BL6	X	X	X	X	X

R24MCSCT006	OOP WITH JAVA					
	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	

BLOOM'S LEVEL - UNITS CATCHMENT ARTICULATION MATRIX

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

R24MCIVT020	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	Design a simple welfare plan for workers by including safety rules, insurance schemes, and incentive measures. **(BL6)**
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	**BL6**					X
C06	**BL6**	X	X	X	X	X

R24MCIVT029 DSC-E2	Environmental Impact Assessment					
	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.
3	

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

R24MCIVT038	RAILWAYS, AIRPORTS AND HARBOURS					
	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	**BL3**	X				
CO2	**BL4**		X			
CO3	**BL4**			X		
CO4	**BL5**				X	
CO5	**BL5**					X
CO6	**BL6**	X	X	X	X	X

R24MCIVT021	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

R24MCIVT030	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

R24MCIVT039	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

R24MCIVL006	APPLIED COMPUTATIONAL METHODS LABORATORY					
	Total Contact Hours	45 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Highway Engineering, Open Channel Hydraulics, Engineering Hydrology	**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

<table>
<tr><td rowspan="3">R24MCSCL004</td><td colspan="6">OOP WITH JAVA LAB
(for MEC, ECE, EEE, CIV and CHE)</td></tr>
<tr><td>Total Contact Hours</td><td>42 (P)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisite</td><td>-</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td colspan="7">Course Objective</td></tr>
<tr><td colspan="7">Students will have the ability to apply object-oriented programming concepts in Java to develop and implement modular and reusable software solutions.</td></tr>
<tr><td colspan="7">Course Outcomes</td></tr>
<tr><td>1</td><td colspan="6">Students will be able to implement object-oriented programming concepts such as classes, inheritance, polymorphism, and exception handling to build modular Java applications.</td></tr>
<tr><td>2</td><td colspan="6">Students will be able to examine and debug Java programs to identify and resolve logical errors, ensuring correctness and efficiency.</td></tr>
<tr><td>3</td><td colspan="6">Students will be able to assess the design and performance of Java applications, optimizing for scalability, maintainability, and resource management.</td></tr>
<tr><td>4</td><td colspan="6">Students will be able to design and develop advanced Java applications by integrating OOP principles, multithreading, GUIs, and data structures to solve real-world problems.</td></tr>
<tr><td colspan="7">List of Experiments</td></tr>
<tr><td>1</td><td colspan="6">Week 1: Introduction to Java and Structured Programming
1. Write a simple Java program that prints "Hello, World!" to the console.
2. Write a Java program that takes user input using the Scanner class.
3. Write a Java program to demonstrate all primitive data types.
4. Implement a Java program that converts a floating-point number to an integer.
5. Create a Java program that uses the final keyword to define constants.</td></tr>
<tr><td>2</td><td colspan="6">Week 2: Operators, Control Statements - Selection
1. Implement a Java program that uses arithmetic, relational, and logical operators.
2. Write a Java program to find the largest of three numbers using if-else statements.
3. Use the ternary operator to implement a simple conditional check.</td></tr>
<tr><td>3</td><td colspan="6">Week 3: Control Statements - Iteration
1. Write a Java program that prints all even numbers between 1 and 100 using a for loop.
2. Create a Java program that calculates the factorial of a</td></tr>
</table>

	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

R24MMAT007	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

VII Semester

R24MCIVT018	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

R24MCIVT022	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

R24MCIVT031	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 MEASUREMNT 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

R24MCIVT040	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

R24MCIVT023	SOLID WASTE MANAGEMENT					
	Total Contact Hours	42(L)	**L**	**T**	**P**	**C**
	Prerequisite		**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

R24MCIVT032	RURAL WATER RESOURCES MANAGEMENT					
	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

R24MCIVL007	STRUCTURAL DETAILING					
	Total Contact Hours	45 (P)	**L**	**T**	**P**	**C**
	Pre-requisite	Basic Reinforced Concrete Design, Design of Steel Structures, Computer Aided Engineering Drawing	**0**	**0**	**3**	**2**

Course Objective

The objective of a structural detailing lab course is to detail reinforced concrete elements, such as beams, columns, footings, and staircases. Students also learn to apply basic structural engineering concepts and prepare bar bending schedules.

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

1	Construct the plan and elevation of reinforcement in concrete beam, column, slab and footing
2	Estimate the reinforcement requirements of RCC elements and prepare bar-bending schedule
	LIST OF EXPERIMENTS
1	Draw detailing of RCC doubly reinforced beam and prepare its bar bending schedule with longitudinal reinforcement and transverse reinforcement
2	Draw the plan and elevation showing detailing of reinforcement of T-Beam with longitudinal reinforcement and transverse reinforcement
3	Draw the plan and elevation showing detailing of reinforcement of circular tied column and circular spiral column
4	Draw the plan and elevation showing detailing of reinforcement of rectangular column
5	Draw the plan and elevation showing detailing of reinforcement of two-way slab with corner reinforcement
6	Draw the plan and elevation showing detailing of reinforcement of isolated column footing (stepped)
7	Draw the plan and elevation showing detailing of reinforcement of longitudinally spanning staircase
8	Draw the detailing of reinforcement in beam column junction
9	Draw the ductile detailing of reinforcement in beam column junction as per IS13920
10	Draw the plan and elevation showing detailing of reinforcement of continuous slab
11	Draw the plan and elevation showing detailing of reinforcement of isolated column footing (sloped)
12	Draw the plan and elevation showing detailing of reinforcement of a dog legged staircase

LEARNING RESOURCES	
TEXTBOOKS:	
1	Neelam Sharma RCC Design and Drawing S K Katria & Sons
2	Limit state design of reinforced concrete structures by P C Varghese, PHI Learning Pvt. Ltd.
REFERENCE BOOKS:	
1	Design of Reinforced Concrete Structures, N.Subrahmanian, Oxford University Press.
2	Estimating and Costing by B.N. Dutta, UBS publishers

R24MSCST014	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 Reference Model; TCP/IP Reference Model, Addressing; Physical Layer-Different types of Transmission Media-Guided; Different types of Transmission Media-Unguided; Multiplexing-TDM, FDM, WDM; Line Encoding (NRZ, NRZI, Manchester, AMI, 4B/5B); Switching and Taxonomy: Circuit Switched, Packet Switched.

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

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

Unit III	**DATALINK LAYER**	**8 hr**

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

Unit IV	**NETWORK LAYER**	**8 hr**

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

Bloom's level - Units catchment articulation matrix

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

R24MCSCT008	**ARTIFICIAL INTELLIGENCE: PRINCIPLES AND TECHNIQUES**					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Pre-requisite	Data Structures	**3**	**0**	**0**	**3**

Course Objective

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

Course Outcomes

After completing this course, the students will be able to

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

SYLLABUS

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

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

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

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

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

Conceptual introduction to Machine Learning and Neural Networks: Biological Neural Networks and Artificial Neural Networks; Supervised Learning: (Linear and Non-Linear regression); Logistic Regression; Classification: Decision Tree and Support Vector Machines; Unsupervised Learning (clustering approach); Association; Semi-Supervised Learning; Reinforcement Learning

Unit IV	**MACHINE LEARNING TRAINING EXAMPLES**	**8 hrs**

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

R24MCSCT009	OOAD AND DESIGN PATTERNS (Common to all Branches)					
	Total Contact Hours	42 (L)	**L**	**T**	**P**	**C**
	Prerequisite	Object Oriented Programming	**3**	**0**	**0**	**3**

Course Objectives

1. Understand the importance and basic concepts of object oriented modeling,
2. Specify, analyze and design the requirements for a system and model the state of the set of objects and their implementation specifications.
3. Identify, Analyze the subsystems, various components and collaborate them nterchangeably.
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