

Academic Regulations, Curriculum and Syllabi 2023

B. Tech. Civil Engineering

(Duration of Study : 4 years)



Department of Civil Engineering
GMR Institute of Technology
Rajam, Andhra Pradesh
(An Autonomous Institute, Affiliated to JNTUGV, Vizianagaram, AP)
NBA Accredited and NAAC Accredited



Academic Rules and Regulations

2023

Undergraduate Programs



GMR Institute of Technology
Rajam 532 127, Andhra Pradesh
(An Autonomous Institute, Affiliated to JNTUGV, Vizianagaram, AP)
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Academic Regulations

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www.gmr.it.edu.in

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The Vision of GMRIT

- ❖ To be among the most preferred institutions for engineering and technological education in the country
- ❖ An institution that will bring out the best from its students, faculty and staff – to learn, to achieve, to compete and to grow – among the very best
- ❖ An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture

The Mission of GMRIT

- ❖ To turnout disciplined and competent engineers with sound work and life ethics
- ❖ To implement outcome based education in an IT-enabled environment
- ❖ To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty and staff
- ❖ To develop teaching, research and consulting environment in collaboration with industry and other institutions

Academic Regulations for B. Tech. Program

(For all the candidates admitted from the Academic Year 2023 onwards)

1. Eligibility for Admission

The total seats available as per the approved intake are grouped into two categories viz. category A and Category B with a ratio of 70:30 as per the state government guidelines

- a. The admissions for category A and B seats shall be as per the guidelines of Andhra Pradesh State Council for Higher Education (APSCHE) in consonance with government reservation policy
- b. Admission eligibility-Under Lateral Entry Scheme

Students with diploma qualifications have an option of direct admission into 2nd year B. Tech. (Lateral entry scheme). Under this scheme 10% seats of sanctioned intake will be available in each course as supernumerary seats. Admissions to this three-year B Tech later entry Programme will be through APECET. The maximum period to complete B. Tech. under lateral entry scheme is six consecutive academic years from the date of joining

2. Duration of the Programme

The course duration for the award of the Degree in **Bachelor of Technology** will be four academic years, with two semesters in each year. However, if a student is unable to complete the course within 4 years, he/she can do so by giving more attempts but within 8 consecutive academic years from the date of admission.

2.1 Academic Calendar

For all the eight semesters a common academic calendar shall be followed in each semester by having sixteen weeks of instruction, one week for the conduct of practical exams and with three weeks for theory examinations and evaluation. Dates for registration, sessional and end semester examinations shall be notified in the academic calendar of every semester. The schedule for the conduct of all the curricular, co-curricular and extra-curricular activities shall be notified in the semester planner.

3. Award of the Degree

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

1. Pursues a course of study in not less than four and not more than eight academic years
2. After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech. course and their admission stands cancelled
3. Registers for 160 credits and must secure all the **160** credits
4. A student shall be eligible for the award of B.Tech degree with Honours or Minors if he/she earns 20 credits in addition to the 160 credits
5. A student shall be permitted to register for Honors or Minors and not for both.

4. Branches of Study

B. Tech. Programmes

1. Civil Engineering (CE)
2. Computer Science and Engineering (CSE)
3. CSE (Artificial Intelligence & Data Science)
4. CSE (Artificial Intelligence & Machine Learning)
5. Electrical and Electronics Engineering (EEE)
6. Electronics and Communication Engineering (ECE)
7. Information Technology (IT)
8. Mechanical Engineering (ME)

5. Program Structure & Curriculum Framework

The curriculum of B.Tech. program has different categories of courses. For a total of 160 credits the indicative credit distribution among these categories is listed in table below for all the programs.

No.	Categories of Courses	Credits
1	Basic Science & Humanities	26
2	Engineering Science	25
3	Professional Core	37.5
4	Professional Core Electives	12
5	Open Electives	11
6	Skill Oriented	30.5
7	Internships and Project	18
8	Audit Courses	Non-Credit

The curriculum and its structure is designed based on the philosophy of Outcome Based Education with a composition of courses spread out in the various categories listed above and syllabi is prescribed by the respective Boards of Studies from time to time. The students have an option of taking nine electives based on their interest/career path spanned across 5th to 8th semesters from the list of electives prescribed in the curriculum. Under Choice Based Credit System (CBCS) the students also have the flexibility to choose one elective from the list of open electives offered by the other programs of study in consultation with their respective department. The following are some of the distinct courses that are being offered in the curriculum.

- a. **Skill Oriented Courses:** Skill Oriented Courses are offered in the form of Integrated courses that are exclusively designed to provide a unique learning experience of layered learning where in the students have the chances to practice while learning. These courses are designed by blending both theory and laboratory components one over the other.
- b. **Mini project:** The curriculum offers Mini Project for the students during 6th semester. They will be divided into batches and the report will be evaluated by a committee as nominated by CoE constituted with internal and external members.
- c. **Term paper:** The term paper is a self-study report with an objective enhancing the students' written technical-communication and shall be carried out in 5th semester. Every student will take up this either individually or as a batch of a maximum of four members and submit a report. The scope of the term paper could be an exhaustive literature review choosing any engineering concept with reference to standard research papers or an extension of the concept of earlier course work in consultation with the term paper supervisor. The report will be evaluated by a committee nominated by HoD with the approval of the Controller of Examinations (CoE).
- d. **Project work:** Project work shall be carried out during the 7th or 8th semester. Students shall take up the capstone project at the industries along with the full semester internship (FSI) in the same industry. However, students should take prior permission if he/she is interested to take up both the above said courses and shall submit separate report. Projects shall be taken up either as a team or as an individual.

Internal evaluation will be done by the Project Review Committee (PRC), comprising of HOD and two senior members of faculty along with the project supervisor. Semester end evaluation will be done by Project Evaluation Committee (PEC) comprising of three members including HOD, project guide and an external examiner nominated by the office of the CoE.

- e. Audit courses:** Audit courses are those courses which do not carry any credits and are not accounted for the calculation of CGPA. Students shall take three audit courses in the beginning of **3rd semester** and shall complete those courses in self-study mode. One of the audit courses will be by the choice of the students from the list of the courses notified at the beginning of the third semester. The second and third audit course is common to all the students and is viz. “Environmental Studies” and “Professional Ethics and Human values”. All the students (regular and lateral entry students) shall complete the audit course before the announcement of 6th semester results by taking all the chances provided along with the regular/supplementary examinations scheduled. Multiple attempts to clear the audit courses before the 6th semester will not affect the eligibility for the award of distinction. The results will be indicated with “Satisfactory” (40% of the total marks) or “Not Satisfactory” performance and will be reflected in the 6th Semester Grade Memo.
- f. MOOCs and Self-Study Courses:** Massive Open Online Courses (MOOCs) are free online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills in self-learning mode. The Curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent mode with minimal guidance of faculty mentor to earn credits for the award of the degree B. Tech. (Regular) and B. Tech. (Honours) and B. Tech. (Minors). Elective Courses are offered in two modes

1) Self Learning through MOOCs. 2) Direct Teaching as like Regular Courses

If the students opted for Elective Courses through NPTEL/SWAYAM: Each BoS, for its UG program, shall approve a list of around 2 to 15 (number as per their suitability) courses with minimum 8-weeks (45 Hours) duration and shall be announced in the beginning of the 3rd semester. These courses shall be offered as an alternative to “Elective Courses” of the respective branch offered in any semester from 5th to 8th semesters. Courses offered through NPTEL should not have similar or overlapping contents vis-à-vis the core subjects offered in the department in any of the semesters. Students opted for Elective Courses in self-learning mode (NPTEL/SWAYAM /MOOCs) need not attend the regular classes in the respective subject.

Students opting for Elective Courses through NPTEL/SWAYAM, shall submit the certificate before the beginning of the respective offering semester for the award of credits equal to Elective Courses. The conversion from percentage of marks given by NPTEL to the corresponding grades shall be similar to regular courses. If the student fails to submit the NPTEL certificate, he/she will have an option to choose either “self-learning through MOOCs with proctored assessment” or “a regular Elective Course”.

The evaluation and assessment pattern for such courses which are part of the curriculum for the B. Tech. (Regular) Degree shall be carried out as similar to other regular theory courses. However, for B. Tech. (Honours) and B. Tech. (Minors) the grade/marks offered by the NPTEL-SWAYAM is considered for the calculation of grade point.

g. Summer Internships (I and II)

Summer Internship-I: As a part of curriculum in all UG programmes, it is mandatory for all students to undergo summer internship-I at industries (core or allied) / R & D organization to get practical insight of their subject domain or community engagement during summer break after the 4th semester. This summer internship programme shall be for a period of 6 weeks duration and the assessment shall be carried out during the 5th semester and the credits will be reflected along with grade point in the 5th semester Grade memo.

If any student is unable to take up summer internship-1 in the physical mode due to any functional challenges, the respective BoS may suggest substitute online courses (MOOCS)/Online internship as approved by AICTE.

Further, in case of students who could not successfully complete the allotted Summer Internship-I in the specified duration, he/she will be given substitute online courses (MOOCs)/Online internship as suggested by BoS chairman and schedule notified by the CoE and will be treated as second attempt.

Summer Internship-II: Will be deployed in the form of skill bridge training for a duration of 6 weeks during summer break after the 6th semester, wherein the students will be trained on Problem Solving and Computer Coding Skills to enhance the employability skills. The assessment shall be carried out during the 7th semester and the credits will be reflected along with grade point in the 7th semester Grade memo.

In case students fail to attend the Summer Internship-II regularly and could not secure the required percentage of attendance he/she will be allowed to take the assessment only after attending the make-up classes and will be treated as second attempt.

h. Co-Curricular and Extra Curricular (ECA & CCA) Activities:

Students shall acquire 1 credit in 1st & 2nd semesters at 0.5 credit per semester based on the various activities conducted on Health & Wellness, Yoga & Sports, NSS & NCC and Community Service. Assessment will be based on the level of participation/performance of the students in the various activities.

i. Employability Skills: It is mandatory for all students to take a course on Employability Skills from 3rd Semester to 6th Semester. The Employability Skills are covered under three broad streams viz. **Aptitude Skills, Soft Skills and Domain Specific Knowledge**. The credits earned through these courses will be indicated in the grade memos of 4th and 6th semester and will be taken into account for CGPA calculation. The End semester assessment for all the four semesters will be done independently by an internal examiner(s) nominated by CoE.

j. Industry Driven One Credit Courses (IDC): Meeting with the industry requirements/research organizations as well as to reduce the gap between industry-academia-research organizations, the one credit (15 hours.) course has been introduced. The credits earned through these courses will be indicated in the grade memo over and above the graduation requirements and will not be considered for CGPA calculation.

k. Full Semester Internship (FSI):

Students shall undergo mandatory FSI either in India or abroad at industries/R&D Institutions/Premier Institutions during 7th or 8th semester to get practical insights relevant to their core branch of engineering or in allied branches of study under the guidance of expert members from the institution and at industries.

All the students shall register their choice of interest either in 7th or 8th semester for FSI in the beginning of 6th semester with Career Development Cell. However, the Institute shall allow the students to pursue FSI during the 7th semester or 8th semesters based on the availability of the opportunities.

The students opting for FSI bundle (FSI plus two theory courses) in 7th or 8th semesters shall take up the respective bundled theory courses offered on self-study mode during the internship period. Students opting for Project work bundle (Project work plus Three theory courses) during the 7th or 8th semester shall take up the respective theory courses in offline mode.

However, the self-study courses offered for FSI bundle will be supplemented by delivering the course either by ONLINE or OFFLINE. Attendance for these classes is not mandatory.

FSI bundle completed in 7th semester and got PPO in the 8th semester. (Double FSI):

If the students completed FSI bundle in 7th semester and got preplacement offer (PPO) before the beginning of the 8th semester shall be allowed to pursue FSI in the industry where he/she got PPO. Work carried out at Industry during the 8th semester can be submitted as Project Work report. Respective theory class teachers will conduct the classes for the three theory courses in virtual mode and attendance is mandatory. Students need to maintain a minimum of 75% attendance (Attendance for three theory courses (ONLINE) and FSI attendance at Industry put together). However, 10 % of attendance is condoned on medical grounds.

If the student/s got preplacement offer (PPO) after the commencement of 8th semester classwork shall also be allowed to pursue FSI during the balance period in the industry where he/she got PPO. The respective supervisor for project work will continue as Internal supervisor for the FSI. Project work carried out on the campus and work carried out in Industry shall be presented to the Project Review Committee periodically (PRC) and upon ratification from PRC he/she will be allowed for assessment of Project Work.

Respective teacher/s will conduct the classes for the three theory courses in virtual mode for the balance period. Students need to maintain a minimum of 75% attendance (Attendance for three theory courses (ONLINE and OFFLINE), Project work and FSI attendance at Industry put together). However, 10 % of attendance is condoned on medical grounds. However, students must attend to all the continuous assessment and end semester assessment along with all other students to fulfill the academic requirements.

Change of FSI industry in 8th semester due to PPO after commencement:

Students pursuing FSI in 8th semester at Industry and got preplacement offer (PPO) at other industry after the commencement of 8th semester shall also be allowed to relocate

to the industry where he/she got PPO. The same FSI supervisor will continue to review the performance of the students in the second industry. Work carried out in the first Industry and work carried out in PPO-Industry shall be presented to the Project Review Committee periodically (PRC) and upon ratification from PRC he/she will be allowed for assessment. Students need to maintain a minimum of 90% attendance at FSI (Sum of attendance in first Industry and at PPO Industry) However, 15% of attendance is condoned on medical grounds.

In the above cases the students shall attend to all the continuous assessments and end semester assessment along with all other students to fulfill the academic requirements.

If the student is unable to continue FSI for sixteen weeks in the allotted industry and wishes to move to another industry for continuing FSI, he/she will be allowed with prior approval from the principal. In all such cases all the above guidelines need to be followed.

Permission for double FSI and Moving from one Industry to another industry during FSI with above said reasons shall availed only once.

In case of those students who could not appear/fail in the semester end assessment for FSI, he/she will be given chance to appear during the immediate supplementary exam conducted and will be treated as second attempt.

I. Career Path Electives (CPE):

- The curriculum provides opportunities to the students to gain expertise in the emerging technologies in the form of Career path with expertise by offering elective courses in a sequential mode from 5th semester onwards. The students can choose any one of these career paths during the 5th semester and shall continue in the same career path by selecting specific electives in the 6th and 7th semesters in a sequence and finally leading to a Capstone project aligning with the career path in the 7th /8th semester.
- All the students who successfully complete the elective course aligned as per the CPE will have their Consolidated Grade Memos mentioning the title of the career path. Further, they will also receive a certificate/citation issued by the college.
- After choosing CPE during 5th semester and if any student fails to take up the specific electives courses as per the sequence in the subsequent semesters and select the electives from the general pool of electives, the student will be automatically gets out of the CPE.
- All those students who don't take up the Capstone project in the CPE domain will also get out the CPE
- In case of the students who are going for FSI/SAP in 7th semester shall take the respective elective course on self-study mode and further, complete the Capstone project in the 8th semester on campus
- In case of the students who are going for FSI in 8th semester shall take the respective elective course on self-study mode and further, complete the Capstone project in the 7th semester itself
- In case of the students going for FSI as a preplacement offer during 8th semester, he/she shall take up the elective courses on self-study mode and complete the Capstone project in the industry.
- The assessment pattern pertaining to the career path courses will be similar to those of other theory and integrated courses.
- The students who are not interested in any of these career paths can choose any of the other core electives as furnished in the respective list of the electives in the curriculum

5.1. Basis for Credit Allotment for Courses Offered

No	Course	L	T	P	Credits
1	Theory Course (Regular)	1	0	0	1.0
2	Integrated Course (Theory +Lab)	1	0	1	1+0.5
3	Laboratory/Drawing Course	0	0	1	0.5
4	Elective Courses	1	0	0	1
5	Elective Courses (Integrated)	1	0	1	1+0.5
6	Term Paper	0	0	1	0.5
7	Mini Project	0	0	1	0.5
8	Project work	0	0	1	0.5
9	ECA and CCA	0	0	1	0.5
10	Employability Skills (ES)	0	0	1	0.5
11	Audit /Mandatory Courses	0	0	0	0
12	Theory Course (Honours/Minors)	1	0	0	1
13	MOOCs/ Industry Driven courses /Self Study (For every 15hrs of Duration)				1
14	Summer Internship (6 Weeks: Offline/Online)				1
15	Full Semester Internship (16 Weeks)				8

5.2. Semester-wise Curriculum Structure**Course Pattern for Four Year Regular and Three-Year Lateral Entry Programme**

Sem.	No. of Theory Courses	No. of Lab Courses, Internship, Term Paper, Project	Total Credits (4-Year)	Total Credits (3-Year Lateral Entry)
I	5 Theory /5 Theory	4 Labs/4Labs+ECA+CCA	20/20	-
II	5 Theory/ 5 Theory	4Labs+ECA +CCA /4Labs	20/20	-
III	6 (4 Theory + 2 Integrated)	2 Labs + Employability Skills - I	23	23
IV	5 (4 Theory + 1 Integrated)	2 Labs + Employability Skills - I	21	21
V	6 (2 Theory + 2 Integrated + 1 Professional Elective +1 Open Elective)	1 Lab + Term Paper + Employability Skills-II + Summer Internship -I	24	24
VI	8 (3 Theory + 1 Professional Integrated Elective +1 Open Elective + 3Audit Course)	1 Lab + Mini Project + Employability Skills -II	21	21
VII	3 (2 Professional Elective + 1 Open Elective)/ 2 (1 Professional Elective + 1 Open Elective)	Project/FSI + Summer Internship-II	18/14	18/14
VIII	2 (1 Professional Elective + 1 Open Elective)/ 3 (2 Professional Elective + 1 Open Elective)	FSI/ (Project)	12/18	12/18
Total Credits			160	120

The credit requirement for three-year programme i.e. students admitted through lateral entry will be as per the sum of credits from third semester through eighth semester as above i.e. 120.

5.3 Credit Break-up for Various Category of Courses

For Four Year/Three Year Regular Programme

S. No.	Category	Total No. of Credits and Courses					
		Four Years			Three-Year Lateral Entry		
		Credits	Courses	Total Credits	Credits	Courses	Total Credits
1	Theory courses	3/2	22/1(23)	68	3	13	39
2	Integrated course	4	5	20	4	5	20
3	Laboratory course	1.5/1	10/4(14)	19	1.5	6	9
4	Professional elective	3/4	4/1 (5)	16	3/4	4/1 (5)	16
5	Open Elective	3/2	3/1(4)	11	3/2	3/1(4)	11
6	Employability Skills	2	2	4	2	2	4
7	CCEC Activities (ECA & CCA)	0.5	2	1	-	-	-
8	Internship (Summer Internship/FSI)	1/8	2/1 (3)	10	1/8	2/1 (3)	10
9	Term paper	1.5	1	1.5	1.5	1	1.5
10	Mini Project	1.5	1	1.5	1.5	1	1.5
11	Project	8	1	8	8	1	8
Total		-	61	160	-	41	120

5.4 Division of Marks for Continuous and Semester End Assessment

Course	Marks for Continuous Assessment	Marks for Semester end Assessment
Theory	30	70
Integrated Course	40 (30T+10L)	90 (70T+20L)
Drawing Courses	30	70
Laboratory	30	70
Term Paper	30	70
Audit Courses	--	50
Mini Project	30	70
Industry Driven Courses	--	25
ECA and CCA	--	100
Employability Skills (AS+SS+DSS)	20+20+20	30+30+30
Summer Internship (I & II)	--	50
Full semester Internship	100	100
Project Work	100	100

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

6. Evaluation Methodology

- The assessment will be based on the performance in the semester-end examinations and /or continuous assessment, carrying marks as specified
- At the end of each semester, final examinations will normally be conducted during October/November and during April / May of each year. Supplementary examinations shall be conducted as per the schedule announced
- Continuous Assessment Marks will be awarded based on Continuous Evaluation made during the semester as per the scheme
- The letter grade and the grade points are awarded based on the absolute grading system having earned grades based on the marks scored. Grading is done based on the percentage of marks secured by a candidate in individual course (Theory & Laboratory) as detailed below:

Range of Percentage of Marks -Theory	Qualitative Meaning	Letter Grade	Grade Point
90 to 100	Superior	S	10
80 to 89	Excellent	A	9
70 to 79	Very Good	B	8
60 to 69	Good	C	7
50 to 59	Average	D	6
40 to 49	Pass	E	5
< 40	Fail	F	0
	Absent	AB	0

- After completion of the programme, the Cumulative Grade Point Average (CGPA) from the I Semester to VIII Semester (from III to VIII semester for lateral entry) is calculated using the formula:

$$CGPA = \frac{\sum_{i=1}^n (c_i \times g_i)}{\sum_{i=1}^n c_i}$$

Where n is the number of courses registered for, 'c_i' is the credits allotted to the given course and 'g_i' is the grade point secured in the corresponding course

- In view that grading system is adopted for the award of the grade points in each of courses, for the benefit of the students and other stack holders who wish to have an equivalence for the CGPA secured for the graduation, the following empirical relation is provided.
Equivalent Percentage: (CGPA-0.5) x 10

7.1 Continuous Assessment Pattern for all courses

a. Theory Course:

Out of 30 marks allotted for continuous assessment 20 marks will be awarded based on two tests (Each test will be conducted for 40 marks and scale down to 20 marks) conducted and 10 marks shall be awarded based on Open book examination/ Assignment test enabling to assess Higher Order Thinking skills (HOT)

For finalization of the 20 marks, 80 % of marks secured in 1st best internal tests and 20% marks secured in 2nd best internal test will be considered.

The duration of each internal test will be 90 minutes addressing predominantly on lower order thinking skills and shall cover two units of syllabus in each test.

All the students will be notified with the marks secured within one week after the completion of the sessional exams.

Students are permitted for reconciliation within a period of two working days after the notification of marks.

The evaluation methodology of Design and Drawing courses coming under theory will be given in their respective course handouts which will be approved by the respective chairperson of the BoS.

Open book Examination is an assessment process providing the students a realistic environment to assess the higher order learning/thinking skills with the questions that mimic professional ability to demonstrate Creating, analyzing, and evaluating skills. Open Book Examination carries 1/3rd weightage in the continuous assessment and the exam will be conducted for 30 marks at the end of every semester and will be scaled down to 10 marks. The duration of each test will be 120 minutes predominantly focusing on Higher Order Thinking Skills. In case the course has limited scope of HOTs, the assessment shall be carried out with LOTs. In this assessment, the students are allowed to use any printed and handwritten material of their choice.

In the case of the course that has limited scope for Open Book Examinations, Assignment Test is preferred. However, BoS chairmen shall ensure that OBE system is followed for a min of 50% of the courses in each of the semesters.

For the conduct of assignment test Eighteen questions will be given one week in advance to the students. These eighteen questions shall address all the six COs at three questions for each CO. Further, the question preferably shall be from Old GATE/IES question papers, and each question carries 5Marks. The question paper shall not have any choice and the students need to answer all Six questions covering all the six COs. The marks secured will be scaled down to 10 Marks.

b. Laboratory Course:

30 marks are awarded for continuous assessment and following is the pattern for the award of 30 marks.

- Preparation, Observation & Result : 05 Marks
- Record : 05 Marks
- Viva - Voce : 05 Marks
- Internal Test : 15 Marks

c. Integrated Course (Theory Component +Lab Component):

40 marks are allotted for continuous assessment as given below

Theory part:

30 marks will be awarded based on two tests conducted similar to theory. Each Test will be conducted for 40 marks and scale down to 30 marks. 80 % of marks secured in 1st best internal test and 20% marks secured in 2nd best internal test for the final award of the marks

Laboratory Part:

10 marks are awarded for continuous assessment and following is the pattern for the award of 10 marks

- Preparation, Observation & Result and Record : 05 Marks
- Internal Test : 05 Marks

d. Engineering graphics

30 marks are awarded for continuous assessment and following is the pattern for the award of 30 marks.

- Day-to-day assessment of drawing sheets :15 marks
- Internal test* :15 marks

Out of 15 marks allotted for internal tests, there shall be two internal tests for 15 marks each. 80 % of marks secured in 1st best test and 20% marks secured in 2nd best test will be considered for the award of 15 marks.

e. Term Paper:

30 marks are awarded for continuous assessment and following is the pattern for the award of 30 marks.

- Literature Survey : 05 Marks
- Review 1 : 05 Marks
- Review 2 : 05 Marks
- Publication/Presentation of paper: 05 Marks
- Presentation : 10 Marks

f. Mini Project:

30 marks are awarded for continuous assessment and following is the pattern for the award of 30 marks.

- Review 1 : 10 Marks
- Review 2 : 10 Marks
- Final Presentation : 10 Marks

g. Project Work:

100 marks are awarded for continuous assessment and following is the pattern for the award of 100 marks.

- Innovativeness of the Project : 05 Marks
- Literature Survey : 10 Marks
- Experimentation / Simulation : 15 Marks
- Result Analysis : 05 Marks
- Review 1 : 10 Marks
- Review 2 : 10 Marks
- Product development : 25 Marks
- Publication/Presentation of Paper: 05 Marks
- Final Presentation : 05 Marks
- Project Report : 10 Marks

h. Full Semester Internship:

100 marks are awarded for continuous assessment and following is the pattern for the award of 100 marks.

- Internship Progress Report : 10 Marks
- On Site Assessment : 15 Marks
- Assessment by Industry : 50 Marks (Intern Assessment Tool)
- Final Assessment on Campus : 25 Marks

i. Employability Skills:

Students shall take this course during from 3rd – 6th semesters and will have three components 1) Aptitude Skills AS 2) Soft Skills_SS and 3) Domain Specific Skills_DSS having equal weightage. The course content for AS and SS will be common for all the programs whereas the course content for DSS will be program specific and shall be notified before the commencement of every semester based on the demand and need.

The students will be assessed in all the three components in each of the semesters with equal weightage. For the two components AS & DSS the students are assessed based on the marks secured in continuous assessment. For SS, the students are assessed based on the performance in various activities. A minimum of 16 periods shall be allotted for each stream per semester.

Assessment for Aptitude Skills

For continuous assessment, tests will be conducted along with midterm examinations. 20 marks will be awarded by taking into account 80% of marks secured in 1st best assessment test and 20% marks secured in 2nd best assessment test

Assessment of Soft Skills

Minimum of six activities are conducted for SS training in a semester. Assessment for Soft Skills is done based on the participation and performance of the students under different SS activities. Students are expected to perform in at least four activities to get qualified in each semester out of six activities.

Under continuous assessment, the students will be assessed for the four activities based on this performance for 20M.

Assessment of Domain Specific Skills

The Domain specific skill training will be preferably a training program on branch specific Application Software tool. For continuous assessment, tests will be conducted along with midterm examinations. 20 marks will be evaluated by taking into account 80% of marks secured in 1st best assessment test and 20% marks secured in 2nd best assessment test.

The sum of the marks scored in all the three components put together is considered as a continuous assessment of the Employability course.

7.2 Semester End Assessment

After the completion of the course work as per the academic calendar, semester assessment will be done for all courses as per the curriculum. A common schedule will be notified by the controller of examinations for all the semester end examinations. All the students who fulfill the attendance requirements shall be eligible to appear for the semester end examinations.

All the students who could not clear the semester end examinations for those courses that carry credits will be given an opportunity to appear for the supplementary examinations conducted subsequently.

a. Theory Course:

For all the theory courses students shall appear for subjective examination of three hours duration and the assessment will be done for Max of 70 Marks. Students shall score a min of 25 marks (**35% of 70 marks rounded off to higher integer**) and score a min of 40 marks (40% of 100 Marks) in continuous and end semester assessment both put together to clear the course and acquire the credits.

b. Laboratory Course

Students are assessed for a Max of 70 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE.

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

Students shall score min of 25 marks (35% of 70 marks) and score a min of 40 marks (40% of 100 marks) in continuous and end semester assessment both put together to clear the course and acquire the credits.

c. Integrated Course**Theory part:**

For the theory part students shall appear for a subjective examination of three hours duration and the assessment will be done for Max of 70 Marks.

Laboratory Part:

For the Laboratory part students shall appear for the examination of three hours duration and the assessment will be done for Max of 20 Marks.

Students shall score a min of 25 marks (35% of 70 marks) in the theory part and a min of 7 marks (35% of 20 marks) in the semester end examination. However, the students shall score a min of 52 marks (40% of 130 marks) in total both semester end and continuous assessment put together.

In case the students fails to secure min of 35% marks in the semester end theory part and lab part, he/she shall appear for both theory and lab supplementary examinations.

d. Engineering Graphics:

Students are assessed for a Max of 70 marks during the semester end assessment and the assessment will be done along with theory examination as per the schedule. Students shall score min of 25 marks (35 % of 70 marks) and score a min of 40 marks (40% of 100 marks) in continuous and end semester assessment both put together to clear the course.

e. Term Paper:

Students are assessed for a Max of 70 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE. Students shall score min of 25 marks (35% of 70 marks) and score a min of 40 Marks (40% of 100Marks) in continuous and end semester assessment both put together to clear the course and acquire the credits.

f. Audit Courses:

Students are assessed for a Max of 50 marks by an MCQ test conducted on Moodles platform and score a min of 20 Marks (40% of 50 marks) to clear the course. The assessment will be conducted along with semester end examinations from 3rd semester onwards for both the opted and common audit courses. The students shall clear the course by the end of 6th semester.

g. Mini Project:

Students are assessed for a Max of 70 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE. Students shall score min of 25 marks (35% of 70 marks) and score a min of 40 Marks (40% of 100Marks) in continuous and end semester assessment both put together to clear the course and acquire the credits.

h. Project Work:

Students are assessed for a Max of 100 marks during the semester end assessment and the assessment will be done by the project evaluation committee appointed by the Chief controller of examination. Assessment will be based on the project report submitted and presentation given by the project team.

Students shall score a min of 35 marks (35% of 100 Marks) in the end semester assessment and score a min of 80 marks (40% of 200 Marks) in continuous and end semester assessment both put together to clear the course and acquire the credits.

i. Full Semester Internship:

Students are assessed for a Max of 100 marks during the semester end assessment and the assessment will be done by evaluation committee appointed by Chief controller of examination. Assessment will be based on the internship report submitted and presentation given by the students.

Students shall score a min of 35 marks (35% of 100 Marks) in the end semester assessment and score a min of 80 marks (40% of 200 Marks) in continuous and end semester assessment both put together to clear the course and acquire the credits

j. Summer Internship

In Summer internship I & II Students are assessed for a maximum of 50 marks during the 5th and 7th semesters respectively and the assessment will be done by two examiners appointed by CoE. For both summer internships I & II, the students shall clear the assesment by securing min of 20 marks (40% of 50 Marks) and acquire credits. These credits will be reflected in 5th and 7th semester grade memos.

Summer Internship- I:

- Report : 25 Marks
- Oral Presentation : 25 Marks

In case of the students who have taken MOOCS/Online internship as a substitute to summer internship-I, the assessment will be based on the marks/Grade secured in the courses/Online Internship. In case the students fail to clear the summer internship-I, the student shall appear for the subsequent supplementary examinations

Summer Internship-II:

- Assessment1 (Cognitive MCQs): 20 Marks
- Assessment2 (Technical MCQs): 20 Marks
- Comprehensive Test (Cognitive& Technical- MCQs and Programs): 30 Marks

For finalization of the 50 marks, highest marks secured among the two assessments and Marks secured in the Comprehensive test will be considered. In case the students fail to clear the summer internship-II, the student shall appear for the subsequent supplementary examinations.

k. ECA &CCA (Health and Wellness, Yoga and Sports, NSS/NCC, Community Service):

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

l. Employability Skills (ES):

The students will be assessed in all the three components i.e 1) Aptitude Skills-AS 2) Soft Skills-SS and 3) Domain Specific Skills-DSS at the end of 3rd, 4th, 5th and 6th semesters with equal score of 30 marks each. Assessment will be by an MCQ based question paper having 90 questions with equal weightage to the three components.

Students shall score a min 32 marks in the MCQ test **(35% of 90 marks rounded off to higher integer)** in the end semester assessment and score a min of 60 Marks (40% of 130 Marks) in continuous and end semester assessment both put together to clear the course.

The total marks secured by the student in both 3rd and 4th semesters will be scaled down to 100 marks for the calculation of the overall grade point and will be reflected in the 4th semester grade memo. Similarly, the grade point for the 5th and 6th semesters will be reflected in the 6th semester grade memo.

Student who fails to score a min of 32 marks (35% of 90 marks) in the semester end assessment and a min of 60 Marks (40% of 150 Marks) in continuous and semester end assessment both put together shall appear for the subsequent supply exams

8. Credit Transfer Policy for MOOCs

The curriculum shall allow up to a maximum of 20% of the total courses being offered in a particular programme i.e. maximum of 32 credits through MOOCs platform.

9. Attendance Requirements:

If his/ her academic progress and conduct have been satisfactory...

- a. It is desirable for a candidate to put on 100% attendance in all the subjects. However, a candidate shall be permitted to appear for the semester end examination by maintaining at least 75% of attendance on an average in all the courses in that semester put together.
- b. The shortage of attendance on medical grounds can be condoned to an extent of 10% provided a medical certificate is submitted to the Head of the Department when the candidate reports back to the classes immediately after the leave. Certificates submitted afterwards shall not be entertained. Upon the payment of the Condonation fee as fixed by the college, students who put on attendance between $\geq 65\%$ and $<75\%$ shall be permitted to appear for the semester end examinations. Attendance may also be condoned as per the State Government rules for those who participate in sports, co-curricular and extra-curricular activities provided their attendance is in the minimum prescribed limits for the purpose and recommended by the concerned authority.
- c. In case of the students having overall attendance less than 65% after condonation shall be declared detained and has to repeat semester again.
- d. During the Summer Internship -I, Summer internship-II and Full semester Internship it is required for the candidate to put on 90% of attendance. The shortage of attendance on medical grounds can be condoned to an extent of 15% and permitted to appear for the final assessment by maintaining at least 75% of attendance.
- e. If the candidate failed to maintain 75% of attendance during FSI he /she shall be declared detained and has to repeat FSI, however the student will be allowed to appear for semester end examinations of two self-study courses.
- f. If the candidate detained in FSI in the 8th semester, he/she will be allowed to repeat the FSI immediately after completing the 8th semester. If the candidate could not complete FSI in the 7th semester, he/she will be allowed to continue in the 8th semester course work and needs to repeat the FSI, with immediately after completing the 8th semester.
- g. For the students repeating the FSI, with regard to two self-study courses, student have an option of taking the continuous and end semester assessments together either in the regular slot or while repeating FSI.

- h. If the candidate failed to maintain 75% of attendance during Project Work bundle either in 7th or 8th semester, he/she shall repeat the same in the next year.
- i. In case of the student having less than 65% of attendance in any of the theory/lab courses/ECA & CCA activities/Employability skills during a particular semester and less than 75% in Summer Internship-I/Summer Internship-II, he/she will not be permitted to appear for the semester end examination in the that particular course.
- j. In all such cases, the students need to register for the makeup classes which will be notified by the CoE office at appropriate time. The students shall secure 90% of the attendance in the make-up classes to appear for the semester end assessment and will be treated as a second attempt. The number of makeup classes to be conducted will be at least 35% of the regular class work taken in a particular course.

10. Promotion Policies:

- a. In four-year, B. Tech. Programme, a student shall be promoted from 2nd year to 3rd year only if he/she fulfils the academic requirements and earning of minimum 50% of credits up to 2nd year
- b. In four-year, B. Tech. Programme, a student shall be promoted from 3rd year to 4th year only if he/she fulfils the academic requirements and earning of minimum 50% credits up to 3rd year
- c. In three-year, lateral entry B. Tech. Programme, a student shall be promoted from 3rd year to 4th year only if he/she fulfils the academic requirements and earning of minimum 50% credits up to 3rd year

11. Graduation Requirements:

a) Academic Requirements:

The following academic requirements shall be met for the award of the B. Tech. degree:

- ❖ Students shall secure 160 credits for the regular B. Tech. Programme and 120 credits for the students who entered in second year through lateral entry scheme and CGPA is calculated accordingly for the award of Grade/Class/Division.
- ❖ A student of a regular Programme who fails to earn 160 credits within eight consecutive academic years from the year of his/her admission shall forfeit his/her degree and his/her admission stands cancelled.
- ❖ A student of a lateral entry Programme who fails to earn 120 credits within six consecutive academic years from the year of his/her admission shall forfeit his/her Degree and his/her admission stands cancelled.

b. 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.

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.

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.

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

Structure of Grading of Academic Performance

Range of Percentage of Marks	Qualitative Meaning	Letter Grade	Grade Point
90 & above	Superior	S	10
80 - 89	Excellent	A	9
70 - 79	Very Good	B	8
60 - 69	Good	C	7
50 - 59	Average	D	6
40 - 49	Pass	E	5
< 40	Fail	F	0
Absent	Absent	AB	0

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

SGPA: Semester Grade Point Average is the ratio of sum of the product of the number of credits with the grade point 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.

CGPA: 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.

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

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

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

c. Award of degree:

Classification of degree will be as follows:

- I. CGPA ≥ 8.0 + No history of arrears +20 addl. Credits : Degree with Honours
(20 credits shall be earned through core domain courses)
- II. CGPA ≥ 8.0 + No history of arrears +20 addl. Credits : Degree with Minors
(20 credits shall be earned through inter-disciplinary courses)
- III. CGPA ≥ 7.5 : Degree with Distinction
- IV. CGPA ≥ 6.5 and < 7.5 : Degree with First Class
- V. CGPA ≥ 5.5 and < 6.5 : Degree with Second Class
- VI. CGPA ≥ 5.0 and < 5.5 : Degree with Pass Class

- ❖ **First Class with Distinction:** A candidate who acquires credits for the award of the Degree (vide clause 11(a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) in the first attempt (without appearing for supplementary exams), within eight consecutive semesters (six consecutive semesters for lateral entry candidates) after the commencement of his/her study and securing a CGPA of 7.5 and above shall be declared to have passed in **First Class with Distinction**.
- ❖ **First Class:** A candidate who acquires credits for the award of the Degree (vide clause 11 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) and securing a CGPA of 6.5 and above shall be declared to have passed in **First Class**
- ❖ **Second Class:** A candidate who acquires credits for the award of the Degree (vide clause 11 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) and securing a CGPA of 5.5 and above shall be declared to have passed in **Second Class**
- ❖ **Pass Class:** A candidate who acquires credits for the award of the Degree (vide clause 11 (a)) having passed all the courses of study of all the four semesters and securing a CGPA of 5.00 and above shall be declared to have passed in **Pass Class**
- ❖ **Degree with Honour/Minors:** The students can register for Honours/Minors by earning additional 20 credits over and above the credit requirement of B. Tech. (Regular) Degree Programme and also maintain minimum of 6.5 CGPA in Honours/Minors courses clearing the courses in single attempt.

CGPA to Percentage conversion Formula – (CGPA – 0.5) x 10

d. Grafting:

In order to extend the benefit to the students with one/ two backlogs after either 6th semester or 8th semester, a GRAFTING option is provided to the students enabling their placements and fulfilling graduation requirements. Following are the guidelines for the Grafting:

- ❖ Grafting of the marks will be done among the courses within the semester. A maximum of 10% of max marks in semester end examinations shall be drawn from any one of the cleared courses in the semester and will be grafted to the maximum of any two failed courses in the same semester.
- ❖ Students shall be given a choice of grafting only once in the 4 years Programme, either after 6th semester (Option#1) or after 8th semester (Option#2)
- ❖ Option#1: Applicable to students who have maximum of TWO theory courses in 5th and/or 6th semesters.
- ❖ Option#2: Applicable to students who have maximum of TWO theory courses in 7th and/or 8th semesters.
- ❖ Students can opt for grafting only after declaration of the results for regular examinations conducted for 6th or 8th semesters.
- ❖ Eligibility for grafting:
 - i. He/she must appear in all regular or supplementary examinations as per the provisions laid down in regulations for the courses, he/she appeals for grafting
 - ii. The marks obtained by her/him in latest attempt shall be taken into account for grafting of marks in the failed course(s)
 - iii. Grafting is applicable only for theory courses.
- ❖ Students having no backlog history till 5th semester /7th semester and would like to avail grafting in 6th/8th semester respectively are eligible for the award of a B.Tech degree first class with distinction. Further, students who clears the courses will also be eligible for Honours/Minors

- e. **Betterment Chance:** Student who clears all the subjects up to 6th semester and wishes to improve their CGPA can register and appear for one betterment chance for maximum of any five theory courses up to 6th semester. Betterment chance can be availed along with 7th and 8th semester examinations by paying the registration and examination fee. Students who opt the "Betterment Chance" will also be eligible for the award of a B.Tech degree first class with distinction and will also be eligible for Honours/Minors.
- f. **Quick Supplementary Examination:** The supplementary examinations for the 8th semester will be conducted as a Quick Supplementary Examination (immediately after the completion of 8th semester) to clear the failed courses of 8th semester.
- g. **Memorandum of marks:** All the candidates who register for the semester end examination will be issued a memorandum of marks by the Institute. Apart from the semester wise grade memos, the institute will issue the consolidate grade memo subject to the fulfillment of all the academic requirements.

12. Eligibility for Degree with Honours or Degree with Minors

The curriculum provides flexibility to enable the competent students to register for B. Tech. degree with Honours or B.Tech Degree with Minors by earning additional 20 credits which are over and above 160 credits for the award of B. Tech. (Regular) degree. He/She shall register Honours/Minors by paying registration fee during the 4th semester provided he/she secures ≥ 8 CGPA clearing all the courses in single attempt till 3rd semester. In case of students admitted through lateral entry, the CGPA compliance will be considered from 3rd semester performance and diploma CGPA.

The students shall have scope to earn these additional 20 credits from 4th semester onwards and at any point of time if he/she wishes to withdraw from B. Tech. (Honours) program, the additional credits acquired till that time will get lapsed and cannot be used to compensate with those 160 credits needed for the award of the degree. A separate grade sheet will be issued to the students who register for the Honours and minors degree program indicating the domain name for Honours and Minor degree title name for Minors along with the GPA.

All the students who maintain ≥ 8 CGPA are eligible to enrollment for B. Tech. with Honours, However, registration for Minors degree will be limited to maximum of 35% of the total intake in a particular batch of students.

These additional courses offered by the program may change from time to time based on the demand and resources availability. The courses may be offered in different modes i.e. guided learning/taught courses/Blended mode or combination.

To acquire 20 additional credits, the students shall register for four 4-credit courses under the list of the courses offered by the respective departments and acquire the balance 4 credits by taking One course on self-study mode (MOOCs) course as per the prescribed syllabus

For the award of **B. Tech. degree with Honours** an additional 20 credits shall be earned by taking the courses offered by the respective department of study in one domain. A set of five courses are offered under each of the four different domains, preferably from the new emerging areas as recommended by the BoS.

For the award of **B. Tech degree with Minors** an additional 20 credits shall be earned by taking the inter-disciplinary courses offered preferably from the new emerging areas by the other departments. Minors degree will be awarded with a Title among the pool of titles recommended by the various BoS.

The students who acquire 20 additional credits and maintain 8.0 CGPA at the time of registration and graduation clearing all the courses in single attempt and acquiring 160/120(lateral Entry) credits will be awarded the B.Tech degree Honours or Minors.

The students shall register for the courses related to additional 20 credits as per the calendar released by the respective departments and clear them in a single attempt. All the students who maintain 8.0 CGPA at the time of registration and graduation in regular B.Tech courses and acquire GPA of minimum of 6.5 in Honour/Minor courses are eligible for the award of B. Tech. (Honours)/B.Tech (Minors) . Any student who fails to full fill these conditions will automatically get deregistered for B. Tech. (Honours)/B.Tech (Minors) without any notification. A separate grade memo will be issued for B. Tech. (Honours)/B.Tech (Minors) along with the CGM.

13. Withdrawal from the Examination

Candidates opting for withdrawal from the examination shall not have backlogs by the date of application.

- A candidate for valid reasons which could be due to the overlap of the schedule of the events (Participation in state/national/international sports and games events; NSS or NCC camps; National/international competitions of high repute) with the semester end examination schedule, may be granted permission with prior approval to withdraw from appearing for the examination in any course or courses of only one semester examination during the entire duration of the Degree Programme.
- Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made two weeks prior to the commencement of the examination in that course or courses and recommended by a committee nominated by the principal.
- The candidate opting out of examinations shall appear for all the courses in the next immediate examinations that are scheduled (regular/supply) and will be treated as first attempt.

14. With-holding of Results

If the candidate did not clear all the tuition fee dues or if any case of indiscipline or malpractice is booked against him/her, the result of the candidate shall be withheld in such cases.

15. Multiple Entry / Exit Option

(a) Exit Policy:

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

- i) **UG Certificate in (Field of study/discipline)** - Programme duration: First year (first two semesters) of the undergraduate programme, 40 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that would help the candidates acquire job-ready competencies required to enter the workforce.
- ii) **UG Diploma (in Field of study/discipline)** - Programme duration: First two years (first four semesters) of the undergraduate programme, 80 credits followed by an additional exit 10-credit bridge course(s) lasting two months, including at least 6-credit job-specific internship/ apprenticeship that 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)**- Programme duration: First three years (first six semesters) of the undergraduate programme, 120 credits.

(b) Entry Policy:

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

Note: The Institute 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 and State government.

16. Gap Year Concept:

The curriculum provides flexibility for the students to take a break of one year at any time after the end of I/II/III year of study to pursue entrepreneurship full time. This period of gap shall be counted within the maximum time of graduation. The student shall apply for the gap year before the commencement of the respective academic year.

17. Semester Away Programme (SAP): Interested students can have the option of undergoing Semester Away Programme during 7th or 8th semester with Higher Learning Institutions at Foreign Countries or Institutions of National Repute or Research Organizations in India, by earning necessary credits as per the curriculum subject to the terms and conditions as prescribed by the respective host organization. The student shall acquire 8 credits at the host institution to compensate the 8 credits required for the Project and take up the other three courses in self-study mode as per the curriculum. The students who are interested in opting for SAP shall register at the beginning of 6th semester and initiate the process with the host institute.

18. Transitory Regulations:

To enable the students to get into GMRIT either by Re-admission, Admission, or Transfer from other Autonomous and Non-Autonomous Engineering colleges affiliated to JNTUK/Academic regulation within GMRIT, the following transitory regulations will be applicable based on the situation and the case of transfer following are possible cases that may arise in transitory regulations

- Transfer of a student from a non-autonomous engineering college affiliated to JNTUK
- Transfer of a student from an Autonomous engineering college affiliated to JNTUK
- A student within the Institution gets transferred from one regulation to the other regulation

a. Transfer of candidates from Non-Autonomous Engineering College affiliated to JNTUK:

A student who wishes to transfer from a non-autonomous engineering college affiliated to JNTUK either in the 3rd semester or thereafter, shall acquire the credits required for graduation as per the GMRIT regulations and the following two cases may arise.

Students getting admission into 3rd semester shall be treated at par with the lateral entry students and shall complete all the course works in the 1st & 2nd semester before joining as per the JNTUK regulations. The credits acquired per course during 1st & 2nd semester will be calculated as per the GMRIT regulations. In case of any credit mismatch for the 1st & 2nd semester when compared with JNTUK regulations, the student shall take the additional courses approved by the concern Board of Studies and Academic council during 3rd semester at GMRIT.

Students getting admission into 5th or 7th semesters, the students shall clear all the earlier courses under JNTUK regulations and curriculum before joining and acquiring the required credits. The credits acquired per course at JNTUK regulation will be calculated as

per the GMRIT regulations. After joining at GMRIT the students shall follow the GMRIT regulations and in case of credits mismatch, students will take up additional courses approved by the concern Board of Studies and Academic council at GMRIT

After getting necessary approvals from the concerned Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

b. Transfer of candidates from an Autonomous college affiliated to JNTUK:

A student who wishes to transfer from an Autonomous engineering college affiliated to JNTUK either in the 3rd semester or thereafter, shall acquire the credits required for graduation as per the GMRIT regulations and the following two cases may arise:

Students getting admission into 3rd semester shall be treated at par with the lateral entry students and shall complete all the course works in the 1st & 2nd semester before joining as per the other Autonomous regulations of the earlier college. The credits acquired per course at the earlier autonomous college will be calculated as per the GMRIT regulations. In case of any credit mismatch for the 1st & 2nd semester when compared with the previous Autonomous college regulations, the student shall take the additional courses approved by the concern Board of Studies and Academic council during from 3rd semester at GMRIT.

Students getting admission into 5th or 7th semesters, the students shall clear all the earlier courses under the earlier college regulations and curriculum before joining and acquire the required credits. The credits acquired per course at the earlier autonomous college will be calculated as per the GMRIT regulations. After joining at GMRIT the students shall follow the GMRIT regulations and in case of credits mismatch, students will take up additional courses approved by the concern Board of Studies and Academic council at GMRIT.

After getting necessary approvals from the concerned Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

c. Students getting readmitted within GMRIT moving from one regulation to another regulation.

A student who gets admission into one regulation in the first year shall continue with the same graduation requirements in terms of total credits required for the award of Degree.

However, in case the students get readmitted into a subsequent new regulation, and if the readmission is in the 1st semester, the student shall follow the new regulations and secure the required number credits in the new regulations.

In case the students getting readmitted into a subsequent new regulation, and if the readmission is into any of the semesters from 2nd to 4th semester, the student shall follow the regulations applicable to the ongoing batch to which he/she gets admitted and continue in the same regulation till graduation. The substitute courses will be offered, and number of credits/ semesters shall be compensated and balanced between the old and new regulations on case-to-case basis. Necessary approvals from the concern Board of Studies and Academic council shall be taken

In case the students getting readmitted into a subsequent new regulation, and if the readmission is into any of the semesters from 5th to 8th semester, the student shall follow the regulations applicable as per the regulations existing at the time of his/her admission and will clear all the subjects and acquire the credits for graduation. For all the common courses he/she will continue along with the students in the new regulations. Necessary approvals from the concern Board of Studies and Academic council shall be taken.

After getting necessary approvals from the concerned Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

19. Minimum Instruction Days for a Semester:

The minimum instruction days including exams for each semester shall be checked mistakes if any 90 days.

20. Medium of Instruction:

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

21. General Instructions:

- The academic regulations should be read as a whole for purpose of any interpretation.
- Malpractices rules-nature and punishments are appended.
- Where the words “he”, “him”, “his”, occur in the regulations, they also include “she”, “her”, “hers”, respectively.
- The Institute 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.
- 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.

The Vision of GMRIT

- ❖ To be among the most preferred institutions for engineering and technological education in the country.
- ❖ An institution that will bring out the best from its students, faculty, and staff – to learn, to achieve, to compete and to grow – among the very best.
- ❖ An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture.

The Mission of GMRIT

- ❖ To turnout disciplined and competent engineers with sound work and life ethics.
- ❖ To implement outcome-based education in an IT-enabled environment.
- ❖ To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty, and staff.
- ❖ To develop teaching, research, and consulting environment in collaboration with industry and other institutions.

Department Vision

- ❖ To be a preferred department of learning for students and teachers alike, with a commitment towards Academics & Research, serving the students in an atmosphere of innovation, critical thinking and making them Industry ready.

Department Mission

- M1: To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Civil Engineering
- M2: To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation
- M3: To instil ethical values and nurture the graduates who will be able to contribute to society.

Program Educational Objectives (PEOs)

- PEO 1: Employ logical and analytical skills in solving complex real-world engineering problems in the areas of civil engineering.
- PEO 2: Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research.
- PEO 3: Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest.

Program Outcomes (POs):

Engineering graduate will be able to:

- PO 1: Apply the knowledge of basic sciences and fundamental engineering concepts in solving civil engineering problems (**Engineering knowledge**)
- PO 2: Identify and define civil engineering problems and investigate to analyze and interpret data to arrive at substantial conclusions. (**Problem analysis**)
- PO 3: Propose appropriate solutions for engineering problems complying with functional constraints such as economic, environmental, societal, ethical, safety and sustainability in accordance with Indian standard codes of practices. (**Design/development of solutions**)
- PO 4: Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusions. (**Conduct investigations of complex problems**)
- PO 5: Select/develop and apply appropriate techniques and IT tools to analyze, design and scheduling of activities with an understanding of the limitations and successfully implement and adopt to technological changes in civil engineering with intervention of IT industries (**Modern tool usage**)
- PO 6: Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practice. (**The engineer and society**)
- PO 7: Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development. (**Environment and sustainability**)
- PO 8: Demonstrate knowledge of professional and ethical practices. (**Ethics**)
- PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations. (**Individual and team work**)
- PO 10: Communicate effectively with respect to oral, written and graphical communication (**Communication**)
- PO 11: Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment. (**Project management and finance**)
- PO 12: Recognize the need for, and have the ability to engage in independent and lifelong learning. (**Life-long learning**)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

- PSO 1: Demonstrate the quality and suitability of construction materials (**Program Specific**)
- PSO 2: Ability to apply the practical aspect of analysis, design and safe construction practices (**Program Specific**)

Department of Civil Engineering

Minimum Credits to be earned: 160 (for Regular students)

120 (for Lateral Entry Students)

First Semester							
N o	Course Code	Course	POs	Contact Hours			
				L	T	P	C
1	23PYX01 23CYX02	Engineering Physics/ Engineering Chemistry	1,2,7,10,12/1,2,6,7, 12	3/3	0	0	3/3
2	23MAX01 23MAX02	Linear Algebra& Calculus/ Differential Equations and Vector calculus	1,2,3,4,12/1,2,3,4,12	3/3	0	0	3/3
3	23BEX01/ 23BEX02	Basic Electrical and Electronics Engineering/ Basic Civil & Mechanical Engineering	1,3,6,7,9,12/1,2,3,6,7, 8,12	3/3	0	0	3/3
4	23BEX03	Introduction to Programming	1,2,3,12	3	0	0	3
5	23BEX04/ 23HSX01	Engineering Graphics/ Communicative English	1,5,10,12/1,9,10, 11,12	2/2	0	2/0	3/2
6	23PYX02/ 23CYX04	Engineering Physics Lab/ Engineering Chemistry Lab	4,6,9,11,12/1,6,7,9, 12	0	0	2/2	1/1
7	23BEX05/ 23BEX06	Electrical & Electronics Engineering workshop/Engineering Workshop	4,5,6,9,12/1,9,12	0	0	3/3	1.5/1.5
8	23BEX07	Computer Programming Lab	2,3,4,12	0	0	3	1.5
9	23HSX11	-/ECA (Yoga / Sports)	-	-	-	-/1	-/0.5
10	23HSX12	-/CCA (NSS/NCC/Community Service)	-	-	-	-/1	-/0.5-
11	23BEX08	IT Workshop/-	1,2,3,4,9,12	0	0	2/-	1/-
12	23HSX02	/Communicative English Lab	1,9,10,11,12	0	0	0/2	-/1
Total				14/14	0	12/12	20/20
Second Semester							
1	23HSX01/ 23BEX04	Communicative English/ Engineering Graphics	10,12/1, 5,10	2/2	0	0/2	2/3
2	23MAX02/ 23MAX01	Differential Equations and Vector calculus/Linear Algebra& Calculus	1,2,3,4,12/1,2,3,4,12	3/3	0	0	3/3
3	23CYX01/, 23PYX01	Engineering Chemistry/ Engineering Physics	1,2,6,7,12/1,2,7,10,12	3/3	0	0	3/3
4	23BEX02/ 23BEX01	Basic Civil & Mechanical Engineering/ Basic Electrical and Electronics Engineering	1,2,3,6,7,8,12/1,3,6,7, 9,12	3/3	0	0	3/3
5	23ME201	Engineering Mechanics	1,2,3,12, PSO1	3/3	0	0	3/3
6	23CYX04/ 23PYX02	Engineering Chemistry Lab/ Engineering Physics Lab	1,6,7,9,12/4,6,9,11,12	0	0	2/2	1/1
7	23BEX06/ 23BEX05	Engineering Workshop/Electrical & Electronics Engineering workshop	1,9,12/ 1,4,5	0	0	3/3	1.5/1.5
8		IT Workshop/-	1,2,3,4,9,12	0	0	2/-	1/-
9	23HSX02	Communicative English Lab/-	1,9,10,11,12	0	0	2/-	1/-
10	23CE201	Engineering Mechanics and Building Practices Lab	2,3,4,12, PSO1	0	0	3/3	1.5/1.5
11	23HSX11	-/ECA (Yoga/ Sports)	-	-	-	-/1	-/0.5
12	23HSX12	-/CCA (NSS/NCC/Community Service)	-	-	-	-/1	-/0.5
Total				14/14	0	12/12	20/20
Third Semester							
1	23MA303	Numerical Methods	1,2,3,4,12	3	-	-	3
2	23CE302	Building Materials and Concrete Technology	2,4,8,12, PSO1	3	-	2	4
3	23CE303	Building Planning and Drawing	1,5,10,12,PSO2	3	-	2	4
4	23CE304	Fluid Mechanics	1,2,3,4, PSO1	3	-	-	3
5	23CE305	Solid Mechanics I	1,2,3,12, PSO1	3	-	-	3

6	23CE306	Surveying	1,2,3,4, PSO1	3	-	-	3
7	23CE307	Solid Mechanics Laboratory	1,4,5,9, PSO1	-	-	3	1.5
8	23CE308	Surveying Laboratory	1,4,5,9, PSO1	-	-	3	1.5
9	23ESX01	Employability Skills I	1,2,5,8, 10,12	1	-	1	-
Total				19	-	11	23
Fourth Semester							
1	23CE401	Hydraulics and Hydraulic Machinery	1,2,3,4,5,6,7	3	-	-	3
2	23CE402	Soil Mechanics	1,2,3,12,PSO1	3	-	-	3
3	23CE403	Solid Mechanics II	1,2,3,12, PSO2	3	-	-	3
4	23CE404	Structural Analysis	1,2,3,12, PSO2	3	-	-	3
5	23CE405	Transportation Engineering	1,2,3,12, PSO2	3	-	2	4
6	23CE406	Fluid Mechanics and Hydraulic Machinery Laboratory	1,2,5,9, PSO2	-	-	3	1.5
7	23CE407	Soil Mechanics Laboratory	1,4,5,10, PSO1	-	-	3	1.5
8	23ESX01	Employability Skills I	1,2,5,8,10,12	1	-	1	2
Total				16	-	9	21
Fifth Semester							
1	23CE501	Design and Detailing of RC Structures	2,3, 10, 12,PSO2	3	-	2	4
2	23CE502	Environmental Engineering	2,3,6,7,12	3	-	-	3
3	23CE503	Foundation Engineering	1,2,3,7, PSO2	3	-	-	3
4	23CE504	Hydrology	1,2,3,4, 7,PSO2	3	-	2	4
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Sequential Open Elective I)		3	-	-	3
7	23CE505	Environmental Engineering Laboratory	3,6,7,9, 12,PSO2	-	-	3	1.5
8	23TPX01	Term Paper	1,4,10,12	-	-	3	1.5
9	23ESX02	Employability Skills II	1,2,5,8, 10,12	1	-	1	-
10	23SIX01	Summer Internship I	1,2,8,10, 12	-	-	-	1
Total				19	-	11	24
Sixth Semester							
1	23CE601	Problem solving using OOPS	1, 2,3,5, 12	3	-	-	3
2	23CE602	Design of Steel Structures	1,2,3,4,12,PSO2	3	-	-	3
3	23CE603	Estimation and costing	1,2,3, 11,PSO2	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Sequential Open Elective II)		3	-	-	3
6	23CE604	Programming Language Laboratory	1,2,3,5,12	-	-	3	1.5
7	23MPX01	Mini Project	1,2,3,4,5,6,7,8,9,10, 11,12, PSO1, PSO2	-	-	3	1.5
8	23ESX02	Employability Skills II	1,2,5,8, 10,12	1	-	1	2
10	23ATX01	Environmental Studies	12	-	-	-	-
11	23ATX02	Professional Ethics and Human Values	12	-	-	-	-
12	23ATX---	Audit Course	12	-	-	-	-
Total				16	-	9	21
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3
2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Sequential Open Elective III)		3	-	-	3
4	23PWX01	Project Work	1,2,3,4,5,6,7,8,9, 10,11,12, PSO1, PSO2	-	-	16	8
5	23SIX02	Summer Internship II	1,2,5,6, 10,12	-	-	-	1
Total				9	-	16	18
Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Sequential Open Elective IV)		-	-	-	2

3	23FIX01	Full semester Internship (FSI)	1,2,5,8,9,10,PSO1, PSO2	-	-	-	8
Total				-	-	-	13
Elective I							
Career Path I, II, III, IV and Other Core Electives							
1	23CEC11	Principles of Building Architecture	1,2,6,7, PSO2	3	-	-	3
2	23CEC21	Geometric Design and Highway Materials	1,2,3,4, PSO1,PSO2	3	-	-	3
3	23CEC31	Environmental Sustainability and Climate Resilience	1,2,3,6,7,8,12	3	-	-	3
4	23CEC41	Data Analysis and Visualization Using Python	1,2,3,4,5,10,12	3	-	-	3
5	23CE001	Prefabricated Structures	1,2,3,12, PSO2				
6	23CE002	Construction Techniques	1,2,7,11, 12,PSO2	3	-	-	3
7	23CE003	Airport, Railways and Harbour Engineering	1,2,3,12, PSO2	3	-	-	3
8	23CE004	Construction Economics and Finance	2,3,10,11,12	3	-	-	3
		MOOCs		-	-	-	3
Elective II (Sequential Open Elective I)							
1	23CES11	Fundamentals of IoT for Civil Engineering	1,2,3,4,5, 12	3	-	-	3
2	23CES21	Fundamentals of Data Science and Statistics	1,2,3,5,12	3	-	-	3
3	23CES31	Entrepreneurship Theory and Practice	1,2,4,11,12	3	-	-	3
4	23CES41	Principles of Safety Management	4,6,8,10,12	3	-	-	3
5	23CES51	Introduction to Smart Cities	1,6,7,11, 12	3	-	-	3
Elective III							
Career Path I, II, III,IV and Other Core Electives							
1	23CEC12	Building Services	1,5,8,12, PSO2	3	-	2	4
2	23CEC22	Highway Design and Simulation	1,2,3,4, PSO1, PSO2	3	-	2	4
3	23CEC32	Environmental Data Analytics and IoT for Smart Monitoring	1,2,3,4,7,8,11	3	-	2	4
4	23CEC42	ML for Civil Engineering	1,2,3,4,5,10,12	3	-	2	4
5	23CE005	Pre Engineered Buildings	1,3,4,12, PSO2	3	-	2	4
6	23CE006	Engineering Geology	1,2,6,7, PSO1	3	-	2	4
7	23CE007	Irrigation and Water Resources Engineering	1,2,3,7, PSO1	3	-	2	4
Elective IV (Sequential Open Elective II)							
1	23CES12	IoT Applications in Building Automation	1,2,3,4,5,12	3	-	-	3
2	23CES22	Database Management Systems for Data Science (SQL & Oracle)	1,2,3,5,12	3	-	-	3
3	23CES32	Design Thinking and Innovation Management	2,3,5,11,12	3	-	-	3
4	23CES42	Safety in Construction	1,2,6,8,12	3	-	-	3
5	23CES52	Sustainable Urban Planning and Development	1,2,3,5,6,7,12	3	-	-	3
Elective V							
Career Path I, II, III,IV and Other Core Electives							
1	23CEC13	Building Information Modeling	1,2,5,12, PSO1	3	-	-	3
2	23CEC23	Highway Project Formulation and Economics	1,2,6,12, PSO1	3	-	-	3
3	23CEC33	Pollution Control and Waste Management	3,6,7,8,12	3	-	-	3
4	23CEC43	AI for Civil Engineering	1,2,3,4,5,10,12	3	-	-	3

5	23CE008	Ground Improvement Techniques	1,2,3,12, PSO2	3	-	-	3
6	23CE009	Advanced Reinforced Concrete Design	1,2,3,4, 12,PSO2	3	-	-	3
7	23CE010	Construction Methods and Equipment	1,2,5,11, PSO2	3	-	-	3
		MOOCs		-	-	-	3
Elective VI							
1	23CE011	Basics of Dynamics and Earthquake Engineering	1,2,3,12, PSO2	3	-	-	3
2	23CE012	Pavement Analysis and Design	1,2,3,4,5,12,PSO1	3	-	-	3
3	23CE013	Prestressed Concrete Structures	1,2,3,12, PSO2	3	-	-	3
		MOOCs		-	-	-	3
Elective VII (Sequential Open Elective III)							
1	23CES13	IoT for Structural Health Monitoring	1,2,3,4,5, 12	3	-	-	3
2	23CES23	Data Mining and Exploratory Data Analysis (EDA)	1,2,3,5,12	3	-	-	3
3	23CES33	Product Design and Innovation	2,3,4,5,10,12	3	-	-	3
4	23CES43	Safety in Engineering Industries	1,2,6,8,12	3	-	-	3
5	23CES53	Remote Sensing and GIS for Smart Cities	1,2,3,4,5,7,12	3	-	-	3
Elective VIII							
1	23CE014	Repair and Rehabilitation of Structures	1,2,3,12,PSO2	-	-	-	3
2	23CE015	Remote Sensing and GIS	1,2,5,12, PSO1, PSO2	-	-	-	3
3	23CE016	Pavement Management System	1,2,3,12, PSO2	-	-	-	3
		MOOCs		-	-	-	3
Elective IX (Sequential Open Elective IV)							
1	23CES14	AI and ML for IoT Data Analytics in Civil Engineering	1,2,3,4,5, 12	-	-	-	2
2	23CES24	Predictive Analytics and Machine Learning	1,2,3,5,12	-	-	-	2
3	23CES34	Business Analytics for Entrepreneurship	2,3,4,5, 10,11,12	-	-	-	2
4	23CES44	Reliability Engineering And Integrated Management Systems	1,2,6,8,12	-	-	-	2
5	23CES54	Intelligent transportation systems	1,2,3,4,5,6,9,10	-	-	-	2
Audit Course							
1	23AT001	Communication Etiquette in Workplaces					
2	23AT002	Contemporary India: Economy, Policy and Society					
3	23AT003	Design The Thinking					
4	23AT004	Ethics and Integrity					
5	23AT005	Indian Heritage and Culture					
6	23AT006	Intellectual Property Rights and Patents					
7	23AT007	Introduction to Journalism					
8	23AT008	Mass Media Communication					
9	23AT009	Science, Technology and Development					
10	23AT010	Social Responsibility					
11	23AT011	The Art of Photography and Film Making					
12	23AT012	Gender Equality for Sustainability					
13	23AT013	Women in Leadership					
14	23AT014	Introduction to Research Methodology					
15	23AT015	Climate Change and Circular Economy					
B. Tech. (Honors)							
Domain I: Structural Engineering							
01	23CEH11	Advanced Concrete Technology	1,2,12,PSO1,PSO2	4	-	-	4

02	23CEH12	Advanced Structural Analysis	1,2,3,12, PSO2	4	-	-	4
03	23CEH13	Design of Industrial Structures	1,2,3,4, PSO1,PSO2	4	-	-	4
04	23CEH14	Bridge Engineering	1,2,3,12, PSO2	4	-	-	4
Domain II: Transportation Engineering							
01	23CEH21	Rural Road Technology	1,2,3,4, PSO1, PSO2	4	-	-	4
02	23CEH22	Evaluation and Strengthening of Pavements	1,2,3,4,5,PSO1, PSO2	4	-	-	4
03	23CEH23	Traffic Engineering and Management	1,3,7,12, PSO2	4	-	-	4
04	23CEH24	Planning and Design of Airport	1,3,7,12, PSO2	4	-	-	4
Domain III: Geotechnical Engineering							
01	23CEH31	Elements of Rock Mechanics	1,2,7, PSO1,PSO2	4	-	-	4
02	23CEH32	Construction in Expansive Soils	1,2,3,7, PSO2	4	-	-	4
03	23CEH33	Geosynthetics in Soil Structures	1,2,3,7, PSO1	4	-	-	4
04	23CEH34	Soil dynamics	1,2,3,7, PSO1	4	-	-	4
Domain IV: Construction Management							
01	23CEH41	Modern Construction Material	1,2,4,7,12,PSO2	4	-	-	4
02	23CEH42	Construction Planning and Project Management	1,2,7,10, 11,12, PSO2	4	-	-	4
03	23CEH43	Quality Control and Assurance in Construction	1,2,3,4,6,PSO1	4	-	-	4
04	23CEH44	Safety in Construction	1,2,3,4,6,PSO1	4	-	-	4

23PYX01 - ENGINEERING PHYSICS
(Common to all branches of Engineering)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Comprehend the basic principle of diffraction and observe the diffraction pattern in various cases
2. Illustrate the concepts of Interference and polarisation and their applications
3. Understand the space lattices and crystal symmetry
4. Summarize the fundamental concepts of quantum mechanics
5. Explore the properties and applications of dielectric and magnetic materials
6. Demonstrate the conduction process of charge carriers in semiconductors

COs - POs Mapping

COs	PO1	PO2	PO7	PO10	PO12
1	3	2	1	1	1
2	3	2	1	1	1
3	3	2	1	1	1
4	3	2	1	1	1
5	3	2	1	1	1
6	3	2	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Wave Optics

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton’s Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol’s Prism -Half wave and Quarter wave plates

13 Hours

UNIT II

Crystallography and X-ray diffraction

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

10 Hours

UNIT III

Dielectric and Magnetic

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

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials

12 Hours

Unit IV

Quantum Mechanics, Free electron theory and Semiconductors

Quantum Mechanics: Dual nature of matter – Heisenberg’s Uncertainty Principle – Significance and properties of wave function – Schrodinger’s time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy.

Semiconductors: Semiconductors: Formation of energy bands – classification of crystalline solids – Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein’s equation – Hall effect and its applications

13 Hours

Total: 48 hours

Textbooks

1. A Text book of Engineering Physics - M. N. Avadhanulu, P.G.Kshirsagar& TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).
3. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning

Reference Books

1. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
2. Engineering Physics” - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.
3. Engineering Physics - D.K.Bhattacharya and PoonamTandon, Oxford press (2015).

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	-
Understand	50	50	-
Apply	10	10	70
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Polarization of light
2. State Bragg’s law of x-ray diffraction
3. Define Bohr magneton
4. List any two merits of classical free electron theory

Understand

1. Draw and explain the variation in intensity in diffraction due to single slit
2. Explain with diagram the Powder method of X-ray diffraction
3. Explain hysteresis behavior of ferromagnetic materials
4. Derive Schrodinger’s time dependent wave equation

Apply

1. A parallel beam of light of wavelength 6000 \AA is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is 50° . Find the least thickness of the glass plate which will appear dark by reflection.
2. Draw and label $(1\ 0\ 0)$, $(0\ 2\ 0)$, $(0\ 2\ 2)$ crystallographic planes.
3. Draw and compare soft and hard magnetic materials based on their hysteresis loops.
4. An electron is confined to a one dimensional potential box of length 2 \AA . Calculate the energies corresponding to the second and fourth quantum states in eV.

**23CYX02 - ENGINEERING CHEMISTRY
(CIVIL, MECH)**

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Assess the quality of water and its treatment methods
2. Estimate the potentials for electrochemical cells
3. Describe corrosion factors and implement prevention methods.
4. Illustrate the types of polymers and Fuels with applications
5. Describe the concepts of colloids, micelle and nanomaterials
6. Explain the uses of refractory materials, lubricants and cements.

COs - POs Mapping

COs	PO1	PO2	PO6	PO7	PO12
1	3	1	1	3	1
2	3	1	1	2	1
3	3	1	1	3	1
4	3	1	1	2	1
5	3	1	1	3	1
6	3	1	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT I

Water Technology

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen -Boiler troubles -Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment - Specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO)standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis

10 Hours

UNIT II

Electrochemistry and Applications

Electrodes -electrochemical cell, Nernst equation, cell potential calculations. Primary cells - Zinc-air battery, Secondary cells - Nickel-Cadmium (NiCad),and lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts, the principle and working of hydrogenoxygen Fuel cell. Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

12 Hours

UNIT III

Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growthpolymerization. Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications ofpoly styrene. PVC Nylon 6,6 and Bakelite. Elastomers - Preparation, properties and applications of BunaS, Buna N, Thiokol rubbers.

Fuels - Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis ofcoal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetanenumberalternativefuels- propane, methanol, ethanol and bio fuel-bio diesel.

10 Hours

UNIT IV

Surface Chemistry and Modern Engineering Materials

Surface Chemistry- Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelleformation, synthesis of colloids (Braggs Method), adsorption isotherm (Freundlich and Langmuir), BET equation (no derivation). Nano Materials- Chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, applications of colloids and nanomaterials- catalysis, medicine, sensors, etc. Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories and lubricants- Classification, Properties, Factors affecting the refractory materials and Applications. Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils- Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications. Building materials- Portland cement, constituents, Setting and Hardening of cement.

16 Hours
Total: 48 Hours

Textbook (s)

1. P.C. Jain and Monica Jain, Engineering Chemistry, 16th Ed., Dhanpat Rai Publishing Company, New Delhi, 2015.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
3. C.N.R. Rao, A. Muller and A.K. Cheetham, Nanomaterials Chemistry: Recent Developments and New Directions, 2010.

Reference (s)

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

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/ Assignment Exam (%)
Remember	40	40	-
Understand	50	50	-
Apply	10	10	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define hardness
2. Differentiate between primary and secondary battery
3. Define Octane and cetane number
4. What are the good characteristic properties of good refractory material?

Understand

1. Explain in detail how hard water is purified by ion exchange process
2. How the underground buried pipeline is protected by sacrificial anodic protection?
3. Explain the preparation of Nano metal oxide by chemical precipitation method
4. Explain the chemistry involved in setting and hardening of cement

Apply

1. What are different treatment methods for removal of hardness and compare their merits and demerits
2. What are the points are to be taken into account in the construction of a good battery with life?
3. How to get commercial products obtaining from crude oil and list out the byproducts with carbon content, Boiling point and its uses

23MAX01 - LINEAR ALGEBRA & CALCULUS

3 0 0 3

Course Outcomes

At the end of the course, the student will be able to

1. Solve the system of linear equations
2. Construct the eigenvectors of a matrix, use the applications of Cayley Hamilton theorem
3. Identify the nature of the quadratic form using matrix theory
4. Apply Mean value theorems to solve single variable problems.
5. Make use of partial derivatives to solve multivariable problems
6. Utilize multiple integrals to find the area and volume of solids

COs - POs Mapping

COs	PO1	PO2	PO3	PO4	PO12
1	3	3	2	2	1
2	3	2	3	3	1
3	3	3	3	2	1
4	3	2	2	1	1
5	3	3	2	1	1
6	3	3	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Matrices

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

12 Hours

Unit II

Linear Transformation and Orthogonal Transformation:

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

12 Hours

Unit III

Single and Multi-Variable Calculus

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

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

14 Hours

Unit IV

Multiple Integrals

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

10 Hours

Total: 48 Hours

Textbooks

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

Reference Books

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
3. Glyn James, Advanced Modern Engineering Mathematics, 5/e, Pearson publishers, 2018.
4. Michael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
5. H. K Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand, 2021.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test (%)
Remember	10	10	-
Understand	40	40	20
Apply	50	50	50
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define rank of a matrix
2. State Cayley-Hamilton theorem
3. State Rolle's theorem
4. State Taylor's theorem

Understand

1. Find the rank of the matrix $A = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$ by reducing it to echelon form.
2. Using Cayley-Hamilton theorem find A^4 , for $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$
3. Verify Lagrange's mean value theorem for $(x)^{\frac{3}{4}}$ in $[-1, 2]$
4. Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} \sqrt{a^2-x^2-y^2} dx dy$

Apply

1. Utilise Gauss-Jordan method, to find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$
2. Find the eigen values and the corresponding eigen vectors of $A = \begin{bmatrix} 1 & 2 & -1 \\ 0 & 2 & 2 \\ 0 & 0 & -2 \end{bmatrix}$
3. If $a < b$, prove that $\frac{b-a}{1+b^2} < \tan^{-1} b - \tan^{-1} a < \frac{b-a}{1+a^2}$ using Lagrange's mean value theorem. Deduce that $\frac{5\pi+4}{20} < \tan^{-1} 2 < \frac{\pi+2}{4}$
4. Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by change into polar coordinates

**23BEX01 BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common to all branches of Engineering)**

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate the electrical parameters of DC & AC circuits.
2. Illustrate the operation of electrical machines and power plants.
3. Summarize electrical measurements and safety measures
4. Explain the operation of semiconductor devices and their characteristics.
5. Illustrate the operation of rectifiers.
6. Illustrate the number systems, binary codes, and combinational circuits using logic gates.

COs - POs Mapping

COs	PO1	PO3	PO6	PO7	PO9	PO12
1	3	2	1	1	1	1
2	3	2	1	1	1	1
3	3	2	1	1	1	1
4	3	2	1	1	1	1
5	3	2	1	1	1	1
6	3	2	1	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

PART A: BASIC ELECTRICAL ENGINEERING

Unit I

Electrical Circuits and Machines

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: AC Fundamentals: Equation of AC Voltage and current, waveform, time-period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor. (Simple Numerical problems).

Electrical Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer and (iv) Three Phase Induction Motor, Applications of electrical machines.

12 Hours

Unit II

Electrical Measuring Instruments and Safety Measures

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB) Personal safety measures: Electric Shock, Safety precautions to avoid shock, Earthing and its types.

12 Hours

PART B: BASIC ELECTRONICS ENGINEERING

Unit III

Semiconductor Devices and Electronic Circuits

Introduction - Evolution of electronics - Vacuum tubes to nanoelectronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

Rectifiers and power supplies: Block diagram description of a DC power supply, working of a half wave rectifier, full wave rectifier.

12 Hours

Unit IV

Digital Electronics

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits– Minterm, Maxterm, SOP, Standard SOP, POS, Standard POS, 3-Variable K-Map, Half and Full Adders.

12 Hours

Textbooks:

1. R. L. Boylestad & Louis Nashlesky, “Electronic Devices & Circuit Theory,” Pearson Education, 2nd Edition 2021.
2. D. C. Kulshreshtha “Basic Electrical Engineering” Tata McGraw Hill, 1st Edition, 2019
3. Ramana Pilla, N.V.Lalitha & G.Suresh, “Basic Electrical and Electronics Engineering”, S Chand and Company Ltd., 1st Edition, 2024.

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. T. K. Nagsarkar & M. S. Sukhija, “Basic Electrical Engineering” Oxford University Press, 1st Edition, 2017
3. R. P. Jain, “Modern Digital Electronics” Tata Mc Graw Hill, 4th Edition, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering,” PHI publishers, 3rd Edition. 2014

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test (%)
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyze	-	-	
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

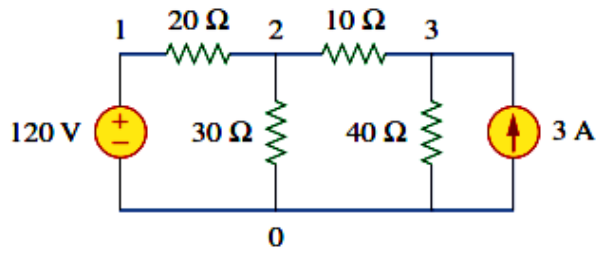
1. Define KVL and KCL
2. Define Units
3. Define amplifier
4. Define Rectifier

Understand

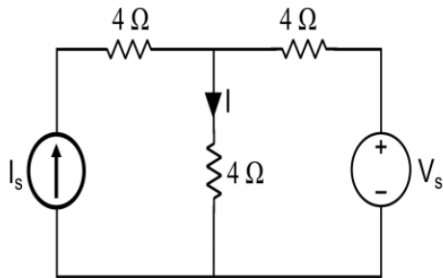
1. List out energy sources and explain anyone with a neat diagram
2. Illustrate the operation instruments with a neat diagram
3. List any three applications of Zener diode
4. Illustrate the CE amplifier circuit diagram.

Apply

1. Find currents in each branch using nodal analysis for the given circuit.



2. Find I by using the superposition theorem for the below circuit with $V_s=20V$, $I_s= 4A$.



3. Solve these conversions

- i) $(10101)_2$ to $(?)_{gray}$
- ii) $(23B)_{10}$ to $(?)_{10}$
- iii) $(45)_{10}$ to $(?)_8$

4. Minimize the given switching function using k-map $f(A, B, C) = \sum m(2,6,7)$

23BEX02 - BASIC CIVIL & MECHANICAL ENGINEERING

(Common to All branches of Engineering)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Describe the basics of civil engineering streams, water resources and environmental engineering
2. Outline the concepts of surveying
3. Demonstrate the pavements and the concept of Airport, Harbour, Tunnel & Railway Engineering
4. Understand the different Engineering Materials, Manufacturing process and the role of mechanical Engineering in different sectors.
5. Understand the basic concepts of thermal engineering and working principles of different power plants
6. Describe the working of different mechanical power transmission systems and basic configurations and applications of robots

COs - POs Mapping

CO	PO ₁	PO ₂	PO ₃	PO ₆	PO ₇	PO ₈	PO ₁₂
1	3	-	-	2	2	2	2
2	3	3	3	1	2	-	2
3	3	-	-	1	2	-	2
4	3	-	-	2	2	-	2
5	3	-	-	2	2	-	2
6	3	-	-	2	2	-	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT I

Basics of Civil Engineering

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering- Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to prefabricated construction techniques.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology-Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

12 Hours

UNIT II

Surveying and Transportation Engineering

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

Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering

12 Hours

UNIT III

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

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

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

11 Hours

UNIT IV

Thermal Engineering: working principle of Boilers, Otto cycle, Diesel cycle, Refrigerator and air-conditioner, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

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

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

Introduction to Robotics: configurations and applications of robots.

13 Hours

Textbooks:

1. Basics of Civil and Mechanical Engineering, O. Srikanth and M. Sreenivasa Reddy, S. Chand and company limited, first edition, 2024.
2. Basic Civil Engineering, M. S. Palanisamy, Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
3. Introduction to Civil Engineering, S. S. Bhavikatti, New Age International Publishers. 2022. First Edition.
4. Basic Civil Engineering, SatheeshGopi, Pearson Publications, 2009, First Edition.
5. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
6. A Text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
7. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, cengage learning India pvt. Ltd.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016.
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S. K. Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.
6. AppuuKuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
7. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications
8. Thermal Engineering by Mahesh M Rathore Tata Mcgraw Hill publications (India) Pvt. Ltd.
9. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata Mcgraw Hill publications (India) Pvt. Ltd.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	9	9	9
Understand	63	63	63
Apply	28	28	28
Analyze			
Evaluate			
Create			
Total (%)	100	100	

Sample Question (s)

Remember

1. What is Portland cement? Write the Cement composition?
2. Define surveying. What are the principles of surveying?
3. Outline the key elements of railway engineering?
4. Write the purpose of tunnels?

Understand

1. Describe the key characteristics of contour mapping?
2. Discuss the fundamental differences between flexible pavements and rigid pavements.
3. What are the various types of transportation system? How the transportation is contributing the economy of the country India?
4. What is the importance of construction materials such as brick, cement, aggregates, concrete and steel in building construction?

Apply

1. The following readings were taken with a level in sequence as follows 1.625, 1.535, 2.365, 1.355, 1.465, 1.105, 1.925, 2.015, 2.350, 1.815, 1.985, 2.115 and 2.560. The elevation of B.M at 1st reading is 210m. Find the reduced levels at each and every station using rise and fall method.
2. In a closed traverse the following bearings were observed with a compass. Calculate the included angles with sketch?

Line	Fore bearing
AB	65° 00'
BC	125° 30'
CD	200° 00'
DE	265° 15'
EA	330° 00'

3. Convert the following whole circle bearings into reduced (quadrantal) bearings?
(i) 65° (ii) 143° 15' (iii) 252° 30' (iv) 320° 42' (v) 181° 12' (vi) 270° 42'
4. The following fore bearings were observed for lines, AB, BC, CD, DE, FE and FG respectively. Determine their back bearings.
 - i) FB of AB 310° 30'
 - ii) FB of BC 145° 15'
 - iii) FB of CD 210° 30'
 - iv) FB of DE 60° 45'
 - v) FB of EF 39° 50'
 - vi) FB of FG 289° 30'

**23BEX03 - INTRODUCTION TO PROGRAMMING
(Common to all branches of Engineering)**

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Illustrate the Algorithms for programming and problem solving.
2. Formulate sequential and iterative programming.
3. Implement Basic Dynamic Data structures
4. Develop Modular program aspects in solving complex problems.
5. Apply the concepts for optimal utilization of memory
6. Understand the techniques of storage and processing the data.

COs - POs Mapping

COs	PO ₁	PO ₂	PO ₃	PO ₁₂
1	3	3	3	2
2	3	2	2	2
3	3	2	2	2
4	3	3	3	2
5	3	2	2	2
6	2	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Computer Problem Solving:

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

Introduction, Structure of a C Program, Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion Relational Expressions

Unit II

Introduction to C Programming:

Control Flow, Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

Arrays:

Introduction, Operations on Arrays, Arrays as Function Arguments, Two Dimensional Arrays, Multidimensional Arrays.

Strings: String Fundamentals, String Processing with and without Library Functions, Pointers and Strings.

Unit- III

Functions: Introduction Function: Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes, Recursion.

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

Unit-IV

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Type def keyword, Bit Fields. **Data Files:** Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Textbook(s)

1. A Structured Programming Approach Using C, Forouzan, Gilberg, 3rd Edition, Cengage.
2. How to solve it by Computer. G. Dromey, 12th Edition, Pearson Education.
3. Programming In C-Practia1 Approach. Ajay Mittal, 1st Edition Pearson

References:

1. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2020, McGraw-Hill.
2. Computer Programming. Reema Thareja, 3rd Edition, 2023, Oxford University Press
3. The C Programming Language, Dennis Richie And Brian Kernighan, 2nd Edition, Pearson Education.
4. Programming In C, Ashok Kamthane, 2nd Edition, Pearson Publication.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	20	10	
Understand	50	40	
Apply	30	30	100
Analyze	--	20	
Evaluate			
Create			
Total (%)			

Sample Question (s)**Remember**

1. Define an algorithm.
2. List out the types of operators.
3. Define a function.
4. List any 5 file handling functions.

Understand

1. What is a 2D array? Explain the process of creating, initializing and accessing the elements of a 2D array.
2. Explain the 4 categories of functions.
3. Explain the difference between structure and union.
4. Explain the modes of opening a file.

Apply

1. Write a program to generate the Fibonacci sequence using recursion.
2. Write a program to perform matrix multiplication.
3. Write a program to copy the contents of

**23BEX04 - ENGINEERING GRAPHICS
(Common to All branches of Engineering)**

2 0 2 3

Course Outcomes

At the end of the course, student will be able to

1. Understand the principles of engineering drawing, including engineering curves, scales.
2. Draw and interpret orthographic projections of points, lines, planes in front, top and side views.
3. Construct Ortho-graphic projections of planes inclined to both reference planes and Projections of Solids in simple positions.
4. Understand and apply concepts of projections of solids inclined to a reference plane and sectional views of solids in simple positions using CAD software.
5. Gain a clear understanding of the principles behind development of surfaces and to understand how to unfold basic geometric shapes into flat patterns using CAD software.
6. Develop the ability to draw isometric views and orthographic views and convert isometric views to orthographic views and vice versa using CAD software.

COs - POs Mapping

CO	PO ₁	PO ₅	PO ₁₀	PO ₁₂
1	3	-	3	3
2	3	-	3	3
3	3	-	3	3
4	3	3	3	3
5	3	3	3	3
6	3	3	3	3

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general and special methods – Arcs of circle method, concentric circles method, Oblong method, Rectangle method, Normal and tangent to Curves.

Scales: Introduction to scales, Plain scales, Diagonal scales.

9 Hours

UNIT II

Projections of Points & Straight Lines: Projections of points, Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes. **Projections**

of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane.

(Conventional drawing up to this)

9 Hours

(Using CAD)

UNIT III

Projections of Solids

Introduction to AUTOCAD, Projection of Solids with axis inclined to one reference plane and parallel to other, Projection of Solids with axis parallel to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

10 Hours

UNIT IV

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

10 Hours

Total: 48 Hours

Textbook:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

23HSX01 COMMUNICATIVE ENGLISH
(Common to all branches of Engineering)

2002

Course Outcomes

At the end of the course, student will be able to

1. Understand the context, topic, and specific information from social or transactional dialogues
2. Speak clearly using discourse markers on a specific topic in formal as well as informal discussions
3. Comprehend and appreciate literary texts by reading
4. Write summaries, coherent paragraphs, essays, letters/e-mails and resume
5. Apply grammatical structures to formulate sentence and use them appropriately
6. Improve communicative competence with enhanced vocabulary in formal and informal contexts

COs – POs Mapping

COs	PO1	PO09	PO10	PO11	PO12
1	1	1	3	1	2
2	1	1	3	1	2
3	1	1	3	1	1
4	1	1	3	1	2
5	1	1	3	1	1
6	1	1	3	1	1

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

Unit I

Lesson : The power of plate of Rice- Ifeoma Okoye

Listening: Identifying the topic, the context and specific pieces of information by listening to Short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words

Unit II

Lesson: Night of the Scorpion by Nissim Ezekiel, Steve Jobs

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts. Listening for global comprehension and summarizing what is listened

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks and reporting what is discussed

Reading: Identifying sequence of ideas; verbal techniques that connect ideas in a paragraph, reading a text by making inferences-using context clues for comprehension.

Writing: Structure of a paragraph - Paragraph writing (specific topics), summarizing

Grammar: Cohesive devices -linkers, use of articles and zero article, prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

Unit III

Lesson: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Note-making, paraphrasing Letter Writing: Official Letters, Resumes

Grammar: Verbs – tenses, subject-verb agreement Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Compound words, Collocations

Unit IV

Lesson: The Power of Interpersonal Communication

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic on texts

Reading: Reading comprehension.

Writing: Writings structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject-verb agreement)

Vocabulary: Jargons, Technical vocabulary

Textbook (s)

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023.
2. Empowering English by Cengage Publications, 2023

Reference Books:

1. Dubey, Sham Ji& Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20%	20%	
Understand	29%	29%	
Apply	51%	51%	50%
Analyse			50%
Evaluate			
Create			
Total (%)			

Sample Question (s)

Remember

1. Explain the role of body language in inferential listening.
2. What announcement by the national peace council does Eleanor show her brother?
3. Reflect on the role of intrapersonal communication in personal growth, how can engaging in self-reflection and self-talk contribute in enhancing one's character and decision-making abilities?
4. Explain the role of body language in inferential listening.

Understand

1. What do you mean by listening for main ideas and supporting ideas?
2. What are the qualities of a good listener?
3. You recently have purchased a smartphone that has unexpectedly poor battery life. Compose a letter to the customer service department of the store where you bought it, explaining the issue and politely requesting a replacement or repair.
4. Explain briefly some situations that require inferential listening.

Apply

1. Write a short talk on 'memorable incident in your life'
2. Develop a conversation between two friends on positive impact that regular physical exercise can have on both physical and mental well-being.
3. Summarize the central idea of the poem *Night of the Scorpion* by Nissim Ezekel.
4. Imagine you are a customer support representative dealing with a dissatisfied customer. Create a role-playing scenario to address the customer's concerns and resolve the issue to their satisfaction.

**23PYX02 - ENGINEERING PHYSICS LAB
(Common to all branches of Engineering)**

0 0 2 1

Course Outcomes

At the end of the course, student will be able to

1. Infer the knowledge from the scientific methods and learn the process of measuring different physical parameters
2. Develop the laboratory skills in handling of electrical and Optical instruments
3. Demonstrate the interference and diffraction phenomena of light
4. Inspect and experience physical principles of Magnetic fields and optical fiber communications
5. Apply the principles of physics and measure the solid state properties of materials
6. Design and analyze experiment based on physics concepts

COs - POs Mapping

COs	PO4	PO6	PO9	PO11	PO12
1	3	2	2	2	1
2	3	2	2	2	1
3	3	2	2	2	1
4	3	2	2	2	1
5	3	2	2	2	1
6	3	2	2	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments:

1. Study of variation of magnetic field along the axis of current-carrying circular coil-Stewart and Gee's Method.
2. Determination of wavelengths of spectral line of mercury spectrum using diffraction grating.
3. Determination of radius of curvature of convex lens by forming Newton's rings.
4. Study of series and parallel Resonance in LCR circuit.
5. Measurement of thickness of a thin paper using wedge method.
6. Calculation of Numerical Aperture (NA) and bending losses of a given fiber.
7. Determination of frequency of an electrically vibrating tuning fork in Transverse and longitudinal modes - Melde's Experiment.
8. Determination of wavelength of Laser by diffraction grating.
9. Determination of Hall Coefficient and charge carrier density of semi-conductor.
10. Determination of Band gap of a semiconductor.
11. Determination of Rigidity modulus of a given wire using torsional pendulum.
12. Determination of size of particle using diffraction pattern.
13. Verification of Malu's law.
14. Determination of temperature coefficients of a thermistor.
15. Determination of dispersive power of the material of a prism.
16. Determination of Time constant of an R-C circuit.

List of Augmented Experiments¹

1. To study the magnetization (M) of a ferromagnetic material in the presence of a magnetic field B and to plot the hysteresis curve (M vs. B)
2. Study the Thermoemf of the thermo couple
3. LCR Series and Parallel-Design of circuit for various resonance frequencies
4. Determination of characteristics of Laser beam
5. Determination of Horizontal component of earth's magnetic field
6. Study of double refraction in calcite crystals

¹ Students shall opt any one of the Augmented Experiments in addition to the regular experiments

7. Dispersive power of various liquids using spectrometer
8. Photo cell–Characteristics and determination of Planks constant
9. Michelson’s interferometer.

References:

1. Physics Lab manual–Department of Physics, BS & H, GMRIT, Rajam, 2019
2. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers, 2017
3. Y. Aparna and K. Venkateswararao, Engineering Physics–I and II, VGS Techno series, 2010
4. S. Panigrahi and B. Mallick, Engineering Practical Physics, Cengage learning, Delhi, 2015
4. <http://www.amrita.vlab.co.in> Virtual Labs, Amrita University.
5. <http://www.iitk.vlab.co.in>

Course Outcomes:

At the end of course student will be able to

1. Determine the concentration of acids by Conductometry.
2. Prepare the Bakelite polymer and ZnO nanomaterial
3. Estimate the strength of an acid present in secondary battery by pH metry
4. Identify the organic compounds by IR Spectroscopy.
5. Verify the Beer- Lamberts law and measure the wavelength
6. Estimate concentration of ferrous iron by potentiometry and dichrometry

COs - POs Mapping

COs	PO1	PO6	PO7	PO9	PO12
1	3	1	3	1	1
2	3	1	3	1	1
3	3	1	3	1	1
4	3	1	2	1	1
5	3	1	3	1	1
6	3	1	3	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

LIST OF EXERCISES:

1. Introduction to qualitative analysis- Demonstration
2. Measurement of 10Dq by spectrophotometric method
3. Conductometric titration of strong acid vs. strong base
4. Conductometric titration of weak acid vs. strong base
5. Determination of cell constant and conductance of solutions
6. Potentiometry - determination of redox potentials and emfs
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of a Bakelite
9. Verify Lambert-Beer's law
10. Wavelength measurement of sample through UV-Visible Spectroscopy
11. Identification of simple organic compounds by IR
12. Preparation of nanomaterials by precipitation method
13. Estimation of Ferrous Iron by Dichrometry
14. Determination of acid number of lubricating oil
15. Determination of Hardness of a groundwater sample.
16. Determination of Viscosity of lubricating oil by Redwood Viscometer 1

List of Augmented Experiments1

1. Assessment of synthesis of carbon fibers by polymerization
2. Synthesis of nanomaterials by other nanomethodlogy
3. Identification of simple organic compounds by IR
4. Making a battery of required potential
5. Calculation of Ferrous Iron by Dichrometry.
6. Find the acid number of various industrial oils or edible oils

Reference Books

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar

Course outcomes:

At the end of course student will be able to

1. Assess the percentage moisture of a solid fuel
2. Prepare the Bakelite polymer and ZnO nanomaterial
3. Determine acid number and viscosity of lubricating oil
4. Estimate the Iron and Calcium in cement.
5. Estimate the hardness and dissolved oxygen in water.
6. Determine the Strength of an acid in lead acid Battery

COs - POs Mapping

COs	PO1	PO6	PO7	PO9	PO12
1	3	1	3	1	1
2	3	1	3	1	1
3	3	1	3	1	1
4	3	1	2	1	1
5	3	1	3	1	1
6	3	1	3	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

LIST OF EXERCISES:

1. Introduction to Quantitative Analysis - Demonstration
2. Determination of Hardness of a groundwater sample.
3. Estimation of Dissolved Oxygen by Winkler's method
4. Determination of Fluoride in water sample
5. Determination of nitrite in water sample by spectrometric method
6. Determination of percentage of Iron in Cement sample by colorimetry
7. Estimation of Calcium in Portland cement
8. Determination of Strength of an acid in Pb-Acid battery
9. Preparation of a polymer (Bakelite)
9. Preparation of nanomaterials by precipitation method
10. Adsorption of acetic acid by charcoal
11. Determination of percentage Moisture content in a coal sample
12. Determination of acid number of lubricating oil
13. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
14. Determination of Viscosity of lubricating oil by Redwood Viscometer 2
15. Determination of Calorific value of gases by Junker's gas Calorimeter

List of Augmented Experiments1

1. Assessment of ground water quality of your village/Mandal (by taking min. 6 locations and determining min. 4 parameters – Fluoride, Chloride, Hardness, TDS etc.)
2. Preparation of a desired quality of Viscosity Index lubricating oil
3. Proximate analysis of coal – Ultimate analysis of coal
4. Making a battery of required potential
5. Energy scenario in India- Various sources, % consumption, solutions to meet future demand etc.
6. Find the viscosity of various edible and non-edible lubricating oils

Reference Books

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar
2. Waste Water Engineering Treatment and Reuse, 4th Edition, Metcalf and Eddy, Inc
3. Engineering chemistry laboratory manual & record By Srinivasulu D. Parshva publications

**23BEX05 - ELECTRICAL & ELECTRONICS ENGINEERING WORKSHOP
(Common to All branches of Engineering)**

0 0 3 1.5

Course Outcomes

At the end of the course, student will be able to

- 1 Apply fundamental electrical principles to resolve complex circuit problems.
- 2 Develop proficiency in conducting electrical measurements and studying machine characteristics for practical applications.
- 3 Demonstrate skills in measuring power parameters and calculate energy consumption for residential applications.
- 4 Analyze the characteristics of semiconductor devices
- 5 Find the frequency response of amplifiers using BJT
- 6 Verify the truth tables of logic gates and basic flip flops

CO-PO Mapping

COs	PO4	PO5	PO6	PO9	PO12
1	3	2	1	1	1
2	3	2	1	1	1
3	3	2	1	1	1
4	3	2	1	1	1
5	3	2	1	1	1
6	3	2	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set, wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
 - Provide some exercises so that hardware tools and instruments are learned to be used by the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
 - Provide some exercises so that measuring instruments are learned to be used by the students.
3. Components:
 - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
 - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises **Note:** Minimum Six Experiments to be performed.

PART B: ELECTRONICS ENGINEERING LAB

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifiers Plot Input & Output characteristics of BJT in CE and CB configurations
4. Frequency response of CE amplifier.
5. Simulation of RC coupled amplifier with the design supplied
6. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
7. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs. Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

List of Augmented Experiments.

1. Connections of Tube Light wiring
2. Connections of Godown Wiring
3. Connections of stair case wiring
4. Generate fixed positive 5V using IC7405
5. Generate fixed Negative 5V using IC7905
6. Generate sinusoidal wave form using function generator

Reference Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.
4. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
5. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
6. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software.

**23BEX06 - ENGINEERING WORKSHOP
(Common to all branches of Engineering)**

0 0 3 1.5

Course Outcomes:

At the end of this course a student will be able to

1. Demonstrate the simple wooden components like Cross Lap joint, T-Lap joint, Dovetail Joint.
2. Develop the simple house hold items like Taper Tray, Square box, Open Scoop using sheet metal.
3. Build the V- Fit, Square fit, Dovetail fit using mild steel.
4. Understand simple house wiring circuits like Parallel/Series connection of three bulbs, Stair Case Wiring, Godown Wiring.
5. Create the Green Sand Mould for given the patterns like rectangular shape, circular shape.
6. Construct the metal joint using Arc Welding like: Lap joint, Butt joint.

COs - POs Mapping:

COs	PO ₁	PO ₉	PO ₁₂
1	3	3	2
2	3	3	2
3	3	3	2
4	3	3	2
5	3	3	2
6	3	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Demonstration: Safety practices and precautions to be observed in workshop.

Wood Working: Familiarity with different types of woods and tools used in wood working and make following joints: a) Cross Lap joint, b) T-Lap joint, c) Dovetail Joint.

Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets: a) Taper Tray, b) Square box, c) Open Scoop.

Fitting: Familiarity with different types of tools used in fitting and do the following fitting exercises: a) V-Fit, b) Dovetail fit, c) Half Round Fit.

Electrical Wiring: Familiarity with different types of basic electrical circuits and make the following connections: a) Parallel/Series connection of three bulbs, b) Stair Case Wiring, c) Godown Wiring

Foundry: Demonstration of Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns: a) rectangular shape mould, b) circular shape mould

Welding Shop: Demonstration and practice on Arc Welding. Preparation of a) Lap joint and b) Butt joint.

LIST OF EXPERIMENTS:

Wood Working:

1. Cross Lap joint,
2. T-Lap joint,
3. Dovetail Joint

- Sheet Metal Working:**
4. Taper Tray,
 5. Square box,
 6. Open Scoop

Fitting:

1. V- Fit,
2. Square fit,
3. Dovetail fit, **Electrical Wiring:**
4. Parallel/Series connection of three bulbs,
5. Stair Case Wiring,
6. Godown Wiring

Foundry Trade:

1. Mould cavity for rectangular shape

2. Mould cavity for a straight pipe **Welding Shop:**
3. Lap joint
4. Butt joint.

Any two jobs from each trade must be performed by the student.

AUGMENTED EXPERIMENT / MINI PROJECT: An innovative and creative useful house hold product/model should be prepared by the group of 6-10 students using the knowledge gathered from the all shops in workshop.

TEXTBOOKS:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

REFERENCE BOOKS:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

**23BEX07 - COMPUTER PROGRAMMING LAB
(Common to all branches of Engineering)**

0 0 3 1.5

Course Outcomes

At the end of the course, student will be able to

1. Read, understand, and trace the execution of programs.
2. Select the proper control structure for solving the problem.
3. Construct programs using homogenous data types.
4. Develop modular programming using functions
5. Formulate programs for optimal utilization of memory.
6. Develop programs using files.

COs - POs Mapping:

COs	PO2	PO3	PO4	PO12
1	2	2	3	2
2	2	3	3	2
3	2	3	3	2
4	2	3	3	2
5	2	3	3	2
6	2	3	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments:

UNIT-I

WEEK 1:

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with the programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc. ii)

Exposure to Turbo C, gcc iii) Writing simple programs using printf(), scanf()

WEEK 2:

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps

using textual and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs i)

Sum and average of 3 numbers ii) Conversion of Fahrenheit to Celsius and vice

versa iii) Simple interest calculation

WEEK 3:

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions. i)

Finding the square root of a given number ii) Finding compound interest

iii) Area of a triangle using Heron's formulae iv)

Distance traveled by an object

UNIT-II

WEEK4

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression, and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:

Lab4: Simple computational problems using the operator's precedence and associativity i)

Evaluate the following expressions.

a. $A+B*C+(D*E) + F*G$

b. $A/B*C-B+A*D/3$

c. $c. A+++B---A$

d. $d. J= (i++) + (++i)$

ii) Find the maximum of three numbers using the conditional operator iii) Take

marks of 5 subjects in integers, and find the total, average in float

WEEK 5:

Objective: Explore the full scope of different variants of –if construct||, namely if-else, null-- else, if-else if*-else, switch, and nested-if, including in what scenario each can be used and how to use them.

Explore all relational and logical operatorswhile writing conditionals for –if construct||.

Suggested Experiments/Activities:

Tutorial 5: Branching and logical expressions: Lab 5:

Problems involving if-then-else structures.

i) Write a C program to find the max and min of four numbers using if-else.

ii) Write a C program to generate electricity bill. iii) Find the roots of the quadratic equation. iv) Write a C program to simulate a calculator using a switch case.

v) Write a C program to find whether the given year is a leap year.

WEEK 6:

Objective: Explore the full scope of iterative constructs, namely while loop, do-while loop, and for loop in addition to structured jump constructs like break and continue, including when eachof these statements is more appropriate. Suggested Experiments/Activities:

Tutorial 6: Loops, while and for loops

Lab 6: Iterative problems, e.g., the sum of series

i) Find the factorial of a given number using any loop. ii)

Find whether the given number is a prime or not. iii)

Compute sine and cos series iv) Checking whether a

number is palindrome v) Construct a pyramid of numbers.

UNIT-III

WEEK7:

Objective: Explore the full scope of the Arrays construct, namely defining and initializing 1-D and 2-D and,

More generically, n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:

Tutorial 7: 1 D Arrays: searching. Lab 7:1D

Array manipulation, linear search

i) Find the min and max of a 1-D integer array.

ii) Perform linear search on the 1D array.

iii) The reverse of a 1D integer array iv) Find 2's complement of the given binary number. v) Eliminate duplicate elements in an array.

WEEK 8:

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null characters and get comfortable with strings by doing experiments that will

reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:

Tutorial 8: 2 D arrays, sorting and Strings.

Lab 8: Matrix problems, String operations, Bubble sort i)

Addition of two matrices ii) Multiplication two matrices

iii) Sort array elements using bubble sort iv) Concatenate

two strings without built-in functions

v) Reverse a string using built-in and without built-in string functions

UNIT-IV

WEEK9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation value initialization, resizing, changing, and reordering the contents of an array, and memory deallocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C Suggested

Experiments/Activities:

Tutorial 9: Pointers, structures, and dynamic memory allocation Lab 9:

Pointers and structures, memory dereference.

i) Write a C program to find the sum of a 1D array using malloc() ii) Write a C program to find the total average of n students using structures iii) Enter n students data using calloc() and display failed students list iv) Read student name and marks from the command line and display the student details along with the total.

v) Write a C program to implement realloc()

WEEK 10:

Objective: Experiment with C Structures, Unions, bit fields self-referential structures(Singlylinked lists), and nested structures Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10: Bitfields

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bitfields

i) Create and display a singly linked list using self-referential structure.

ii) Demonstrate the differences between structures and unions using a C program. iii) Write a C program to shift/rotate using bitfields. iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT-V

WEEK 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by Parameter passing using call by value. Basic methods of numerical integration Suggested

Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent,

Lab 11: Simple functions using call by value, solving differential equations using Eulers theorem.

i) Write a C function to calculate NCR value.

ii) Write a C function to find the length of a string.

iii) Write a C function to transpose of a matrix.

iv) Write a C function to demonstrate numerical

integration of differential equations using Euler's method

WEEK 12:

Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Recursive functions

i) Write a recursive function to generate Fibonacci series. ii) Write a recursive function to find the lcm of two numbers. iii) Write a recursive function to find the factorial of a number. iv) Write a C Program to implement Ackermann function using recursion. v) Write a recursive function to find the sum of series.

WEEK 13:

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Simple functions using Call by reference, Dangling pointers. i) Write a C program to swap two numbers using call by reference.

ii) Demonstrate Dangling pointer problem using a C program. iii) Write a C program to copy one string into another using pointer. iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

WEEK14:

Objective: To understand data files and file handling with various file I/O functions. Explore the differences

Between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: File operations

- i) Write a C program to write and read text into a file. ii) Write a C program to write and read text into a binary file using fread() and fwrite() iii) Copy the contents of one file to another file. iv) Write a C program to merge two files into the third file using command-line arguments. v) Find no. of lines, words and characters in a file

List of Augmented Experiments:

1. Employee's Management System
2. Library management system
3. Automation of department store
4. Personal Dairy Management
5. Telecom Billing Management
6. Bank Management System
7. Contacts Management

Text books:

1. Ajay Mittal, Programming in C: A practical approach, 1 st Edition, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2020, McGraw Hill.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India. C Programming,
2. A Problem-Solving Approach, Forouzan, Gilberg, Prasad, 3rd Edn, CENGAGE.

23BEX08 - IT WORKSHOP
(Common to all branches of Engineering)

0 0 2 1

Course Outcomes:

At the end of the course, student will be able to

1. Demonstrate the process of Assembling and disassembling the PC.
2. Illustrate the steps involved in installations of various operating systems.
3. Understand the process of Configuring IP address and perform virus free downloads.
4. Create projects using Latex/ Word and organize data and spreadsheets.
5. Design basic and interactive Power Point Presentations.
6. Improve Conversational abilities using AI-Tools.

COs - POs Mapping

COs	PO ₁	PO ₂	PO ₃	PO ₄	PO ₉	PO ₁₂
1	3	2	3	2	3	3
2	2	3	2	3	3	2
3	3	2	2	2	3	2
4	2	3	2	2	3	2
5	3	3	3	2	3	2
6	2	2	2	2	3	2

3 - Strongly Linked | 2 - Moderately Linked | 1 - Weakly Linked

PC Hardware

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor. **Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email. If there are no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN. **Task 2:** Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop-up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 - Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX and MS office or equivalent (FOSS) tool Word as word

Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using LaTeX and Word to create a project certificate. Features to be covered: - Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Task 3: Creating project abstract Features to be covered: -Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered: - Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources. **Task 1:** Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWERPOINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

Ex: Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dream tech
2. The Complete Computer upgrade and repair book, 3rd edition Cheryl A Schmidt, WILEY Dream tech
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
4. PC Hardware - A Handbook – Kate J. Chase PHI (Microsoft)
5. LaTeX Companion – Leslie Lamport, PHI/Pearson.

6. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
7. IT Essentials PC Hardware and Software Labs and Study Guide Third Edition by Patrick Regan– CISCO Press, Pearson Education.

**23HSX02 - COMMUNICATIVE ENGLISH LAB
(Common to all branches of Engineering)**

0 0 2 1

Course Outcomes

At the end of the course, student will be able to

1. Acquire knowledge of the English sound system and get practice to gain accuracy in pronunciation
2. Apply the patterns of accent and intonation for better listening and speaking comprehension
3. Write emails, resume and statement effectively for the purpose for professional communication
4. Evaluate and exhibit professionalism in participating in debates and group discussions
5. Demonstrate the necessary verbal and non-verbal communication in technical presentations
6. Perform different roles and practice interpersonal communication in formal situations

COs - POs Mapping

COs	PO01	PO09	PO10	PO11	PO12
1	1	1	3	1	2
2	1	1	3	1	1
3	1	1	3	1	2
4	1	1	3	1	1
5	1	1	3	1	2
6	1	1	3	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments

- 1 Letters and Sounds of English
- 2 Role play/ Conversation Practice-1
- 3 Jam
- 4 E-Mail Writing
- 5 Pronunciation Rules
- 6 Role play/ Conversation Practice-II
- 7 Accent rules and Intonation
- 8 Presentation Skills
- 9 Resume Writing
- 10 Debating
- 11 Group Discussion
- 12 Interviews
- 13 Poster Presentation
- 14 Statement of Purpose
- 15 Role play/ Conversation Practice-3 16. Role play/ Conversation Practice-4

Augmented Experiment

List of Augmented Experiments²

1. Common Errors in English
2. Listening Skills
3. Writing Skills
4. Reading Skills
5. Public Speaking
6. Interview Skills
7. Business Communication

8. Functional English

9. Preparation for GRE/TOEFL
10. Preparation for IELTS/CAT/GMAT

¹Students shall opt any one of the Augmented Experiments in addition to the regular experiments

Reading Material (s)

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford Press.2018.
2. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India, 2016
3. Hewing's, Martin. Cambridge Academic English (B2). CUP, 2012.
4. J. Sethi& P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle, 2013
5. K. Nirupa Rani, Jayashree Mohan Raj, B. Indira, (Ed) Speak Well (C.D) Orient Black Swan Pvt Ltd, Hyderabad, 2012

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. <https://www.britishcouncil.in/english/online>
5. <http://www.letstalkpodcast.com/>
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. <https://www.youtube.com/c/ArnelsEverydayEnglish/featured>
8. <https://www.youtube.com/c/engvidAdam/featured>
9. <https://www.youtube.com/c/EnglishClass101/featured>
10. <https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists>
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

- 1 <https://www.youtube.com/user/letstalkaccent/videos>
- 2 <https://www.youtube.com/c/EngLanguageClub/featured>
- 3 https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
- 4 https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

23HSX11 - HEALTH AND WELLNESS, YOGA AND SPORTS
(Common to All branches of Engineering)

0 0 1 0.5

Course Outcomes:

At the end of the course, student will be able to

1. Understand the importance of yoga and sports for Physical fitness and sound health.
2. Demonstrate an understanding of health-related fitness components.
3. Compare and contrast various activities that help enhance their health.
4. Assess current personal fitness levels. **CO5: Develop Positive Personality**

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

- i) Organizing health awareness programmes in community ii) Preparation of health profile
- iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

- i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. Human Kinetics, Inc. 2014

General Guidelines:

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

Evaluation Guidelines:

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

**23HSX12 -NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE
(Common to All branches of Engineering)**

0 0 1 0.5

Course Outcomes

At the end of the course, student will be able to

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

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

- i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
- ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc. iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
- iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature Care Activities:

- i) Best out of waste competition.
- ii) Poster and signs making competition to spread environmental awareness.
- iii) Recycling and environmental pollution article writing competition. iv) Organising Zero-waste day.
- v) Digital Environmental awareness activity via various social media platforms.
- vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
- vii) Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

- i) Conducting One Day Special Camp in a village contacting village-area leaders-Survey in the village, identification of problems- helping them to solve via media-authorities-experts-etc.
- ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS, iii) Conducting consumer Awareness. Explaining various legal provisions etc. iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
- v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

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

General Guidelines:

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

Evaluation Guidelines:

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

23MAX02 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All Branches of Engineering)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Model and solve the first order differential equations
2. Experiment with the practical importance of solving first and higher order differential equations in engineering.
3. Solve higher order differential equations and understand about initial value problems
4. Identify methods for solving linear partial differential equations.
5. Make use of central concepts in partial differential equations and vector differentiation
6. Apply vector calculus in the context of estimating the work done, circulation, flux and vector integral theorems

COs - POs Mapping

COs	PO1	PO2	PO3	PO4	PO12
1	3	3	2	2	1
2	3	2	3	3	1
3	3	3	3	2	1
4	3	2	2	1	1
5	3	3	2	1	1
6	3	3	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT- I

Differential equations of first order and first degree

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

UNIT - II

Linear differential equations of higher order (Constant Coefficients)

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

UNIT - III

Partial Differential Equations

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

UNIT - IV

Vector Calculus

Vector differentiation:

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

Vector integration:

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

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

- B.S.Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

Reference Books:

- Dennis G.Zill and Warren S.Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2018.
- Micheael Greenberg, Advanced Engineering Mathematics, 9th edition, Pearson edn
- George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 14/e, Pearson Publishers, 2018.
- R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5/e, Alpha Science International Ltd., 2021 (9th reprint).
- B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	10	10	
Understand	60	60	40
Apply	30	30	60
Analyze			
Evaluate			
Create			
Total (%)	100	100	100

Sample Question (s)

Remember

- State Newton’s Law of Cooling
- Find the Wronskian for the functions $\cos x$ and $\sin x$
- Form the PDE by eliminating the arbitrary constants a and b from $z = ax + by + \frac{a}{b} - b$
- State Gauss divergence theorem.

Understand

- Solve $(1 + e^{x/y})dx + e^{x/y} \left(1 - \frac{x}{y}\right) dy = 0$
- Solve $\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + y = 2e^{3x}$
- Form the PDE by eliminating the arbitrary functions from $Z = f(x) + e^y g(x)$

Apply

- A bacterial culture, growing exponentially, increases from 200 to 500 grams in the period from 6 a.m to 9 a.m. Find the number of grams which will be present at noon.
- If a voltage of $20 \cos 5t$ is applied to a series circuit consisting of 10 ohm resistor and 2 Henry inductor, determine the current at any time t .
- Find the work done in moving a particle in the force field $F = 3x^2\bar{i} + (2xz - y)\bar{j} + z\bar{k}$ along the straight line from (0,0,0) to (2,1,3).

23ME201 ENGINEERING MECHANICS

(Common to MECH & CIVIL)

3 0 0 3

Course Outcome

At the end of the course, student will be able to

1. Compute the resultant force in concurrent and coplanar force systems.
2. Analyze the equilibrium condition for different force systems with and without friction.
3. Determine the forces and their nature in the members of trusses.
4. Determine the centroids, centre of gravity and moment of inertia of different geometrical shapes.
5. Analyze the kinematics of rectilinear and curvilinear motions.
6. Assess the kinetics of rectilinear, curvilinear and rigid body motion.

CO-PO Mapping

COs	PO1	PO2	PO3	PSO ₁
1	3	2	2	2
2	3	2	2	2
3	3	2	2	2
4	3	2	2	2
5	3	3	2	2
6	3	3	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT I

Introduction to Engineering Mechanics – Basic Concepts, Scope and Applications, Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant– Moment of Force and its Application –Couples and Resultant of Force Systems.

Friction: Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Cone of Static friction.

12 hours

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorem, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Analysis of plane trusses by method of joints and sections.

12 hours

UNIT III: Centroid and Centre of Gravity: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. Centre of gravity of composite bodies,

Area Moments of Inertia: Definition– Polar Moment of Inertia, Parallel and perpendicular axis theorems, Moments of Inertia of Composite Figures.

12 hours

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

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

12 hours

Total: 48 hours

Textbooks:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education.
2. Engineering Mechanics, S.S Bhavikatti, 8th Edition, New Age International, 2022.
3. Engineering Mechanics, A.K Tayal, Statics and Dynamics, 14th Edition, Umesh Publishers, 2021
4. Engineering Mechanics: Principles of Statics and Dynamics, R.C. Hibbler., Pearson Press, 2006.
5. Introduction to Statics and Dynamics, Andy Ruina and Rudra Pratap., Oxford University Press, 2011.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examinations (%)
Remember	15	15	-
Understand	30	30	-
Apply	55	55	70
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Questions(s)**Remember**

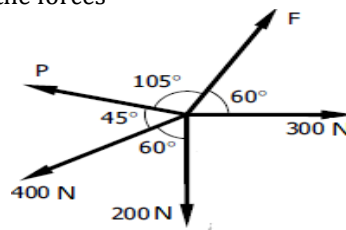
1. Name different types of system of forces
2. Define centroid
3. Define area moment of inertia
4. State the laws of friction
5. List the assumptions of perfect frame
6. Define Rectilinear and Curvilinear motions

Understand

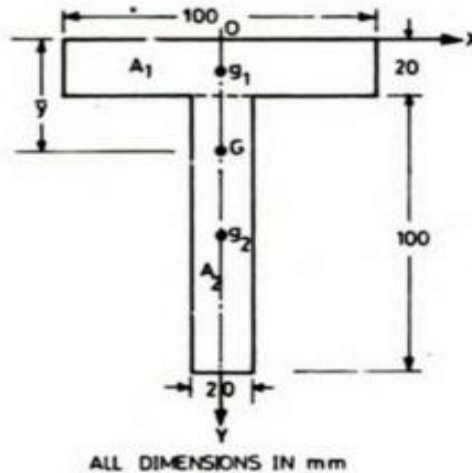
1. Explain Lami's theorem
2. Compare centroid and centre of gravity
3. Explain about area moment of inertia
4. How will you distinguish between static friction and dynamic friction?
5. Explain the difference between frame and truss
6. Explain the D Alembert's principle

Apply

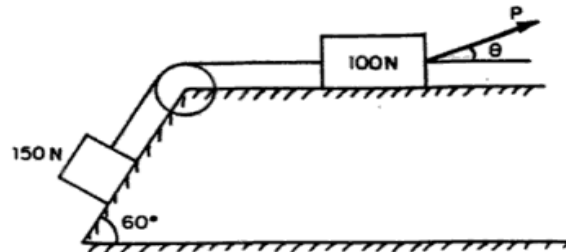
1. Figure represents the concurrent force system acting at a joint of a bridge truss. Determine the value of P and E to maintain equilibrium of the forces



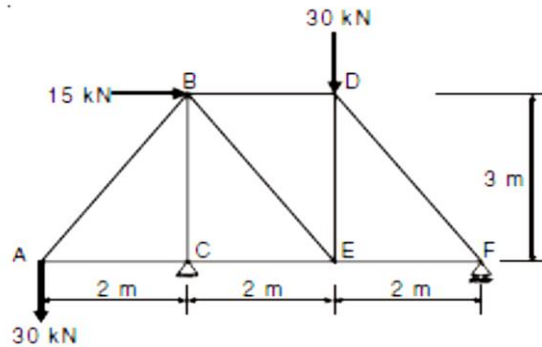
2. Identify the centroid of T-section shown in below Fig.



3. Determine the moment of inertia of the areas of Triangle about its base by first principle
4. Determine the least value of force P to cause motion to impend rightwards. Assume the co-efficient of friction under the blocks to be 0.2 and pulley to be frictionless.



5. Determine the forces in all the members of the truss shown in Fig.



6. A stone is dropped into a well and the splash is heard two seconds later. If sound travels 335m/s, what is the depth of the well?
7. An 1800 kg Toyota Innova travels down the 10° inclined road at a speed of 6 m/s. If the driver jams on the brakes, causing his wheels to lock, solve how far the tires skid on the road using: a. Equation of the motion b. Principles of work-Energy The coefficient of kinetic friction between the wheels and the road is 0.5 **(For Open Book Examination and not for semester end examination)**

Analyze

1. A uniform ladder 3 m long weighs 200 N. It is placed against a wall making an angle of 60° with the floor as shown in Fig. The coefficient of friction between the wall and the ladder is 0.25 and that between the floor and ladder is 0.35. The ladder, in addition to its own weight, has to support a man of 1000 N at its top at B. Calculate: i) The horizontal force P to be applied to ladder at the floor level to prevent slipping. ii) If the force P is not applied, what should be the minimum inclination of the ladder with the horizontal, so that there is no slipping of it with the man at its top?

2. Compare the location of the centroids of an arc of circle and a sector of a circle subtending the same angle at the centre of the circle
3. A car A is travelling on a straight level road with a uniform speed of 60 km/hr. it is followed by another car B moving at a speed of 70 km/hr. when the distance between them is 2.5 km, the car B is decelerated at 20 km/hr^2 . will the car be catch up with A? if not, why not? If yes, at what distance and time?
4. Analyze the ability of a hook (used by a crane) to raise prefabricated walls upright. The hook was approximately J-shaped, with a lip. The hook would grip one end of the wall and lift, while the other end of the wall remained in contact with the ground **(For Open Book Examination and not for semester end examination)**
6. The car A has a forward speed of 18 km/h and is accelerating at 3 m/s^2 Determine the velocity and acceleration of the car relative to observer B, who rides in a nonrotating chair on the Ferris wheel. The angular rate $\omega = 3 \text{ rev/min}$ of the Ferris wheel is constant **(For Open Book Examination and not for semester end examination)**

23CS201 Data Structures
(Common for CSE, CSE-AI&DS, CSE-AI&ML, IT)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Explain the role of linear data structures in organizing and accessing data efficiently in algorithms.
2. Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation.
3. Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.
4. Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues, and apply them appropriately to solve data management challenges.
5. Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees
6. Recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems.

CO-PO Mapping

COs	PO1	PO2	PO3	PO12	PSO1
1	3	2	2	1	3
2	3	3	3	1	3
3	3	3	3	1	3
4	3	3	3	1	3
5	3	3	3	1	3
6	2	3	3	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures. **Searching Techniques:** Linear & Binary Search, **Sorting Techniques:** Bubble sort, Selection sort, Insertion Sort

11Hours

Unit II

Linked Lists and Stacks: Singly linked lists, representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists. **Stacks:** Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists,

13 Hours

Unit III

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists. Deques: Introduction to dequeues (double-ended queues), Operations on dequeues and their applications. **Applications of Stack and Queue:** Applications of stacks in expression evaluation, backtracking, reversing list etc., Applications of queues in breadth-first search, scheduling, etc.

12 Hours

Unit IV

Trees: Introduction to Trees, Binary Search Tree – Insertion, Deletion & Traversals Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations, Applications of hashing in unique identifier generation, caching, etc.

12 Hours

Total: 48 Hours

Textbooks:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008

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 Sedgwick

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	25	25	
Understand	38	38	
Apply	37	37	
Analyze	--		30
Evaluate	--		25
Create	--		45
Total (%)	100	100	100

Sample Question (s)

Remember

1. Compute the time complexity of insertion in a linked list.
2. Define Abstract Data Type (ADT)?
3. Define a linear data structure and give one example.

Understand

1. How does the implementation of ADTs benefit software development?
2. What is the time complexity of a linear search in the worst case?
3. Differentiate between stack and queue.

Apply

1. Describe the process of implementing an ADT for a stack.
2. Draw the logical structure of a doubly linked list.

23EE201 Electrical Circuit Analysis-1(For EEE Branch)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Summarize the V-I relations of electrical circuit elements.
2. Outline magnetic and couple circuits
3. Apply network reduction techniques to DC circuits
4. Summarize the behaviour of AC circuits
5. Apply network theorems to AC and DC circuits.
6. Outline the characteristics of series/parallel resonant circuits

COs - POs Mapping

COs	PO1	PO2	PO3	PO6	PO7	PO9	PO12	PSO1	PSO2
1	3	1	2	1	1	1	1	3	3
2	3	1	2	1	1	1	1	3	3
3	3	1	2	1	1	1	1	3	3
4	3	1	2	1	1	1	1	3	3
5	3	1	2	1	1	1	1	3	3
6	3	1	2	1	1	1	1	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT-I

Introduction to Electrical Circuits

Basic circuit elements R, L, C and their V-I relations, dependent and independent sources, Kirchoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation, source transformation), nodal and mesh analysis to DC networks with dependent and independent voltage and current sources *supernode and supermesh analysis*

12 Hours

UNIT-II: Magnetic Circuits

Terminology used in magnetic circuits, series, parallel and composite magnetic circuits, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling.

Conductively coupled equivalent circuit

10 Hours

UNIT-III: Single Phase Circuits

Characteristics of periodic functions, Average value, R.M.S. value, form factor, peak factor, and representation of a sine function, concept of phasor, phasor diagram.

Steady state analysis of R, L and C circuits to sinusoidal excitations-response of pure resistance, inductance, capacitance, series RL, RC and RLC circuits, parallel RL, RC and RLC parallel circuits, power and power factor Resonance: Series Resonance-Characteristics of a series resonant circuit, Q-factor, selectivity and bandwidth, expression for half power frequencies; Parallel resonance- Q-factor, selectivity and bandwidth.

Locus diagram: RL, RC, RLC series circuits with R, L and C variables.

Comparison between series and parallel resonance, applications of resonant circuits

15 Hours

UNIT-IV: Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem an Millman's theorem and compensation theorem.

Textbook (s)

1. W.H.Hayt, J.E.Kimmerly, and S.M.Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 8th Edition, 2015.
2. Charles K Alexander and Mathew N.O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 5th Edition, 2013.
3. M.E Van Valkenburg, "Network Analysis", Prentice Hall of India, 4th Edition, 2018.
4. P. Ramana, G.T.Chnadra Sekhar, G.Suresh, "Network Theory", SChand and Company Ltd., 1st Edition, 2024.

Reference (s)

1. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co., 6th Edition, 2014.
2. A Sudhakar, and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Higher Education, 5th Edition, 2015.
3. M Nahvi, Joseph Edminister, K Uma Rao, "Electric Circuits, (Schaum's Outline Series)", McGraw Hill Higher Education, 7th Edition, 2017.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test(%)
Remember	20	20	-
Understand	20	20	-
Apply	60	60	60
Analyze	-	-	40
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)**Remember**

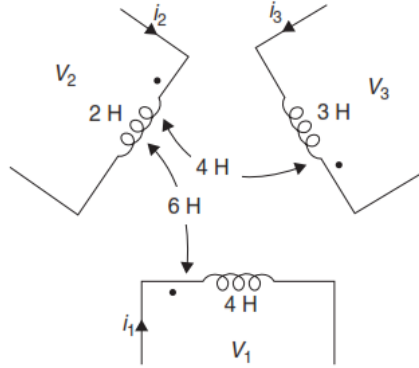
1. When a 25 Ω resistor, 100 Ω resistor, 75 Ω resistor and 50 Ω resistor are connected in parallel, then find the total resistance of the circuit.
2. Define statically induced emf.
3. List the limitations of Millman's theorem
4. State superposition theorem.
5. Define Quality factor and bandwidth.

Understand

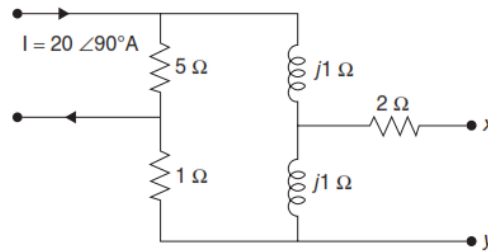
1. Find the two elements in a series circuit, given that the current and total voltage are $i = 10 \cos(5000 t - 23.13^\circ) A$, $v = 50 \cos(5000 t + 30^\circ) V$
2. When two coils are connected in series their effective inductance is found to be 10 H. When the connection of one coil is reversed, the effective inductance is 6 H. If the coefficient of coupling is 0.6, calculate the self inductance of each coil and the mutual inductance.
3. State dot rule for coupled coils and explain its significance.

Apply

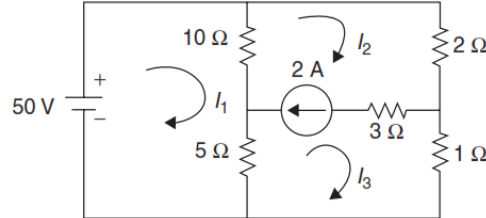
1. For the circuit as shown in the figure, write the inductance matrix.



2. Find the power consumed by a load of $5\angle 60^\circ \Omega$ connected between terminals x and y in the circuit as shown in the figure, using Thevenin's theorem.



3. Determine the current in the 5Ω resistor in the network shown in the figure.



23EC201 Network Analysis (ECE Branch)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Apply network reduction techniques to DC circuits.
2. Apply network theorems to simplify complex networks.
3. Summarize the behavior of AC circuits.
4. Explain series and parallel connected coupled circuits.
5. Interpret various parameters for a given two-port network.
6. Illustrate the transient response of R, L, C circuits for DC and AC excitations.

COs - POs Mapping

COs	PO1	PO2	PO3	PO6	PO7	PO9	PO12	PSO1	PSO2
1	3	1	2	1	1	1	1	1	1
2	3	1	2	1	1	1	1	1	1
3	3	1	2	1	1	1	1	1	1
4	3	1	2	1	1	1	1	1	1
5	3	1	2	1	1	1	1	1	1
6	3	1	2	1	1	1	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

UNIT-I

Introduction to Electrical Circuits and Network theorems

Introduction to Electrical Circuits: Types of circuit elements, types of sources, ohm's law, Kirchoff's laws, source transformation, star-delta conversion, mesh and nodal analysis, problem solving with resistances, principal of duality with examples.

Network Theorems: Superposition, Thevenin's, Norton's, Millman's, Reciprocity, Compensation, Substitution, Max Power Transfer, Tellegen's theorems.

13 Hours

UNIT-II

Steady state AC analysis and Resonance

Steady State AC Analysis: Impedance concept, j-operator, phasor notation, RL, RC, RL C circuits problem solving, calculation of different powers and power factor.

Resonance: Definition of resonance, series resonance, parallel resonance, bandwidth, quality factor of series and parallel resonance.

11 Hours

UNIT-III

Coupled Circuits and Two Port Networks

Coupled Circuits: Faraday's laws of electromagnetic induction, self-inductance, mutual inductance, coefficient of coupling, dot rule of coupled circuits, conductively coupled equivalent circuits- problem solving.

Two-port Networks: Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Interrelationship between parameters, Interconnection of two port networks.

12 Hours

UNIT-IV

Transient Analysis

Transients: First order differential equations, Definition of time constants, RL circuit, RC circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, problem-solving using RLC elements with DC excitation and AC excitation, Response of second order circuit as related to location of poles in s-plane.

Laplace transforms: introduction to Laplace transformation, problem solving using Laplace transform,

12 Hours

Total: 48 Hours

Textbook (s)

1. W.H.Hayt, J.E.Kimmerly, and S.M.Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 8th Edition, 2015.
2. Charles K Alexander and Mathew N.O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 5th Edition, 2013.
3. M.E Van Valkenburg, "Network Analysis", Prentice Hall of India, 4th Edition, 2018.
4. P. Ramana, G.T.Chnadra Sekhar, G.Suresh, "Network Theory", SChand and Company Ltd., 1st Edition, 2024.

Reference (s)

1. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co., 6th Edition, 2014.
2. A Sudhakar, and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Higher Education, 5th Edition, 2015.
3. M Nahvi, Joseph Edminister, K Uma Rao, "Electric Circuits, (Schaum's Outline Series)", McGraw Hill Higher Education, 7th Edition, 2017.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	
Understand	30	30	
Apply	60	60	70
Analyze			20
Evaluate			10
Create			
Total (%)	100	100	100

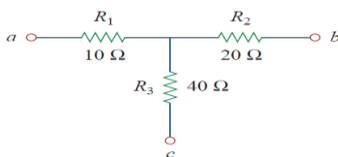
Sample Question (s)

Remember

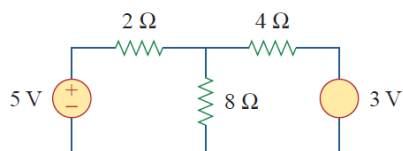
1. Define Kirchoff of current law
2. Define Thevenin Theorem
3. Define Superposition theorem
4. Define time constant of a RL circuit

Understand

1. Convert the below Star network to Delta network.



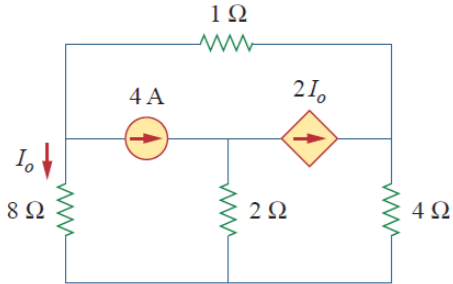
2. What is the Voltage across 8 Ω resistor



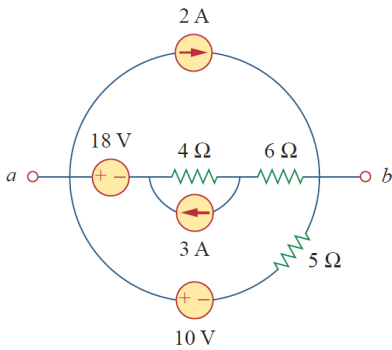
3. An incandescent lamp draws 2 A at 100 V. Find its resistance

Apply

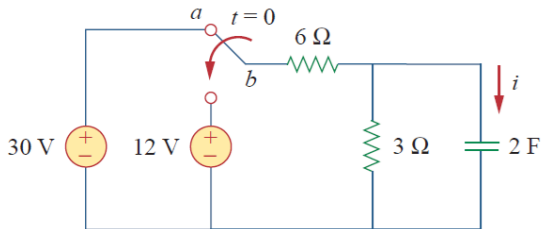
1. Find the value of voltage across 2Ω resistor by using Thevenin's theorem.



2. Find the Thevenin equivalent circuits at terminals a - b .



3. The switch in circuit has been in position a for a long time. At $t=0$, it moves to position b . Calculate $i(t)$ for all $t > 0$.



(Common for CSE, CSE-AI&DS, CSE-AI&ML, IT)
23CS202 Data Structures Lab

0 0 3 1.5

Course Outcomes

At the end of the course, student will be able to

1. Explain the role of linear data structures in organizing and accessing data efficiently in algorithms.
2. Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation.
3. Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems.
4. Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues, and apply them appropriately to solve data management challenges.
5. Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees
6. Recognize scenarios where hashing is advantageous, and design hash-based solutions for specific problems.

CO-PO Mapping

COs	PO2	PO3	PO4	PO12	PSO1
1	2	3	2	1	3
2	2	3	2	1	3
3	2	3	2	1	3
4	2	3	2	1	3
5	2	3	2	1	3
6	2	3	2	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments:

1. Array Manipulation
 - a. Write a program to reverse an array.
 - b. Basic Array Programs
2. Searching Techniques
 - a. C Programs to implement the Searching Techniques – Linear
 - b. C Programs to implement the Searching Techniques - Binary Search
3. Sorting Techniques
 - a. C Programs to implement Sorting Techniques – Bubble Sort
 - b. C Programs to implement Sorting Techniques - Insertion Sort
4. Linked List Implementation
 - a. Implement a singly linked list and perform insertion and deletion operations.
 - b. Develop a program to reverse a linked list iteratively and recursively.
5. Linked List Applications
 - a. Create a program to detect and remove duplicates from a linked list.
 - b. Implement a linked list to represent polynomials and perform addition.
6. Double and Circular Linked List Implementation
 - a. Implement a doubly linked list and perform various operations to understand its properties and applications.
 - b. Implement a circular linked list and perform insertion, deletion, and traversal.
7. Stack Operations
 - a. Implement a stack using arrays
 - b. Implement a stack using linked lists
8. Queue Operations
 - a. Implement a queue using arrays
 - b. Implement a queue using linked lists

9. Queue Types
 - a. Implement a circular queue
 - b. Implement a double-ended queue (deque) with essential operations.
10. Stack Applications -I
 - a. Use a stack to convert an infix expression to postfix
 - b. Write a program to evaluate a postfix expression using a stack.
11. Stack Applications -II
 - a. Implement a program to check for balanced parentheses using a stack.
 - b. Create a program to determine whether a given string is a palindrome or not.
12. Queue Applications
 - a. Develop a program to simulate a simple printer queue system.
 - b. Implement a stack or queue to perform comparison and check for symmetry
13. Binary Search Tree
 - a. Implementing a BST using Linked List.
 - b. Traversing of BST.
14. Closed Hashing: Implement a hash table with open Addressing techniques.
15. Open Hashing: Implement a hash table with Separate chaining techniques.
16. Hashing- Application: Write a program to implement a simple cache using hashing.

Indicative list of applications-based experiments

1. Integer to Roman

Problem Description: Given an integer, convert it to a Roman numeral. Input is guaranteed to be within the range from 1 to 3999.

Implementation: You can create a function that iteratively subtracts the largest possible Roman numeral values from the given integer and appends the corresponding symbols until the integer becomes zero.

2. Merge Two Sorted Linked Lists

Problem Description: Merge two sorted linked lists and return it as a new sorted list.

Implementation: Create a function that takes two sorted linked lists as input and iteratively compares the nodes, merging them into a new sorted linked list.

3. Task Scheduler

Problem Description: Given a character array representing tasks, each task is represented by a character. Tasks could be done without the original order. Each task is done in one unit of time. For each unit of time, any CPU can execute at most one task. Given the character array, find the minimum time required to finish all the tasks.

Implementation: Implement a function that schedules the tasks efficiently based on their frequencies and calculates the minimum time required.

4. Find the kth Smallest or Largest Element in a BST

Problem Description: Given a binary search tree, find the kth smallest or largest element in it.

Implementation: Write a function that performs an in-order traversal of the BST while keeping track of the count of visited nodes. Return the kth element when the count matches k.

5. Construct BST from Preorder or Postorder Traversal

Problem Description: Given an array representing either the preorder or postorder traversal of a binary search tree, construct the tree.

Implementation: Create a function that recursively builds the binary search tree using the given traversal order.

6. Binary Tree Level Order Traversal

Problem Description: Given a binary tree, return the level order traversal of its nodes' values. (i.e., from left to right, level by level).

Implementation: Implement a function that performs a level order traversal using a queue to keep track of each level.

7. Checking for Anagram Pairs using Hash Table

Problem Description: Given an array of strings, group anagrams together.

Implementation: Create a function that uses a hash table to group anagrams. Anagrams will have the same sorted characters, which can be used as keys in the hash table.

8. Check if the Tree is Balanced

Problem Description: Given a binary tree, determine if it is height-balanced.

Implementation: Write a function that calculates the height of each subtree and checks if the difference in heights between left and right subtrees is within one.

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate knowledge of the principles governing the Law of forces and validate them through experimental setups
2. Execute the experiments to achieve equilibrium in coplanar-concurrent force system
3. Asses the significance of friction in mechanical systems.
4. Check the equilibrium of objects subjected to diverse forces, delve into rotational dynamics, and apply principles of conservation laws
5. Apply the principles of static equilibrium to analyse coplanar non-concurrent, parallel force systems
6. Apply the principle of mechanics to system of pulleys, compound pendulum and Bell-crank lever

COs – POs Mapping

CO	PO ₁	PO ₄	PO ₆	PO ₉	PO ₁₀	PSO ₁
1	3	2	2	3	2	2
2	3	2	2	3	2	2
3	3	2	2	3	2	2
4	3	2	2	3	2	2
5	3	2	2	3	2	2
6	3	2	2	3	2	2

Students have to perform any 10 of the following Experiments:

List of Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

References:

1. Engineering Mechanics Lab manual.
2. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
3. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022.

List of Augmented Experiments

1. Prepare a couple for any engineering application
2. Prepare a truss and draw a FBD for it
3. Find the centroid of a composite plane
4. Prepare a demonstrative model for different force systems

Course Outcomes

At the end of the course, student will be able to

1. Analyze the DC Transients of RL & RC circuits
2. Make use of network theorems to simplify the electrical circuits
3. Analyze the DC Transients of RL & RC circuits
4. Demonstrate the characteristics of series RL, RC circuits
5. Demonstrate the characteristics of series RLC circuits and resonant circuit for given specifications
6. Characterize and model the network in terms of all network parameters: Illustrate Kirchhoff's laws, mesh, and nodal analysis for DC circuits

COs - POs Mapping

COs	PO4	PO5	PO6	PO9	PO12	PSO1	PSO2
1	3	2	1	1	1	1	1
2	3	2	1	1	1	1	1
3	3	2	1	1	1	1	1
4	3	2	1	1	1	1	1
5	3	2	1	1	1	1	1
6	3	2	1	1	1	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

SYLLABUS:

The following experiments need to be performed using Simulation Software.

1. Verification of KCL and KVL for DC circuits.
2. Verification of mesh and nodal analysis for DC circuits
3. Verification of Superposition theorems for DC circuits
4. Verification of Thevenin's and Norton's theorems for DC circuits
5. Verification of Maximum power transfer theorem for DC circuits
6. Determination of Impedance and Power factor of Series RL & RC circuits
7. Determination of Active, reactive, and apparent power of Series RL & RC circuit
8. Determination of Impedance, Power factor, Active, Reactive, and Apparent power of a series RLC circuit
9. Construct a Series Resonance circuit to find the Q Factor and Bandwidth
10. Construct a Parallel Resonance circuit to find the Q Factor and Bandwidth
11. Determination of open circuit (Z) and short circuit (Y) parameters
12. Determination of hybrid (H) and transmission (ABCD) parameters
13. Analysis of DC transients in Series RL and Parallel RL circuits
14. Analysis of DC transients in Series RC and Parallel RC circuits
15. Analysis of DC transient and steady-state response of a 2nd order circuit by varying its various parameters and studying their effects on responses.

Textbook (s):

1. M.E Van Valkenburg, Network Analysis, Prentice Hall of India, 3rd Edition, 2015
2. W.H.Hayt, J.E.Kimmerly, and S.M.Durb, Engineering circuit analysis, McGraw Hill Education private limited, 8th Edition, 2013

Software requirements:

Multisim/ Pspice/Orcad Equivalent simulation software tool, Computer Systems with required specifications

References:

1. Network Analysis ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition, 2019.
2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven M. Durbin, 9th Edition 2020

Course Outcomes

At the end of the course, Student will be able to

1. Demonstrate network reduction techniques using basic laws.
2. Compute the parameters of electrical equipment
3. Compute the parameters of magnetic circuit
4. Analyse series and parallel resonant circuits
5. Analyse maximum Power transfer from source to load
6. Apply network theorems to solve electrical circuits

COs - POs Mapping

COs	PO4	PO5	PO6	PO9	PO12	PSO1	PSO2
1	3	2	1	1	1	2	2
2	3	2	1	1	1	2	2
3	3	2	1	1	1	2	2
4	3	2	1	1	1	2	2
5	3	2	1	1	1	2	2
6	3	2	1	1	1	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments

S.No	Name of Experiment	COs
CYCLE 1 (Hardware)		
1	Verification of Kirchoff's circuit laws.	C01
2	Determination of self, mutual inductances, and coefficient of coupling.	C03
3	Determination of Parameters of a choke coil.	C02
4	Verification of Superposition theorem	C06
5	Series and parallel resonance	C04
CYCLE 2 (Simulation)		
1	Verification of node and mesh analysis	C01
2	Verification of Thevenin's and Norton's Theorems	C06
3	Verification of Maximum power transfer theorem	C05
4	Verification of Compensation theorem	C06
5	Verification of Reciprocity and Millman's Theorems	C06

List of Augmented Experiments

1. Locus diagrams of R-L(L Variable) and R-C (C Variable) series circuits
2. Verification of network reduction techniques.
3. Determination of cold and hot resistance of an electric lamp
4. Determination of resonance frequency for a parallel tank circuit.
5. Verification of Tellegen's theorem.

Reference Books

1. W.H.Hayt, J.E.Kimmerly, and S.M.Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 8th Edition, 2015.
2. Charles K Alexander and Mathew N.O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 5th Edition, 2013.
3. M.E Van Valkenburg, "Network Analysis", Prentice Hall of India, 4th Edition, 2018.
4. P. Ramana, G.T.Chandra Sekhar, G.Suresh, "Network Theory", SChand and Company Ltd., 1st Edition, 2024.

Course Outcomes

At the end of the course, student will be able to

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

COs – POs Mapping

COs	PO1	PO6	PO8	PO9	PO10
1	3	2	3	3	2
2	3	2	3	3	2
3	3	2	3	3	2
4	3	2	3	3	2
5	3	2	3	3	2
6	3	2	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Students have to perform any 10 of the following Experiments:**List of Experiments:**

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

References:

1. Engineering Mechanics and Building Practices Lab manual.
2. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
3. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022.

23MA303 Numerical Methods**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply numerical techniques to find approximate solutions of Algebraic and Transcendental Equations.
2. Apply the methods of least squares to fit a best curve for the given data.
3. Apply concepts of interpolation to estimate the unknown functional values.
4. Examine the technique of numerical methods to find the derivative of a function.
5. Evaluate the definite integrals using numerical methods.
6. Solve ordinary differential equations using numerical methods.

COs - POs Mappings

COs	PO1	PO2	PO3	PO4	PO12
1	3	2	2	3	1
2	3	2	2	3	1
3	3	2	3	3	1
4	3	1	2	2	1
5	3	3	2	2	1
6	3	3	2	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Solution of Algebraic and Transcendental Equations, Curve fitting**

Introduction, Bisection method, Regula-Falsi method, Newton-Raphson method, Iterative method, Curve fitting- Fitting a straight line, Second degree curve, Exponential curve, Power curve by method of least squares
Geometrical interpretation - Bisection Method, Regula- Falsi method, Newton-Raphson Method

12 Hours**Unit II****Interpolation**

Introduction, Finite differences, Symbolic relations, Newton's- forward and backward differences, Gauss's forward and backward differences, Lagrange's interpolation method
Newton's divided differences

12 Hours**Unit III****Numerical differentiation and Integration**

Numerical differentiation- First and Second order derivatives using forward, backward and Stirling's difference formulas
 Numerical Integration-Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule
Boole's rule of integration

12 Hours**Unit IV****Numerical solutions of Ordinary Differential Equations**

Taylor's series Method, Euler's and Modified Euler's Methods, Runge-Kutta Methods, Milne's Predictor-Corrector Method
Adams Bashforth Predictor-Corrector Method

12 Hours**Total: 48 Hours****Textbook (s)**

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publishers, New Delhi, 2012
2. B. V. Ramana, Engineering Mathematics, 4th Ed., Tata Mc Graw Hill, 2009

Reference (s)

1. T.KV.Iyengar, S.Ranganatham, B.Krishna Gandhi, Mathematical Methods, 2nd Ed., S.Chand Co., New Delhi, 2006.
2. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Ed., Wiley India Pvt. Ltd., 2012
3. S. S. Sastry, Introductory methods of Numerical Analysis, 4th Ed., Prentice Hall of India Pvt. Ltd., 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	30	30	-
Apply	60	60	70
Analyze	-	-	20
Evaluate	-	-	10
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Find the root of the equation $x^3 - 5x + 1 = 0$ using Bisection method.
2. What is the Newton's forward difference formula?

Understand

1. Explain method of least squares to fit a straight line.
2. Show that $\mu = \frac{1}{2}(E^{\frac{1}{2}} + E^{-\frac{1}{2}})$.

Apply

1. Apply Euler's method to find $y(0.1)$ for $y' = x^2 - y, y(0) = 1$.
2. Choose an appropriate interpolation formula to find $e^{1.75}$ from the following data

X	1.7	1.8	1.9	2.0
y=e ^x	5.474	6.050	6.686	7.389

23CE302 Building Materials and Concrete Technology**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Utilize the characteristics of building materials to determine their suitability for various construction applications.
2. Implement standardized testing procedures to assess the quality and performance of construction materials.
3. Select and apply appropriate finishing materials to enhance the durability and aesthetics of building elements.
4. Prepare and proportion concrete mix designs as per IS code to achieve desired strength and workability.
5. Conduct and analyze tests on fresh concrete to ensure its workability and compliance with standards.
6. Assess and interpret the properties of hardened concrete to evaluate its structural performance.

COs-POs Mapping

COs	PO2	PO4	PO8	PO12	PSO1
1	3	1	1	2	3
2	3	1	1	2	3
3	3	1	1	2	3
4	3	1	1	2	3
5	3	1	1	2	3
6	3	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Building Materials**

Stones- Tests on stones; Bricks – Classification, Manufacturing of clay bricks, Tests on bricks, Bricks for special use - Refractory bricks, Cement Concrete blocks, Lightweight concrete blocks; Timber - Classification of timber, structure of timber, seasoning of timber, Defects on timber. Modern materials: Glass, Aluminum, Ceramics, Sealants for joints, Geosynthetics.

Practical Components

1. Determination of water absorption of clay bricks
2. Determination of compressive strength of clay bricks

12+4 Hours**Unit II****Construction Materials and Building Finishes**

Construction Materials: Constituents of cement and their significance, Manufacturing of Cement, Heat of hydration, types of cement. Aggregates- size and shape, gradation, fineness modulus, bulking of sand. Mortar - mix proportions and compressive strength of mortars for masonry.

Building Finishes: Plastering –Types; Painting –constituents- Types– characteristics, Varnish, Damp proofing - causes and effects of dampness, methods of damp proofing.

Practical Components

1. Determination of fineness and consistency of cement
2. Determination of Initial and Final setting time of cement
3. Determination of compressive strength of mortar
4. Determination of specific gravity of fine aggregate
5. Determination of specific gravity of coarse aggregate
6. Determination of bulking of sand

12 + 12 Hours**Unit III****Concrete Mix Design and Fresh Concrete**

Ingredients, Manufacturing process, Properties of fresh concrete –Workability- slump test, compaction factor, Vee Bee Consistometer, segregation, bleeding; Mix Design - Concrete mix design by I.S. method.

Practical Components

1. Develop a Python programme to design concrete mix as per IS 10269 2019
2. Determine the workability of concrete using slump cone
3. Determine the workability of concrete using compaction factor
4. Determine the workability of concrete using Vee Bee Consistometer

12 +8 Hours

Unit IV

Hardened Concrete

Hardened Concrete: Water / Cement ratio – Abram’s Law –Gel space ratio. Properties of hardened concrete- Factors affecting strength of concrete– Strength in compression, tension and flexure. Relation between compression, tensile, flexural strength and modulus of elasticity of concrete .Shrinkage and creep of concrete.

Practical Components

1. Determine the compressive strength of concrete
2. Determine the Split tensile strength of concrete
3. Determine the flexural strength of concrete
4. Determine the modulus of elasticity of concrete

12 +8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. S. K. Duggal, Building Material, 5th Ed, New Age International Publishers, 2019
2. Rangwala “Engineering Materials (Material science)” Charotar Publishing House Pvt. Ltd., Edition-2017
3. M.S. Shetty, “Concrete Technology” S. Chand & Co., Ltd., Revised Edition - New Delhi, 2018
4. A.M. Neville, Properties of Concrete, 5th Ed., Low Priced Edition, Prentice Hall Publishers, 2012

Reference (s)

1. P.C. Varghese, Building materials, 2nd Ed., Prentice-Hall of India private Ltd, New Delhi. 2015
2. R.K. Rajput “Engineering Materials (Including construction materials)”, 4th Ed., S. Chand Publications. 2014
3. Rofat Siddique “Special structural Concrete” Galgotia Publishing Pvt. Ltd., New Delhi, 2000
4. Code book: IS 10262-2019 “Concrete Mix Proportioning-Guidelines”, Second Revision.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the standard brick size?
2. List out any four types of cements.
3. Define seasoning of timber.
4. What is the most common pozzolana used in the cement?

Understand

1. Explain the formation of metamorphic rocks.
2. Describe various functions of Geosynthetics.
3. Explain the process of Hardening in cement.
4. Illustrate the expansive property of expansive cements.

Apply

1. Design a concrete mix for characteristic strength of 25 MPa at 28 days with a standard deviation of 4MPa. The specific gravity of FA and CA are 2.64 and 2.74 respectively. A slump of 40mm is necessary. The specific gravity of cement is 3.15. Assuming the necessary data design the mix as per IS code method
2. Design mix proportions with the following data using IS code method. Characteristic compressive strength of concrete 30 MPa. 20mm Maximum size of round aggregate. Moderate degree of workability. Specific gravity of cement is 3.15. Specific gravity of coarse and fine aggregates is 2.65. Sand Conforms to Zone III . Good quality control.

23CE303 Building Planning and Drawing**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Describe building byelaws in diverse building scenarios with regulatory standards and legal requirements.
2. Apply the concepts of FAR and FSI in different building types.
3. Evaluate and analyze the preliminary prerequisites for residential buildings.
4. Examine and elucidate the specific planning requisites applicable to different types of buildings.
5. Determine the minimum project duration by applying the principles of critical path methods.
6. Analyze the project durations and examine the probability of project completion using the PERT technique.

COs - POs Mapping

COs	PO1	PO5	PO10	PO12	PSO2
1	3	1	2	3	2
2	3	3	2	2	3
3	3	1	2	3	3
4	3	3	2	3	3
5	2	3	2	3	2
6	3	1	3	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Building Byelaws and Regulations**

Introduction - Terminology - Objectives of building byelaws. Principles underlying building byelaws. Classification of buildings. Floor Area Ratio (FAR). Floor Space Index (FSI). Open space requirements. Built up area limitations. Height of Buildings. Wall thickness and masonry- Lighting and ventilation requirement.

Practical components

1. Conventional signs and symbols used in civil Engineering
2. English bond and Flemish bonds
3. Panelled Doors
4. Panelled Windows

12+8 Hours**Unit II****Components of Residential Buildings**

Minimum standards for various parts of buildings. Requirements of different rooms and their grouping. Characteristics of various types of residential buildings.

Practical components

1. King Post Truss
2. Queen Post Truss
3. Dog Legged Stairs
4. Load Bearing wall

12+8 Hours**Unit III****Planning of Residential and Public Buildings**

Planning of Educational institutions, hospitals, dispensaries, office buildings, banks, industrial buildings, hotels and motels, buildings for recreation.

Practical components

1. Plan and section of a residential building
2. Plan and Section of office building
3. Plan, elevation and section of a two storied residential building
4. Plan, elevation and section of a secondary school

12+8 Hours

Unit IV

Planning and scheduling of Construction Projects

Planning scheduling and monitoring of building construction projects, Bar chart, CPM and PERT Network planning. Computation of times and floats – their significance.

Practical components

1. Constructing a Network Diagram and Identifying Critical Path
2. CPM Network Scheduling
3. PERT Analysis for Project Duration
4. Resource-Constrained PERT Analysis

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. N.Kumaraswamy, A.Kameswara Rao, building planning and drawing, 7th Ed, Charotar Publishing House, 2019
2. R.L. Peurifoyetal, Construction Planning, Equipment and Methods, 7th Ed., Tata Mc. Graw Hill Publications, 2010.
3. B.C.Punmia&Khandelwal, Project Planning and Control with PERT and CPM, 4th Ed., Laxmi publications, 2009.
4. 'A' Series & 'B' Series of JNTU Engineering College, Anantapur.

Reference (s)

1. Building Byelaws by State and Central Governments and Municipal Corporations.
2. Gurucharan Singh & Jagadish Singh, Building Planning, Designing and Scheduling, 5th Ed., Standard Publishers Distributors, 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	50	60	50
Understand	50	40	50
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the objectives of building byelaws?
2. What are the planning factors to be considered in the design of educational institutions?
3. Define CPM and PERT. Explain the difference between both.
4. What are the components of a building used for recreation?
5. Write the various requirements for residential building.

Understand

1. What is FAR and also in what way it is use full to a Civil Engineer?
2. Classify the buildings based on the i) occupancy ii) Fire Resistance
3. Write the various requirements for designing
i)Verandah ii)Drawing room iii)Bedroom iv)Sanitary units of a residential buildings
4. Write the usefulness of specifying the minimum standards in buildings.
5. Write the significance of Scheduling and monitoring of construction projects.

23CE304 Fluid Mechanics**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Outline the importance of fluid properties and their influence on fluid motion.
2. Apply the principles of total pressure, center of pressure and buoyancy in the design of different components in hydraulic structures
3. Explain the principles of fluid kinematics and dynamics in different fluid flow problem.
4. Interpret the concepts of laminar flow, turbulent flow and boundary layer theory.
5. Solve various problems related to fluid flow through pipes.
6. Explain the fundamental principles of fluid motion in the measurement of flow.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PSO1
1	3	2	1	2	3
2	3	3	3	2	3
3	3	3	2	2	3
4	3	3	2	2	3
5	3	3	3	2	3
6	3	3	2	2	3

3-Strongly linked |2-Moderately linked|1-Weakly linked

Unit I**Fluid Properties - Hydro Static Forces on Surfaces – Buoyancy and Floatation**

Fluid Properties: Mass Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Surface Tension and Capillarity, Vapour Pressure and Cavitations, Pressure at a point, Pascal's law, Hydrostatic law, Atmospheric, Gauge and Vacuum pressure; Measurement of Pressure, Manometers.

Hydrostatic forces on Surfaces: Derivations of Total and Centre of Pressure for Horizontal, Vertical, Inclined and Curved surfaces.

Buoyancy and Floatation: Centre of Buoyancy, Meta Centre and Metacentric Height, Stability of Submerged and Floating bodies, Determination of Metacentric Height.

Metacentric Height for Floating bodies containing liquid, Time period of transverse oscillation of a floating body

12 Hours**Unit II****Fluid Kinematics and Fluid Dynamics**

Fluid Kinematics: Velocity of Fluid Particles, Types of Fluid Flow, Description of the Flow Pattern, Basic Principles of Fluid Flow, Equation of Continuity, Acceleration of Fluid Particle, Stream Function and Velocity Potential functions, Flow Net Analysis.

Fluid Dynamics: Forces acting on Fluid in Motion, Euler's Equation of Motion and Bernoulli's Equation, Impulse Momentum Equation and its Application in forces on pipe bend. Angular Momentum Principle – Moment of Momentum Equation

Kinetic Energy Correction Factor

12 Hours**Unit III****Laminar and Turbulent Flows and Boundary Layer Flow**

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer- displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation , velocity distribution for both laminar and turbulent flow.

Methods of Controlling Boundary Layer, Friction in Non -Circular Conduits

12 Hours

Unit IV

Flow through Pipes and Measurement of Flow

Flow through Pipes: Reynolds’s Experiment, Laws of Fluid friction, Froude’s Experiments, Darcy – Weisbach equation, Chezy’s Formula, Mannin’s Formula, Hazen William’s Formula, Minor losses, Pipes in Series, Pipes in Parallel, Total Energy Line and Hydraulic Gradient Line, Flow through long pipes , Compound Pipe, Equivalent Pipe.

Measurement of Flow: Pitot-tube, Venturi Meter, Flow through Orifices and Mouthpieces, Flow over Notches and Weirs.

Water Hammer in Pipes-Submerged Weirs

12 Hours

Total: 48 Hours

Textbook (s)

1. R.K.Bansal, A Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications(P) Ltd.,NewDelhi,2017
2. Modiand Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2014
3. S.K.Som & G.Biswas, Introduction to Fluid Machines, 3rd Ed., Tata McGraw-Hill Publishers Pvt.Ltd., 2013.

Reference (s)

1. J.F.Douglas, J.M.Gaserek and J.A.Swaffird, Fluid Mechanics, 6th Ed., Longman Scientific & Technical, New York,2011
2. Frank.M.White, FluidMechanics, 5th Ed., Tata Mc.Grawhill Pvt.Ltd, 2003
3. A.K.Mohanty, Fluid Mehanics,2nd Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2006
4. Edward J. Shaughnessy, Jr, Ira M.Katzand James, Introduction to Fluid Machines, P.Schaffer, Oxford University Press, New Delhi, 2005

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	35	25	-
Understand	35	25	-
Apply	30	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define total pressure.
2. What is Pitot tube?
3. Define hydraulic gradient line
4. Define friction factor.
5. List out all the types of weir sand notches

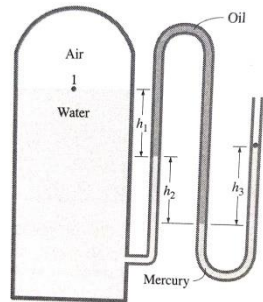
Understand

1. Explain the terms: Dynamic viscosity & kinematic Viscosity. Give their dimensions.
2. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in liquid.
3. Derive an expression for meta-centre height of floating body.
4. Derive an expression for Von Karman Momentum integral equation
5. Mention any four advantages of triangular notch or weir over rectangular notch or weir.

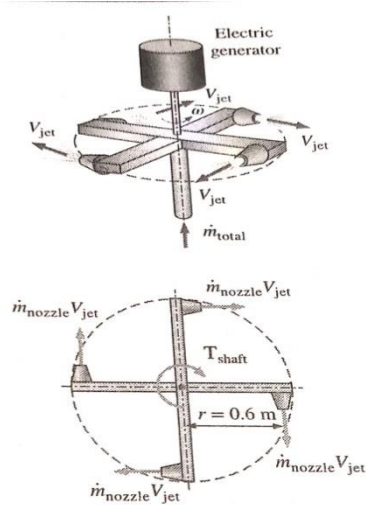
Apply

1. Find the discharge over a triangular notch of angle 60° when the head over the notch is 0.3in. Assume Cd=0.6.
2. A weir 36 m long is divided into 12 equal bays by vertical posts, each 60 cm wide. Determine the discharge over the weir if the head over the crest is 1.20 m and velocity of approach is 2m per second.

3. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take $f=0.009$.
4. A tank has two identical orifices on one of its vertical sides. The upper orifice is 3 m below the water surface and lower one is 5 m below the water surface. If the value of C_v for each orifice is 0.96. Find the point of intersection of the two jets.
5. A block of wood of specific gravity 0.8 floats in water. Determine meta-centric height of the block if its size is $3\text{m} \times 2\text{m} \times 1\text{m}$
6. The water in a tank is pressurised by air, and the pressure is measured by a multi fluid manometer as shown in figure below. The tank is located on a mountain at an altitude of 1400 m where the atmospheric pressure is 85.6Kpa. Determine the air pressure in the tank if $h_1 = 0.1\text{m}$, $h_2 = 0.2\text{m}$, and $h_3 = 0.35\text{m}$. Take the densities of water, oil, and mercury to be 1000 Kg/m^3 , 850 Kg/m^3 , and 13600 Kg/m^3 respectively.



7. A large lawn sprinkler with four identical arms is to be converted into a turbine to generate electric power by attaching a generator to its rotating head as shown in figure. Water enters the sprinkler from the base along the axis of rotation at a rate of 20L/s and leaves the nozzles in the tangential direction. The sprinkler rotates at a rate of 300rpm in a horizontal plane. The diameter of each jet is 1cm, and the normal distance between the axis of rotation and the centre of each nozzle is 0.6m. Estimate the electric power produced.



23CE305 Solid Mechanics I**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply the concepts of normal and shear stresses along with various elastic constants to analyze material behavior.
2. Calculate bending moment and shear force at different cross-sections of a beam under various practical loading conditions.
3. Determine flexural stress for different beam cross-sections subjected to practical loading cases.
4. Construct shear stress distribution diagrams for various beam sections.
5. Analyze the power transmission capacity and required diameter of a shaft subjected to pure torsion.
6. Compute slope and deflection in simply supported and cantilever beams for different loading conditions.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO1
1	3	3	2	3	3
2	3	3	2	3	2
3	3	3	2	3	2
4	3	3	2	3	3
5	3	3	2	3	3
6	3	3	2	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Simple Stresses, Strains and Strain Energy**

Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic modulus and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Resilience – Gradual, sudden, impact loadings – simple applications

*Principle of superposition, Resilience***12 Hours****Unit II****Shear Force, Bending Moment and Flexural Stresses**

Definition of beam – Types of beams – Concept of shear force and bending moment – Relation between S.F., B.M and rate of loading at a section of a beam, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads and combination of these loads – Point of contra flexure. Theory of simple bending – Assumptions – Derivation of bending equation-Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections

*S.F and B.M diagrams for simply supported beam subjected to couple***12 Hours****Unit III****Shear Stresses and Torsion of Circular shaft**

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.

Torsion of Circular Shaft: Theory of pure torsion – Derivation of Torsion equations – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts

*Combined bending and torsion and end thrust***12 Hours****Unit IV****Deflection of beams**

Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration, Moment area method – Determination of slope and deflection for cantilever and

simply supported beams subjected to point loads, - U.D.L- application to simple cases including overhanging beams.

Conjugate Beam Method-application to cantilever beam

12 Hours

Total: 48 Hours

Textbook (s)

1. S. S. Bhavikatti, Engineering Mechanics, 6th Ed New Age International, 2018
2. S. Timoshenko & D. H. Young, and JV Rao, Engineering Mechanics, 4th Ed., TMH Education, 2006
3. R. Subramanian, Strength of Materials, 2nd Ed., Oxford University Press, New Delhi, 2010
4. Ferdinand P Beer, E. Russell, Johnston, Jr, John T Dewolf, Mechanics of Materials, 6th Ed., Tata McGraw-Hill Publications, 2012

Reference (s)

1. R. K. Bansal, Engineering Mechanics, Laxmi Publications, 3rd Ed, 2004
2. R.K.Rajput, Strength of Materials, 4th Ed, S.Chand & Co, New Delhi, 2007
3. U.C. Jindal, Introduction to Strength of Materials, 5th Ed, Galgotia Publications, 2001

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define centroid
2. Define stress
3. Define beam
4. Define the term torsional rigidity
5. Recall the polar moment of inertia expression for a circular shaft

Understand

1. Explain Lami’s theorem
2. Obtain an expression for shear stress distribution for a rectangular beam of cross-Section
3. What is the ratio between the maximum horizontal shear stress to the mean stress in a circular beam?
4. Derive the shear stress expression in a beam of rectangular cross-section
5. The internal diameter of a hollow shaft is two-third of its external diameter. Compare its resistance to torsion with that of a solid shaft of the same weight and material

Apply

1. A rectangular steel bar, 15 mm wide by 30 mm high and 6 m long, is simply supported at its ends. If the density of steel is 7850 kg/m³, determine the maximum bending stress caused by the weight of the bar.
2. A beam of I section 50 cm deep and 20 cm wide has equal flanges 2 cm thick and web 1cm thick. It carries at a cross-section a shear force of 200kN. Determine the shear stress distribution in the beam and the ratio of maximum shear to mean shear
3. What diameter of shaft will be required to transmit 80kW at 80 R.P.M., if the maximum torque is 30 percent greater than the mean and the limit of torsional stress is to be 56 MPa?
4. Find the maximum stress if the diameter of the solid shaft is 30cm and also compute the ratio between polar moment of inertia for hollow shaft to circular shaft
5. A steel ladder 1m long and weighing 1 N/m is resting against a smooth vertical wall and the bottom end is resting on rough ground. If a man weighing 1N stands midway on the ladder draw the Bending moment and shear force diagrams and determine the maximum bending moment in the ladder. Take the inclination of the ladder to the horizontal equal to 45°.

23CE306 Surveying

3 0 0 3

Course Outcome

At the end of the course, student will be able to

1. Explain the chain and compass surveying principles to measure distances and bearings for mapping and layout in civil engineering
2. Utilize the principles of leveling to find the reduced levels of a terrain to draw contour maps
3. Determine the horizontal and vertical angles using theodolite and trigonometric principles
4. Assess areas of irregular boundaries, volumes of barrow pits, embankments and capacity of reservoirs
5. Explain the concept of tachometer in angular measurement to determine the distance and elevation
6. Learn the various curve-setting techniques for roads and railways and make use of advanced techniques to carry out survey work

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PSO1
1	3	2	2	1	3
2	3	2	3	1	3
3	3	2	3	2	3
4	3	3	3	2	3
5	3	2	2	2	3
6	3	3	3	2	3

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I

Basic Surveying: Chain and Compass

Chain Surveying: Principles, Conversions, Basics, Linear Measurement, Ranging, Chain and Tape Corrections.

Compass Surveying: Compass Surveying-Type-Computation of angles from bearings, Local attraction corrections-problems.

Scale usage in plotting Errors in compass survey.

12 Hours

Unit II

Levelling and Contouring, Theodolite Survey, Trigonometric levelling

Levelling and Contouring: Basic Definitions, Types and Methods - Height of Instrument and Rise and Fall methods, Characteristics and uses of contours.

Theodolite Survey: Theodolite- description, uses and adjustments – temporary and permanent, measurement of horizontal and vertical angles.

Trigonometric levelling: Definition, Base is accessible, and Base is inaccessible.

Reciprocal levelling, Fundamental Lines & Desired Relations of Theodolite

12 Hours

Unit III

Computation of Areas and Volumes, Tacheometric Surveying

Computation of areas and volumes: Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two-level sections, determination of the capacity of reservoir, volume of barrow pits.

Tacheometric surveying: Stadia and tangential methods of Tachometry. Distance and Elevation formulae for Staff vertical position

Distance and Elevation formulae for Staff Normal Position, Triangulation systems

12 Hours

Unit IV

Curves and Advanced Surveying

Curves: Elements of Simple curve and Compound curve; Methods of setting out of simple curves.

Total Station: Principle of Electronic distance measurement (EDM), Accessories of a Total station, Advantages and Applications.

Geo-informatics: Fundamentals of Remote Sensing - Electromagnetic Spectrum, Active and Passive Remote Sensing, Stages, Photogrammetry – Types, Scale and Flying Height.
GIS Definition, Components, GPS – Segments.

12 Hours
Total: 48 Hours

Textbook (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol-1), 18th Ed., Laxmi Publications (P) Ltd., New Delhi, 2016
2. S. K. Duggal, (Vol-I & II), 5th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2019.

Reference (s)

1. Chandra A M, Higher Surveying, 3rd Ed., New age International Pvt. Ltd., Publishers, New Delhi, 2015
2. Dr. K. R. Arora, Surveying (Vol-1), 11th Ed, Rajsons Publications Pvt. Ltd., 2010
3. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, 8th Ed., McGraw Hill, 2000

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	--
Understand	30	20	--
Apply	50	60	100
Analyze	-	-	-
Evaluate	--	--	-
Create	--	--	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Surveying
2. List out all the fundamental lines of theodolite
3. Write an expression to calculate horizontal and vertical distances in tacheometry when the line of sight is inclined
4. Define plane and geodetic surveying.

Understand

1. Explain the different classifications of surveying
2. Describe the principle involved in surveying
3. Compare the advantages and disadvantages of plane table surveying with those of chain surveying
4. Explain in detail about obstacles with different cases.

Apply

1. A 30m chain was found to be 10 cm too long, after chaining a distance of 1800 meter, it was found to be 18 cm too long at the end of day’s work, after chaining a total distance of 3300 meter. Find the true distance if the chain was correct before the commencement of work.
2. A survey line BAC crosses a river, A and C on the near and distant banks respectively standing at D, a point 50 meter perpendicular to AB from A, the bearing of C & B are 320^o and 230^o respectively. AB being 25 meter. Find the width of the river.
3. A railway embankment is 20 m wide with a side slope of 2:1. Assuming the ground to be level in a direction traverse to the center line, calculate the volume contained in a length of 120 meters, the center height at 20 m interval being in meters 2.2, 3.7, 3.8, 4.0, 3.8, 2.8, 2.5.

23CE307 Solid Mechanics Laboratory**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Apply knowledge of the mechanical properties of materials to select suitable materials for various construction applications based on performance requirements.
2. Apply appropriate testing methods to estimate the compressive strength of wood, concrete, and brick and analyze their suitability for specific construction purposes.
3. Apply tensile strength evaluation techniques to analyze and recommend appropriate materials for use in reinforced concrete structures.
4. Apply standardized procedures to determine the impact resistance of steel and assess its performance for structural applications in construction projects.
5. Apply experimental methods to determine the Young's modulus of wood and steel and interpret results to inform material selection decisions.
6. Apply practical techniques to determine the shear modulus of rigidity for helical springs and evaluate their performance in structural and mechanical systems.

COs - POs Mapping

COs	PO1	PO4	PO5	PO9	PSO1
1	3	2	3	2	3
2	2	2	3	3	3
3	3	3	3	2	3
4	3	3	3	2	2
5	2	3	3	3	3
6	2	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

List of Experiments

1. Determine the tensile strength of Mild steel rod
2. Determine the young's modulus of elasticity for wooden cantilever beam
3. Determine the young's modulus of elasticity for wooden simple supported beam
4. Determine the young's modulus of elasticity for a mild steel continuous beam
5. Determine the Rockwell's Hardness number for the specimen
6. Determine the shear modulus of rigidity for helical spring
7. Determine the Compression strength of concrete cube
8. Determine the energy absorption of given specimen by using Izod
9. Determine the energy absorption of given specimen by using charpy
10. Determine the Shear strength of given specimen
11. Verification of Maxwell's Reciprocal theorem for beams
12. Determine the Compression strength of wood (along and across the grains)
13. Bend/Rebend Test on steel specimens
14. Determine the stress strain curve for HYSD bars
15. Determine the strain by use of electrical resistance strain gauge
16. Determine the torsional resistance of a given specimen

List of Augmented Experiments¹

1. Determination of compressive strength of different wood and brick specimens which are locally available
2. Determination of tensile strength on different grades of steel
3. Determination of hardness of different metals
4. Verify Maxwell's Reciprocal theorem on a straight beam.
5. Impact resistance of aluminum and wood
6. Determine the rigidity modulus of open coil helical spring

Text Book(s)

1. U.C. Jindal, Introduction to Strength of Materials, Golgotha publications, 2010
2. R. Subramanian, Strength of Materials, 2nd Ed. Oxford university press, New Delhi, 2011

23CE308 Surveying Laboratory**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Utilize conventional survey equipment to measure distance and bearings.
2. Utilize theodolite to find horizontal angles, vertical angles, heights and distances using trigonometric levelling.
3. Utilize theodolite to find vertical angle and find distance and elevation using tacheometric surveying.
4. Evaluate differences in elevation, draw profiles & sections further to draw contour plots using levelling instrument.
5. Take part in calculation of area, missing measurements and elevation using Total station
6. Plot the hand-held Global Positioning System global coordinate in google earth software

COs - POs Mapping

COs	PO1	PO4	PO5	PO9	PSO1
1	3	2	3	2	3
2	2	2	3	3	3
3	3	3	3	2	3
4	3	3	3	2	2
5	2	3	3	3	3
6	2	2	3	3	3

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

List of Experiments

1. Survey of an area by chain survey (Closed traverse) & Plotting.
2. Surveying past obstacles using Chain and Prismatic Compass.
3. Distance between inaccessible points using a compass survey.
4. Surveying of a given area by Prismatic compass (closed traverse) and plotting after adjustment.
5. Horizontal angle measurement between two points using Theodolite.
6. Vertical angle measurement using two points using Theodolite.
7. Trigonometric Levelling-When the base is accessible.
8. Trigonometric Levelling- When the base is inaccessible.
9. Fly leveling (differential leveling).
10. Plotting of the Longitudinal section of a given road.
11. Plotting of Cross-sections of a given road.
12. Distance and elevation computations from tacheometric surveying principles.
13. Determination of the area of the ground using a total station.
14. Determination of remote height using a total station.
15. Determination of the Gradient of the line between two inaccessible points using a total station.
16. Exercise on plotting ground points in Google Earth using Hand Held G.P.S

List of Augmented Experiments¹

1. Determination of the horizontal distance between two inaccessible points using a theodolite.
2. Plot the contour map of a given area using the Grid method.
3. Plotting of existing road details using Total Station traverse.
4. Draw the layout plan of the existing campus.

Text Book (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol-1),18th Ed., Laxmi Publications (P) Ltd., New Delhi, 2016
2. Chandra A M, Higher Surveying, 3rd Ed., New age International Pvt. Ltd., Publishers, New Delhi, 2015
3. Survey Lab Manual – Civil Engineering- GMR institute of Technology, Rajam

23ESX01 Employability Skills I

1 0 1 0

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs -POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

How Communication Skills affect Confidence? How to communicate effectively.(with Examples)
 Listening: Listening?, Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, How Listening can affect our relationships? How Listening helps in Campus Placements also? (with Examples)
 Goal Setting: Vision Vs Mission Vs Goals, Why Goal Setting? SMART Technique to Goal Setting, Putting First things First, SWOT Analysis and Time Management
 Attitude & Gratitude: Attitude Vs Skills Vs Knowledge, Attitude Vs Behaviour, How to develop Positive Attitude? Developing the attitude of Gratitude.
 Public Speaking: JAM, J2M, Presentations by Students on General Topics.

16 Hours

2. Quantitative Aptitude

Number system, L.C.M and H.C.F, Problems on Ages, Averages, Time and work, Pipes and cisterns

16 Hours

Unit II

3. Basics of Python Programming

- a. Write a python program to display “ HELLO WORLD “ .
- b. Write a python program to display different data types.
- c. Write a python program to add two numbers.
- d. Write a python program for checking whether the given number is an even number or not.
- e. Write a python program to find the maximum of three numbers.
- f. Print the characters in the string “STARSTAR’ one by one using for loop.
- g. Write a python program that reverses a given string using slicing.
- h. Write a python program find the factorial of given number using any loop.
- i. Write a python program that prints all prime numbers between 1 and 100 using for loop.
- j. Write a program that reverses the digits of a given integer using a while loop.
- k. Write a python program to create a list of numbers and get the squares of the numbers.
- l. Write a Python program to add an item and create a tuple with different data types
- m. Write a python program to demonstrate working such as to access elements, slice, concatenate, repeat, count and find index with tuples in Python.
- n. Write a python program to demonstrate working with dictionaries in Python.
- o. Write a Python script to sort (ascending and descending) a dictionary by value.
- p. Write a python program to that adds two matrices of the same size.

32 Hours

Total: 64 Hours

23CE401 Hydraulics and Hydraulic Machinery**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Demonstrate the behavior of flow in open channels under various flow conditions.
2. Develop empirical relationships among the physical variables associated with the flow phenomenon in both model and prototype scenarios
3. Determine the hydrodynamic forces exerted by the fluid jet on flat, inclined, and curved vanes.
4. Develop velocity triangles to enhance the understanding of the operations of various turbines and pumps.
5. Design turbines considering diverse hydraulic conditions.
6. Evaluate the performance characteristics of turbines and pumps operating under various conditions.

COs-POs Mapping

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7
1	3	2	1	2	1	1	1
2	3	3	2	3	2	1	1
3	3	3	2	3	2	1	1
4	3	2	3	3	3	1	2
5	3	2	3	3	3	1	2
6	3	2	3	3	3	1	2

3-Strongly linked |2-Moderately linked|1-Weakly linked

Unit I**Open Channel Flow and Critical Flow**

Uniform flow: Types of flows-Type of channels- Velocity distribution -Energy and momentum correction factors- Chezy's, Manning's; and Bazin formulae for uniform flow- Most Economical sections. Criticalflow: Specific energy-critical depth-computation of critical depth-critical sub-critical and supercritical flows.

Non-uniform flow: Dynamic equation for G.V.F., Rapidly varied flow, hydraulic jump, energy dissipation. Condition for Max Discharge for a given value of Specific Energy

Minimum Specific Energy in Terms of Critical Depth

12 Hours**Unit II****Hydraulic Similitude and Impact of Jets**

Dimensional analysis-Rayleigh's method and Buckingham's pi theorem, study of Hydraulic models - Geometric, kinematic and dynamic similarities-dimensionless numbers - model and prototype relations Impact of jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and efficiency-Angular momentum principle, Applications to radial flow turbines.

Model Testing of Partially Submerged Bodies

12 Hours**Unit III****Hydraulic Turbines**

Layout of a typical Hydropower installation - Heads and efficiencies classification of turbines-pelton wheel-Francis turbine-Kaplan turbine-working, working proportions, velocity diagram, work done and efficiency, hydraulic design, draft tube - theory and function efficiency Governing Equations of turbines-surge tanks-unit and specific turbines-unit speed unit quantity-unit power- specific speed performance characteristics-geometric similarity-Cavitation. Outward Radial Flow Reaction Turbines.

The Hydraulic Lift

12 Hours

Unit IV

Centrifugal-Pumps

Pump installation details-classification-work done- Manometric head minimum starting speed-losses and efficiencies-specific speed multistage pumps-pumps in parallel performance of pumps-characteristic curves-NPSH-cavitations., Maximum Suction Lift-Model Testing of Centrifugal Pumps characteristic curves.

The Hydraulic Rams

12 Hours

Total: 48 Hours

Textbook (s)

1. K. Subramanya, Open Channel Flow, 5th Ed., Tata Mc.Grawhill Publishers, New Delhi, 019
2. P.N Modi and S.M Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2013
3. R.K. Bansal, A Text of Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications (P) Ltd., New Delhi, 2015

Reference (s)

1. R.K. Rajput, Fluid Mechanics and Fluid Machines, Revised 9th Ed., S. Chand &Co, 2015
2. V.T. Chow, Open Channel Flow, 7th Ed., McGraw Hill Book Company, 2009
3. S.C Sharma, Fluid Mechanics & Hydraulic Machines, 8th Ed., Khanna Publishers, New Delhi, 2009
4. D.S. Kumar, Fluid Mechanics & Fluid Power Engineering, 8th Ed., Kataria& Sons, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	35	15	-
Understand	35	15	-
Apply	30	35	50
Analyze	-	35	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List out all the types of open Channel Flows
2. Define Energy Correction Factor and Momentum Correction Factor for Open Channel flows.
3. List any two types of dimensionless numbers

Understand

1. Explain about Most Economical sections
2. Discuss critical, sub critical and super critical flows in open channels.
3. Explain Chezy's and Manning's Formulae for open channel flows.

Apply

1. Derive equation for Gradually Varied Flow from fundamentals. Discuss the applications
2. Explain in detail about the hydraulic jump
3. Discuss different similarities between models and prototypes
4. Explain the working of centrifugal pump with neat sketches
5. Gradually varied flow of water in a wide rectangular channel with a per unit width flow rate of $1\text{m}^3/\text{s.m}$ and a manning's coefficient of $n=0.02$ is considered. The slope of the channel is 0.001 , and at the location $x=0$, the flow depth is measured to be 0.8m . (a) Determine the normal and critical depths of the flow and classify the water surface profile, and (b) calculate the flow depth y at $x=100\text{m}$ by integrating the GVF equation numerically over the range $0 \leq x \leq 100\text{m}$.
6. company. One of your company's best selling product is a water pump, which we shall call pump A. Its impeller diameter is $D_A = 6.0\text{ cm}$, and its performance data when operating at $n_a = 1725\text{ rpm}$ ($\omega_A = 180.6\text{rad/s}$) are given below table. The marketing research department is recommending that the company design a new product, namely, a larger pump (which we shall call pump B) that will be used to pump liquid refrigerant R-134a at room temperature. The pump is to be designed such that its best efficiency point occurs as close as possible to a volume flow rate of $V_B = 2400\text{ cm}^3/\text{s}$ and a net head of $H_B = 450\text{cm}$ (R-134a). The chief engineer (your boss) tells you to perform some preliminary analysis using

pump scaling laws to determine if a geometrically scaled up pump could be designed and built to meet the given requirements. (a) plot the performance curves of pump A in both dimensional and dimensionless form and identify the best efficiency point. (b) Calculate the required pump diameter D_B , rotational speed n_B , and brake horsepower P_B for the new product. Manufacturer's performance data for a water pump operating at 175rpm and room temperature.

$V \text{ m}^3/\text{s}$	H, cm	$\eta_{\text{pump}}, \%$
100	180	32
200	185	54
300	175	70
400	170	79
500	150	81
600	95	66
700	54	38

Analyze

1. Water is to be pumped to a height of 90m. The pumps that run at a speed of 1000 rpm with rated capacity of 200 liters per second are available. How many pumps are required to pump the water if specific speed is 800?
2. A reaction turbine develops 7000kW under a head of 45m with a speed of 150 rpm. What is the specific speed of the turbine? What will be the power and speed when the turbine works under a head of 20m.
3. A cylindrical shaft of 90mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal diameter. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 2.0 poise, determine the power required to overcome viscous resistance when the shaft is rotated at a speed of 240 rpm.

23CE402 Soil Mechanics**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Explain the significance of geotechnical engineering.
2. Illustrate the physical properties of soil and their importance in geotechnical applications.
3. Utilize appropriate methods to compute the hydraulic conductivity in soils due to seepage.
4. Experiment with laboratory compaction tests and solve for stress distribution under different types of loading.
5. Utilize one-dimensional consolidation tests to determine the characteristics of fine-grained soils under vertical load.
6. Apply laboratory tests to evaluate the shear strength of soils and differentiate between drained and undrained shear strength.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO1
1	2	2	1	2	1
2	2	2	1	1	3
3	3	3	2	1	2
4	3	3	1	1	2
5	3	2	2	2	2
6	3	3	1	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Soil Properties:** Soil Structure, Basic definitions; Phase relations**Soil Classification:** Index properties; Grain size distribution; Soil aggregate properties. Indian standard soil classification system**Clay Mineralogy:** Introduction, Classification of Clay Minerals, Clay Mineral Groups, Crystal Structure of Clay Minerals, Clay Mineral Properties, Thermal Methods, Base Exchange Capacity, Industrial Applications, Origin of Clay, Clay Mineral Equilibrium*Soil Formation - Unified Classification***12 Hours****Unit II****Principle of effective stress and related phenomena:** Principle of effective stress; Capillarity; Seepage force and quicksand condition; Total, effective and neutral pressures**Permeability and seepage through soils:** One-dimensional flow; Darcy's law; Laboratory methods for permeability determination; Field pumping tests for permeability determination; Permeability as a function of soil type, permanent, void ratio, soil fabric, and effective stress; Two-dimensional flow; Flow nets and their characteristics; Uplift pressure, exit gradient, and piping; Criteria for filters*Coefficient of Permeability by Indirect Tests***12 Hours****Unit III****Compaction & Stress Distribution in Soils****Compaction:** Laboratory compaction tests; Factors affecting compaction; Structure and engineering behavior of compacted cohesive soils; Field compaction; Compaction specifications and field control.**Stress distribution in Soils:** Two to one method, Boussinesq's theory for point, circular loads and Newmark's chart*Stress Distribution for Rectangular Line and Strip Loads***12 Hours**

Unit IV

Compressibility, Consolidation Behavior and Shear Strength

Compressibility and consolidation behavior: Components of total settlement; Effects of soil type, stress history, and effective stress on compressibility; Normally consolidated and over-consolidated soils; Terzaghi’s theory of one dimensional consolidation; Time-rate of consolidation; Evaluation of compressibility and consolidation parameters from consolidometer data.

Shear strength: Mohr’s stress circle; Mohr Coulomb failure criterion; Laboratory tests for shear strength determination; Effective and total stress shear strength parameters; Shear strength characteristics of clays and sands

3D Consolidation

12 Hours

Total: 48 Hours

Textbooks (s)

1. B.C.Punmia, Soil Mechanics and Foundation Engineering, 17th Ed, Laxmi Publications, 2017.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed, New Age International Publishers, 2006

Reference (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 4th Ed, Tata Mc.Graw Hill Publishing Company, New Delhi. 2005.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	25	35	--
Understand	40	35	--
Apply	20	10	50
Analyze	15	20	50
Evaluate			-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Surface Tension and Capillarity
2. State the meaning of the following symbols used in IS classification of soils
 - a. CH
 - b. ML
 - c. CI
 - d. MH-OH
 - e. SP
 - f. GW
 - g. SC
 - h. CL
3. Define and mention the formulae for the following terms
 - a. Void ratio
 - b. Porosity
 - c. Degree of saturation
 - d. Percentage airvoids
 - e. Water content
 - f. Density index
 - g. Percentage of air voids
4. State all the assumptions of Terezaghi’s one dimensional theory of consolidation
5. Write the relationship between principal stresses at failure
6. State the characteristics and application of flow net

7. What are two different methods of compaction adopted in the field?
8. What is liquefaction of sand?

Understand

1. Explain in detail various factors affecting permeability
2. Explain all the factors affecting compaction
3. Explain in detail various factors affecting permeability in detail
4. Explain the affecting shear strength of soil
5. Derive the following relation with neat phase diagrams $e_s = WG$
6. Explain how liquefaction of soil can be prevented?
7. Explain in detail about various soil types
8. Explain in detail important features of Indian soil classification system
9. Explain the different properties of flow net
10. Explain standard compaction test with neat sketch
11. Briefly discuss the Mohr coulomb failure theory
12. Explain how soils formed

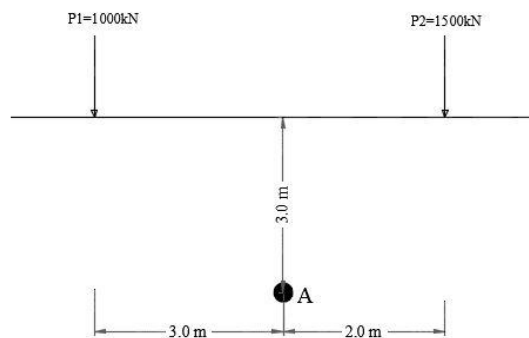
Apply

1. An airport runway needs 500,000 m³ of soil compacted to a void ratio of 0.75. There are two borrow pits A and B from where the required soil can be taken and transported to the site

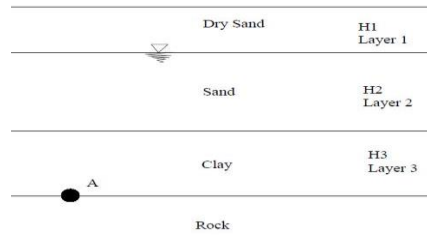
Borrow pit	In-situ void ratio	Transportation cost
A	0.8	Rs. 10/m ³
B	1.7	Rs. 5/m ³

Which of the borrow pits would be more economical?

2. A very long embankment is to be built with a width of 10m and side slope of 1 ½. The height of the embankment is 10m. Compute the vertical stress at a depth of 5m from the base at the following points.
 - i. Below the toe
 - ii. Below the centerline
 - iii. Below a point on the slope. Assume, $\gamma = 21\text{kN/m}^3$.
3. A structure having rectangular area 3m x 1.5m is uniformly loaded with load intensity of 125 kN/m² at the ground surface. Calculate the vertical pressure at a point 4.5m below one of its corners
4. A circular ring foundation for an overhead tank transmits a contact pressure of 300kN/m². Its internal diameter is 6m and external diameter 10m. Compute the vertical stress on the center line of the footing due to the imposed load at a depth of 6.5m below the ground level. The footing is founded at a depth of 2.5m.
5. The four legs of a transmission tower form in plan a square of side 4m and together carry a total load of 300kN. Compute the increase in vertical stress data depth of 2m vertically below a leg and also at the center of the plan at 2m depth. Use Bousnesq's theory.
6. Two point loads acts on the same plane as shown in Figure .Determine the increase in vertical stress at point "A".



7. A soil profile consisting of three layers is shown in figure. Layer 1: H₁=2.0m. e=0.7, G=2.69, Layer 2: H₂=3.5m. e=0.55, G=2.7, Layer 3: H₃=1.5m. e=0.1.2, w=38%. How high should the water table rise so that the effective stress at point A is 8.3kg/m².



Analyze

1. Compute stresses due to load in soil for the given conditions as given below;
 Below point load of 1000kN at depth of 5m
 Below circular load (diameter: 8m) of intensity 100kPa at depth 6m
2. A soil sample has a porosity of 40% .the specific gravity of solids 2.70, Calculate
 - a. Void ratio
 - b. Dry density
 - c. Unit weight if the soil is 50% saturated
 - d. Unit weight if the soil is completely saturated
3. The void ratio of clay is 1.56 and its compression index is found to be 0.8 at the pressure 180kN/m². What will be the void ratio if the pressure is increased to 240kN/m²
4. The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 12m, the soil consists of very fine sand having an average void ratio of 0.7. Above the water table the sand has an average degree of saturation of 50%. Calculate the effective pressure on a horizontal plane at a depth 10m below the ground surface. What will be the increase in the effective pressure if the soil gets saturated by capillarity up to a height of 1m above the water table? Assume G =2.65
5. In a falling head permeameter test, the initial head (t = 0) is 40 cm. The head drops by 5 cm in 10 minutes. Calculate the time required to run the test for the final head to be at 20cm. If the sample is 6 cm is height and 50 cm² in cross sectional area, calculate the coefficient of permeability, taking area of stand pipe = 0.5cm²
6. A sand deposit is 10m thick and overlies a bed of soft clay. The ground water table is 3m below the ground surface. If the sand above the ground water table has a degree of saturation of 45%, plot the diagram showing the variation of the total stress, pore water pressure and the effective stress. The void ratio of the sand is 0.70. Take G=2.65
7. Calculate the void ratio, porosity and degree of saturation of a soil sample, if it has the wet density 2.0 g/cc and dry density 1.8 g/cc. Specific gravity of soil is 2.7.
8. A sieve analysis of a given sample of sand was carried out by making use of IS standard sieves. The total weight of sand used for the analysis was 522 g. The following data were obtained

Size of the sieve in mm	4.75	2.0	1.0	0.6	0.425	0.3	0.15	0.075	Pan
Weight of soil retained (g)	25.75	61.75	67	126	57.75	78.75	36.75	36.75	31.5

Plot the grain size distribution curve on semi-log paper and compute the following:

- a. Percent gravel
 - b. Percent of coarse, medium and fine sand
 - c. Percent of silt and clay
 - d. Uniformity coefficient
 - e. Coefficient of curvature
9. The following test results are obtained from the direct shear test. Compute the shear strength parameters. Dimensions of the sample are 6cm x 6cm x2cm

Normal stress (kg/cm ²)	0.3	0.4	0.5	0.6	0.7
Shear Load (kg)	6.7	9.0	11.2	13.5	15.7

10. A concentrated load of 2000kN is applied at the ground surface. Determine the vertical stress at a point “A” which is 6m directly below the load. Also calculate the vertical stress at a point “B” which is at a depth of 6m and at a horizontal distance of 5m from the axis of the load

23CE403 Solid Mechanics II**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Calculate the principal stresses and strains in materials using analytical and graphical methods.
2. Utilize theories of failure to assess material safety under specified stress conditions.
3. Determine the deflection and stiffness of various types of springs and compute the buckling loads of columns.
4. Compute stresses in thin and thick cylindrical and spherical shells subjected to internal pressure.
5. Examine stresses in structural elements under combined direct loading and bending moments.
6. Assess the resultant stresses and evaluate the stability of dams, retaining walls, and chimneys.

COs - POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	1	2
2	3	2	2	1	3
3	3	3	2	2	3
4	3	3	2	1	2
5	3	3	2	2	2
6	3	3	2	2	3

3- Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Principal Stresses and Strains - Theories of Failures**

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for bi-axial stresses -bi-axial stresses accompanied by a state of simple shear (Analytical solutions) – Mohr's circle of stresses (graphical solutions) **Theories of Failures:** Introduction –Theories of failures like Maximum Principal Stress theory – Maximum Principal Strain theory – Maximum shear stress theory – Maximum strain energy theory – Maximum shear strain energy theory

Strain Rosette, Failure theories using graphical method

12 Hours**Unit II****Springs - Columns and Struts**

Springs: Introduction – Types of springs – deflection of close and open coiled helical springs under axial pull and axial couple – springs in series and parallel – Carriage or leaf springs

Columns and Struts: Introduction – Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns- assumptions- derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Long columns subjected to eccentric loading – Secant formula, Empirical formulae

Straight line formula, Prof. Perry's formula

12 Hours**Unit III****Thin and Thick Cylinders,**

Thin and Thick Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders – Thin spherical shells. Introduction Lamé's theory for thick cylinders – Derivation of Lamé's formulae – distribution of hoop and radial stresses across thickness – design of thick cylinders – compound cylinders.

Necessary difference of radii for shrinkage – Thick spherical shells

12 Hours

Unit IV

Direct and Bending Stresses: Introduction - Stresses under the combined action of direct loading and B.M, – determination of stresses in the case of dams, retaining walls and chimneys – conditions for stability – stresses due to direct loading and B.M. about both axis

Unsymmetrical bending

12 Hours

Total: 48 Hours

Textbook (s)

1. R.K.Bansal, Strength of Materials, 4thEd., Laxmi Publications (P) Ltd., 2009
2. R. Subramanian, Strength of Materials, 3rd Ed., Oxford University Press, NewDelhi,2016
3. Ferdinand P Beer, E. Russell, Johnston, Jr, John T dewolf, Mechanics of Materials, 7th Ed., Tata McGraw-Hill Publications,2014

Reference (s)

1. R.K.Rajput, Strength of Materials, 4th Ed., S.Chand& Co, New Delhi,2007
2. U.C. Jindal, Introduction to Strength of Materials, 5th Ed., Galgotia Publications,200
3. Schaum’s Outline Series, Strength of Materials, 6th Ed., McGraw-Hill Professional Publications,2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	20	20	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define the term torsional rigidity.
2. What are principal stresses?
3. List out all the theories of failures.
4. Define core of a section.

Understand

1. Derive the shear stress expression in a beam of rectangular cross-section.
2. The internal diameter of a hollow shaft is two-third of its external diameter. Compare its resistance to torsion with that of a solid shaft of the same weight and material Illustrate various steps involved in constructing the Mohr’s circle graphically when subjected to a biaxial state of stress.
3. Differentiate between thin and thick cylinders.

Apply

1. Determine (a) The magnitude of principal stresses (b) Find the orientation of principal planes and sketch the principal stresses on a properly oriented element. (c) Find the maximum shear stresses and sketch the maximum shear stresses on a properly oriented element.
2. A wagon weighing 50 kN is moving at a speed of 8 km/hr. has to be brought to rest. Springs made of 25mm dia rods with a mean diameter of 250 mm and with 24 turns are available. Find the number of springs required in the buffer to stop the wagon at a compression of 180 mm. $G = 84 \text{ GPa}$.
3. To what height can the retaining wall shown in below fig. can be constructed without exceeding the maximum compressive stress of 120 MPa and no tension at other end?
Take Masonry density = 22 kN/m^3 .

23CE404 Structural Analysis**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply strain energy and Castigliano's theorem to calculate deflections of statically indeterminate beams.
2. Use analytical methods to determine reactions, shear forces, and bending moments in propped cantilevers under various loading conditions, and sketch the corresponding diagrams.
3. Implement structural analysis techniques to evaluate fixed and continuous beams subjected to different load configurations.
4. Analyze the fixed beams and continuous beam for various load conditions
5. Use the Slope Deflection Method to calculate structural responses of continuous beams and frames.
6. Implement the Moment Distribution Method to analyze continuous beams and frames for various loading scenarios.

COs-POs Mapping

Cos	PO1	PO2	PO3	PO12	PSO2
1	3	3	1	2	2
2	2	3	1	1	2
3	2	3	2	2	3
4	3	3	2	1	3
5	3	3	1	2	3
6	2	3	1	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Indeterminate Structural Analysis & Energy theorems**

Determination of static indeterminacy, kinematic indeterminacy of beams, frames and trusses. Energy Theorems: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano 's theorem-Deflections of statically indeterminate beams. Analysis of truss using method of joint.

Propped Cantilevers: Analysis of propped cantilevers-simple loading-shear force and bending moment diagrams-Deflection of propped cantilevers.

Static indeterminacy, kinematic indeterminacy of truss

12 Hours**Unit II****Fixed beams and Continuous Beams**

Fixed beams: Introduction to statically indeterminate beams with uniformly distributed load, central point load and eccentric point load- shear force and bending moment diagrams - Deflection of fixed beams,

Continuous Beams: Introduction-Clapeyron 's theorem of three moments- Analysis of continuous beams with and without sinking support -shear force and Bending moment diagrams.

Effect of rotation of a support

12 Hours**Unit III****Three Hinged Arches and Two Hinged Arches**

Three Hinged Arches: Elastic theory of arches – Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature.

Two Hinged Arches: Determination of horizontal thrust bending moment, normal thrust and radial shear – Rib shortening.

Eddy's theorem , Temperature Stresses

12 Hours

Unit IV

Slope Deflection Method: Derivation of slope deflection equation of supports application to continuous beams including settlement of supports.

Moment Distribution Method: Stiffness and carry over factors – Distribution factors – Analysis of continuous beams with and without sinking of supports – storey portal frames – including Sway.

Slope Deflection method for frames, Moment Distribution method for frame without sway

12 Hours**Total: 48 Hours****Textbook (s)**

1. V.N. Vazirani, M.M Ratwani and S.K. Duggal, *Analysis of Structures-Vol I*, 17th Ed., Khanna Publishers, New Delhi, 2015
2. V.N. Vazirani, M.M Ratwani and S.K. Duggal, *Analysis of Structures-Vol II*, 16th Ed., Khanna Publishers, New Delhi, 2015
3. S.S. Bhavikatti, *Structural Analysis II*, 5th Ed., Vikas Publishing House Pvt Ltd, 2013

Reference (s)

1. S.B. Junnarkar, *Mechanics of Structures Vol. I*, 31st Ed., Charotar Publishing House, 2015.
2. S.B. Junnarkar, *Mechanics of Structures Vol. II*, 24th Ed., Charotar Publishing House, 2015
3. T.S. Thandavamoorthy, *Analysis of Structures*, 1st Ed., Oxford University Press, New Delhi, 2011.
4. B.C. Punmia, *Strength of Materials and Mechanics of Solids*, 5th Ed., Vol-2 Laxmi Publications, New Delhi, 2010
5. C.S. Reddy, *Structural Analysis*, 11th Ed., Tata Mc Ghill Publications, New Delhi, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	10	--
Understand	10	10	--
Apply	30	30	50
Analyze	50	50	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

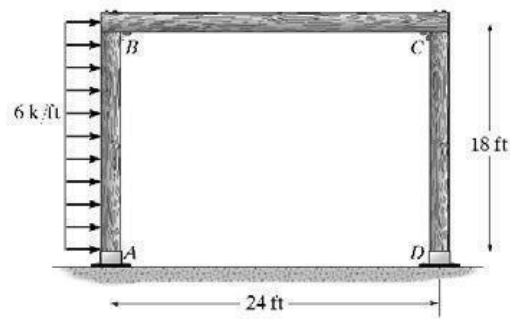
Sample Question (s)**Remember**

1. State the Castigliano's theorem-I and mention its application in trusses.
2. Write down the equation for strain energy due to axial force.
3. Give the three moment equation for the analysis of continuous beam with and without settlement.
4. State the limitations of slope deflection method.
5. Why slope-deflection method is called a 'displacement method'?
6. Define degrees of freedom.
7. In a member AB, if a moment of -10 KNm is applied at A, what is the moment carried over to B?

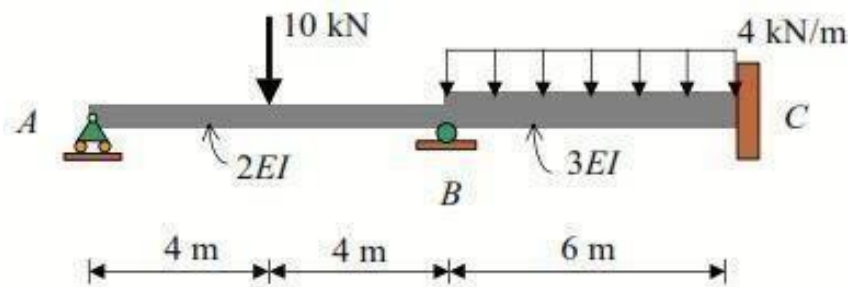
Understand

1. What is the strain energy stored in the simply supported beam of length L subjected to a U.D.L of intensity of w kN/m?
2. Contrast between Statically determinate structures and indeterminate structures?
3. Show the reactions in a fixed beam of length L subjected to a rotation at right support in anti-clockwise direction?
4. Determine the moments at each joint and support using Slope Deflection Method. The connections at B and

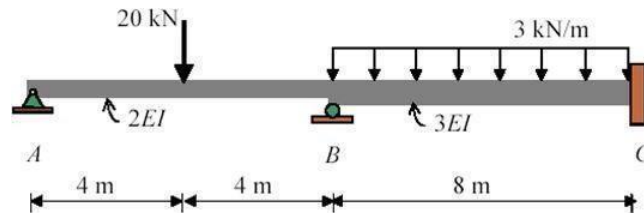
C are rigid fixed. The supports at A and D are fixed. EI is constant.



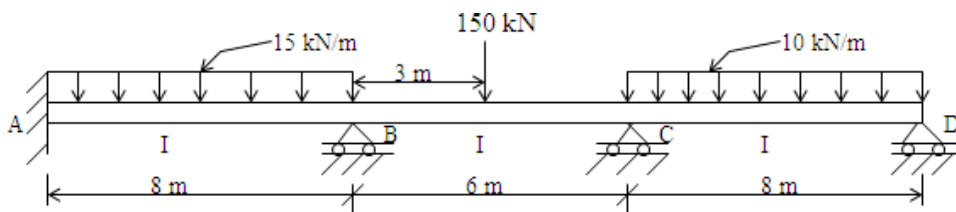
5. Draw the shear force and bending moment diagrams for the beam shown solve using Slope Deflection method. EI is constant.



6. Analyse the Beam shown Below using Moment Distribution Method.

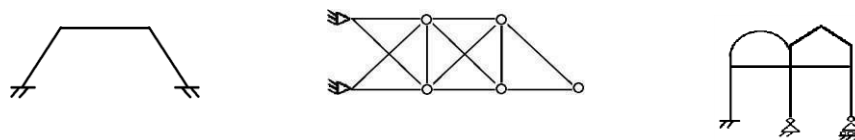


7. Analyse the Beam shown Below using Moment Distribution Method.

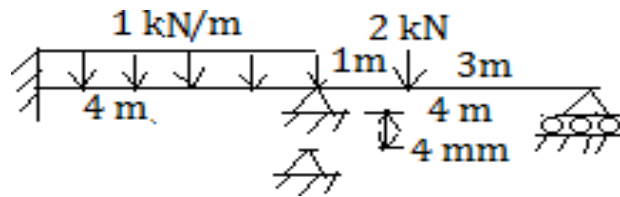


Apply

1. Solve for the static indeterminacy of the frames / trusses shown below?

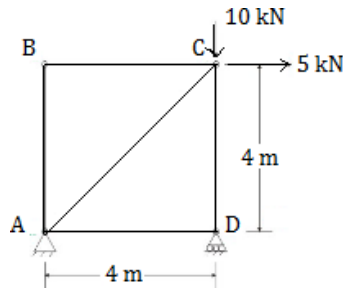


2. A continuous beam loaded as shown in figure determine the support moments. Take $EI =$ Constant. $E = 200 \text{ GPa}$, $I = 8 \times 10^6 \text{ mm}^4$. Solve for all the support moments

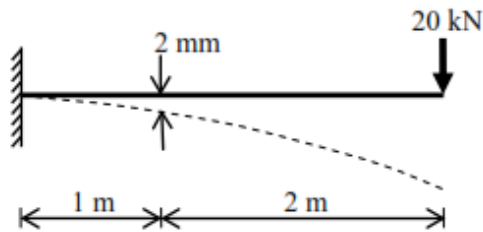


Analyze

1. Examine for the horizontal deflection of joint C of truss ABCD loaded as shown in Fig. Assume that, all members have the same axial rigidity.



2. For the cantilever beam of span 3 m (shown below), a concentrated load of 20 kN applied at the free end causes a vertical displacement of 2 mm at a section located at a distance of 1 m from the fixed end. If a concentrated vertically downward load of 10 kN is applied at the section located at a distance of 1 m from the fixed end (with no other load on the beam), what is the maximum vertical displacement in the same beam (in mm).



23CE405 Transportation Engineering**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Explain the necessity of highway planning, road classifications, and alignment factors to develop efficient road networks.
2. Apply geometric design principles, including sight distances, super elevation, and vertical alignment, to enhance road safety and functionality.
3. Analyze the influence of highway alignment and geometric elements on road performance to optimize design efficiency.
4. Analyze the relationship between traffic characteristics, conduct traffic studies, and interpret accident data to enhance road safety and traffic management.
5. Apply traffic control measures such as traffic signals, signs, and road markings to improve traffic flow and minimize conflicts at intersections.
6. Evaluate different intersection types, including at-grade and grade-separated intersections, and apply design principles for effective intersection management.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	1	2
2	3	3	2	1	3
3	3	2	3	2	3
4	2	2	3	2	3
5	2	3	3	2	3
6	2	2	3	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Highway Development and Planning**

Highway Development in India – Necessity for Highway Planning – Different Road Development Plans; Classification of Roads-Road Network Patterns-Highway Alignment-Factors affecting Alignment-Drawing Reports- Highway Project.

Practical Components:

1. Aggregate Crushing Value,
2. Deval's Attrition,
3. Aggregate Impact Test,
4. Los Angeles Abrasion,
5. Aggregate shape tests,
6. Specific gravity and water absorption test.

12+ 8 Hours**Unit II****Highway Geometric Design**

Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements: Stopping sight Distance- Overtaking Sight Distance and Intermediate Sight Distance - Design of Horizontal Alignment: Super Elevation-Extra widening -Design of Transition Curves; Design of Vertical Alignment: Gradients-vertical curves, Curve Resistance.

Practical Components:

1. Gradation of aggregates for bituminous concrete and dense bituminous macadam.
2. Ductility Test
3. Flash and Fire Point
4. Softening Point
5. Penetration Test

12+ 8 Hours

Unit III

Traffic Engineering

Relation between basic traffic characteristics, Traffic Volume and Speed Studies-Data Collection and Presentation, Origin and Destination study, Parking studies - On street& off street, Road Accidents – Causes and Preventive Measures – Accident Data Recording – Condition and Collision Diagram, Traffic Signs – Types and specifications, Road Markings, Design of Traffic Signals-Webster Method.

Practical Components:

1. Parking Studies
2. Spot Speed Studies
3. Traffic Volume Studies.

12 + 8 Hours

Unit IV

Intersection Design

Types of Intersection- At grade and grade separated-Conflicts at Intersection–Requirements of at grade intersections– Channelized and non-Channelized Intersection, Traffic Islands-Need of Roundabout – Design Factors of Rotary.

Practical Components:

1. Merlin Cycle
2. Visual distress survey
3. Pavement condition rating.

12+8 Hours

Total: 48+32 Hours

Textbooks (s)

1. Highway Engineering – S. K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand & Sons, 10th Ed, 2018.
2. Transportation Engineering – L. R. Kadiyali, Khanna Book Publishing Co. (P) LTD, 3rd Ed, 2016.

Reference (s)

1. Principles of Transportation Engineering– Partha Chakraborty, Animesh Das, PHI Learning, 2nd Ed, 2017.
2. Transportation Engineering –C. Jotin Khisty, B. Kent Lall, Pearson Education, 3rd Edition, 2007.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	25	20	50
Understand	35	30	50
Apply	40	50	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List the necessity for Highway Planning.
2. Give 3 examples of different conceptual Rotary designs used in India.
3. List any four the amendments proposed by Jayakar’s Committee.
4. List the factors affecting Highway Alignment.
5. Recall the classification of Roads in India.
6. Illustrate the difference between channelized and non-channelized intersection.

Understand

1. If the jam density of a particular roadway is 250 vehicles/mile, what is the density at capacity?
2. A vehicle slows from 60 mph down to 30 mph on a flat grade. Using the standard recommended deceleration rate, what is the braking distance over which this occurs?

3. Outline the Importance of Geometric Design in Highways.
4. Relate the concept of Intermediate sight distance with Sight distance.
5. Outline the requirements of a good Intersection.
6. Recall the importance of weaving length in Rotary Design.

Apply

1. At chainage of 613.564 near Chilakapalem, the direction of Rajam from NH-16 has the following characteristics:

- Rural freeway classification
- PHF = 0.97
- No HOV lanes
- 12 ft lane width
- 10 ft right-side shoulders
- 4 lanes total (2 in each direction)
- 0.67 interchanges per mile
- 2% recreational vehicles
- 2.11% upgrade for 0.84 miles
- Driver population adjustment factor = 1.0
- Volume: use highest volume of 2018 according to the Toll plaza Peak Hour Report

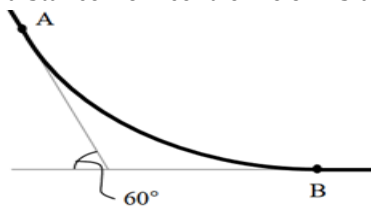
Find and report the following:

1. Free flow speed for this section of freeway (to the nearest mile per hour).
 2. The 15-minute passenger-car equivalent flow rate.
2. A 2-lane (12 ft wide lanes) combined horizontal and crest vertical curve is reportedly designed for 35 mph. Both curves begin at point A and end at point B.

Given the data below, is this section of roadway adequately designed for 35 mph? Show appropriate calculations to support your conclusion.

Horizontal Curve Data

- Curve length = 390 ft
- 60° angle as shown
- 4% super elevation
- $M_s = 25$ ft (perpendicular distance from centreline of inside lane to nearest obstruction)



Plan View

Vertical Curve Data

- Curve length = 390 ft
- $G_1 = 6\%$
- $G_2 = -3.5\%$



Profile View

23CE406 Fluid Mechanics and Hydraulic Machinery Laboratory**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Determine the coefficient of discharge for different flow conditions
2. Demonstrate the calibration of different flow meters
3. Develop the energy equation for various pipe flow problems
4. Apply Bernoulli's equation and Momentum equation for real fluid flow problems
5. Analyse the formation of hydraulic jumps and impact of jet on vanes.
6. Analyze a variety of practical fluid flow devices and utilize fluid mechanics principles in design

COs-POs Mapping

COs	PO1	PO2	PO5	PO9	PSO2
1	3	2	3	3	2
2	3	2	3	3	2
3	3	3	3	3	2
4	3	2	3	3	2
5	3	2	3	3	2
6	3	2	3	3	3

3-Strongly linked |2-Moderately linked|1-Weaklylinked

List of Experiments

1. Calibration of Venturi meter
2. Calibration of Orifice meter
3. Calibration of Rotameter
4. Determination of Coefficient of discharge for a small orifice by a constant head method.
5. Determination of Coefficient of discharge for an external mouth piece by variable head method.
6. Calibration of contracted Rectangular Notch and/or Triangular Notch.
7. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
8. Determination of Coefficient of loss of head in a sudden contraction and friction factor for non-Circular pipe.
9. Verification of Bernoulli's equation.
10. Verification of Reynold's Experiment.
11. Impact of Jet on Vanes
12. Study of Hydraulic jump.
13. Performance test on Pelton wheel turbine
14. Performance test on Francis turbine.
15. Performance test on Kaplan turbine.
16. Efficiency test on Centrifugal Pump.

List of Augmented Experiments¹

1. Determination of co-efficient of discharge for venture flume
2. Determination of minor losses
3. Determination of Coefficient of discharge for an external mouthpiece by variable head method
4. Determination of hydraulic coefficients of orifice
5. Performance test on Pelton Wheel Turbine
6. Performance test on Single Stage Centrifugal Pump
7. Determination of coefficient of loss of head due to pipe fittings
8. Determination of Coefficient of loss of head in a sudden contraction

Text Book (s)

1. D.S.Kumar, Fluid Mechanics & Fluid Power Engineering ,9th Ed .,Kataria & Sons, Publisher. 2 0 1 8
2. Bangaand Sharma, Hydraulic Machines,8th Ed., Khanna Publishers, NewDelhi,2003

Reading Material(s)

1. Fluid Mechanics & Hydraulic Machinery Lab Manual–Civil Engineering-GMR Institute of Technology Rajam

23CE407 Soil Mechanics Laboratory**00315****Course Outcomes**

At the end of the course, student will be able to

1. Explain the basic properties of soil, such as moisture content and specific gravity.
2. Explain the process of field investigations, including soil sample collection and observation of soil properties.
3. Apply laboratory tests to classify soil based on standard geotechnical engineering practices.
4. Experiment with permeability tests using constant head and falling head methods to evaluate soil permeability.
5. Construct compaction curves and determine the California Bearing Ratio (CBR) of soil samples through laboratory testing.
6. Utilize soil test results to assess and interpret the engineering properties of soil samples for practical applications.

COs – POs Mapping

COs	PO1	PO4	PO5	PO10	PSO1
1	3	2	2	2	3
2	3	3	1	2	2
3	3	3	1	2	3
4	3	3	2	2	2
5	3	3	2	2	3
6	3	3	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Determination of water content of the soil.
2. Determination of Specific Gravity of the coarse grained soil.
3. Determination of Specific Gravity of the clayey soil.
4. Determination of Field density using Core cutter method.
5. Determination of Field density using Sand replacement method.
6. Determination of Particle Size Distribution through mechanical analysis.
7. Determination of Liquid limit of the soil.
8. Determination of Plastic limit of the soil.
9. Determination of Optimum Moisture Content and Maximum Dry Density for given soil with Proctor Compaction Test.
10. Determination of Coefficient of Permeability of soil using Constant head method.
11. Determination of Coefficient of Permeability of soil using Variable head method.
12. Determination of strength parameters of given soil using Unconfined Compression strength (UCS) test.
13. Determination of strength parameter of given cohesion-less soil by performing Direct Shear Test.
14. Determination of strength parameter of given C- ϕ soil by performing Direct Shear Test.
15. Determination of C.B.R Value of given soil using Laboratory CBR Test.
16. Determination of Free swell index for soil.

List of Augmented Experiments

1. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 20%) collected at a depth of 10m and determine the strength properties.
2. Determine the OMC and MDD for given soil and draw the Zero air void line and 95% air void line.
3. Prepare a remoulded sample with given field conditions for a cohesionless soils (bulk density is 1.95g/cc; water content is 16%) and determine the strength properties.
4. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 18%) collected at a depth of 1.0m and determine the strength properties.
5. Classify the given fine grained soils by using suitable tests.
6. Find out the field density and dry density of the given soil using suitable test and classify the soil.

Textbook (s)

1. Gopal Ranjan and ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed., New Age International Publishers, 2006
3. B.C.Punmia, Soil Mechanics and Foundation Engineering, 16th Ed., Laxmi Publications, 2005
4. S.K.Gulhati&ManojDatta, Geotechnical Engineering, 4th Ed., Tata McGraw Hill Publishing Company, New Delhi, 2005

Reading Material (s)

1. Soil Mechanics Lab Manual-Civil Engineering- GMR Institute of Technology, Rajam

¹Students shall opt any one of the Augmented Experiments in addition to the regular experiments

23ESX01 Employability Skills I

1 0 1 2

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs -POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

Unit I

1. Building Confidence

Fear? Steps to Overcoming the Fear of Public Speaking?

Self Esteem: Definition? Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem.

Group Discussions (Practice): GD? GD Vs Debate, Overview of a GD , Skills assessed in a GD, Dos & Don'ts, & Conducting practice sessions (Simple Topics).

Motivational Talk: Team Work: Team Vs Group? Stages in Team Building, Mistakes to avoid and Lessons to Learn (Through Stories or Can be a Case Specific)

16 Hours

2. Quantitative Aptitude

Percentages, Profit and loss, Mixtures and Allegations, Simple Interest, Compound Interest

16 Hours

Unit II

3. Revit Architecture

- a. Basic Drawing and editing tools
- b. Setting Up Levels And Grids
- c. Modeling Walls in 2D and 3D
- d. Working With Doors & Windows in 2D and 3D
- e. Modeling floors
- f. Modeling Ceiling and Roofs
- g. Modeling Stairs
- h. Modeling Ramp and Railing
- i. Modeling Curtain System
- j. Adding Components
- k. Working with Quantity
- l. Working with Schedules

32Hours

Total: 64 Hours

23CE501 Design and Detailing of RC Structures**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Demonstrate the concepts of limit state design philosophies and design singly reinforced concrete beams for flexure, shear, and bond.
2. Design the doubly reinforced concrete beams for flexure, shear, torsion, and bond using limit state method.
3. Design the flanged reinforced concrete beams for flexure, shear, and bond using limit state method.
4. Design the reinforced concrete columns subjected to axial load, uniaxial and biaxial bending.
5. Design the reinforced concrete square and rectangular footings subjected to axial load.
6. Design the reinforced concrete one way, two way and continuous slabs with serviceability requirements.

COs-POs Mapping

COs	PO2	PO3	PO10	PO12	PSO2
1	2	2	2	2	2
2	2	3	3	1	2
3	2	3	3	1	2
4	2	3	3	1	2
5	2	3	3	1	2
6	2	3	3	1	2

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Introduction to Reinforced Concrete and Design for Flexure**

Introduction to Design Philosophies, Limit State Design: Concepts of limit state design; Characteristic loads; Characteristic strength; Partial load and safety factors; representative stress-strain curves for cold worked deformed bars and mild steel bars; assumptions in limit state design; stress; block parameters; limiting moment of Resistance; analysis and design of singly and doubly reinforced beams.

Practical Components

1. Design and detailing of under reinforced concrete beams (Problem 1).
2. Design and detailing of under-reinforced concrete beams (Problem 2).
3. Design and detailing of doubly reinforced concrete beams (Problem 1).
4. Design and detailing of doubly reinforced concrete beams (Problem 2).

12+8 Hours**Unit II****Flanged Beams and Shear, Torsion & Bond**

Flanged Beams: Recommendations of IS 456 – 2000 on flanged sections, limit state analysis and design of singly reinforced flanged (T) beam sections; Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion; concept of bond

Practical Components

1. Design and detailing of flanged section concrete beams (Problem 1).
2. Design and detailing of flanged section concrete beams (Problem 2).
3. Design and detailing of RC beams for torsional resistance (Problem 1).
4. Design and detailing of RC beams for torsional resistance (Problem 2).

12+8 Hours**Unit III****Columns and Footings**

Columns: Short and Long columns – under axial loads, uniaxial bending and biaxial bending – IS Code provisions; Footings: Different types of footings; Design of isolated square and rectangular footing for axial loads

Practical Components

1. Design and detailing of concrete columns for uniaxial bending.
2. Design and detailing of column for biaxial bending.
3. Design and detailing of square footing.
4. Design and detailing of rectangle footing.

12+8 Hours

Unit IV

Slabs and Limit State Design for Serviceability

Slabs: Design of one way slabs, two way slab, and continuous slabs - Limit State Design for Serviceability: Deflection.

Practical Components

1. Design and detailing of one-way concrete slab.
2. Design and detailing of two-way concrete slab.
3. Design and detailing of two-way concrete slab with corners held down
4. Design and detailing of two-way concrete slab with two adjacent edges discontinuous.

12+8 Hours
Total: 48+32 Hours

NOTE

IS 456-2000, Plain and Reinforced Concrete - Code of Practice and SP 16-1982, Design Aids for Reinforced Concrete to IS 456-1978 are permitted to use in classroom and examinations.

Textbook (s)

1. S. Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, 3rd Ed., Tata McGraw Hill Publishers, 2010
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced Concrete, 1st Ed., Laxmi Publications Pvt. Ltd., 2015

Reference (s)

1. N. Subramanian, Design of Reinforced Concrete Structures, 1st Ed., Oxford University Press Publishers, 2014
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1st Ed., New age International Publishers, 2018

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Assessment will be done based on the performance of drawing exercises

Sample Question (S)

Remember

1. What are the permissible effective span to effective depth ratio values in case of cantilever and simply supported beams according to IS:456-1900
2. Define effective length and slenderness ratio of a compression member
3. Write the specifications for the minimum spacing of shear reinforcement in beams as per IS:456-2000
4. What are the main requirements of the footing of a structure?
5. What is the magnitude of crack width allowed in concrete structures?

Understand

1. Why it is essential to provide corner reinforcement in two way rectangular slabs?
2. Why it is necessary to provide transverse steel in one way slab?
3. Distinguish between flexural bond and anchorage bond.
4. Differentiate between the terms Factor of safety and partial safety factors for material strength.
5. Explain the difference in the behavior of one way and two way slabs.

Apply

1. A reinforced concrete beam 230 mm wide and 500 mm overall depth is reinforced with 4 bars of 12 mm diameter at an effective cover of 50 mm. Using M19 concrete and Fe415 steel, estimate the moment of resistance of the section using WSD. If the beam is simply- supported over an effective span of 5 m, find the maximum uniformly distributed load the beam can carry, inclusive of its own weight.
2. A reinforced concrete beam of rectangular section having a width of 350mm and overall depth of 700mm is subjected to an ultimate torsional moment of 100kNm together with an ultimate bending moment of

190kNm. Use M19 grade concrete and Fe 415 HYSD bars. Assuming top and bottom cover of 50mm and side cover of 25mm. Design the suitable longitudinal and transverse reinforcements for the section.

3. Design the reinforcements in a column of size 400mm x 600mm subjected to an axial load of 1900kN. The column has an unsupported length of 3m and is braced against side sway in both directions. Adopt M-19 grade concrete and Fe-415 HYSD bars
4. Examine the limiting moment carrying capacity of a doubly reinforced beam if it is reinforced with 3 no.s of 19mm diameter mild steel bars in compression and 4no.s of 25mm diameter mild steel bars in tension. The size of the beam is 300mm x600mm and the effective covers to compression and tension reinforcement are 30mm and 50mm respectively. Use M-19 grade concrete.
5. A simply supported reinforced concrete beam of size 250mmx400mm effective depth is reinforced with 4 no.s of 19 mm diameter bars in tension zone and 2no.s of 16mm diameter bars in compression zone. The span of the beam is 6.5m. Examine the adequacy of the designed section with respect to limit state of deflection if the concrete used is M19 grade.

23CE502 Environmental Engineering**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Describe the objective of water supply and the concept of design period in water supply system planning.
2. Classify the various sources and different characteristics of water.
3. Design various primary units of conventional water treatment plant.
4. Explain the construction, operation, and maintenance of various advanced treatment processes wastewater treatment
5. Design various secondary treatment units in sewage treatment plant
6. Comprehend the regulatory standards for effluent disposal and various sludge disposal methods.

COs-POs Mapping

COs	PO2	PO3	PO6	PO7	PO12
1	1	1	2	3	2
2	2	2	2	3	2
3	1	3	2	3	2
4	1	2	2	3	2
5	2	3	2	3	2
6	1	2	2	3	2

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Water Demand and Quality**

Water Demand: Public water supply system, Planning, Objectives, Design period, Population forecasting; Water demand.

Water Quality: Development and selection of source, Sources of water, Characteristics of water, Significance, Drinking Water quality standards; intake structures, Functions.

*Laying, jointing and testing of pipes; appurtenances***12 Hours****Unit II****Design of Water Treatment Units**

Objectives, Unit operations and processes, Principles, functions, design of water treatment plant units; aerators, flash mixers, Coagulation and flocculation, Clariflocculator, Plate and tube settlers; sand filters; Disinfection; Residue Management; Water softening, Construction, Operation and Maintenance aspects.

*Desalination Process; Membrane Filtration***12 Hours****Unit III****Sewage Quality and Design of Sewage Treatment Units**

Objectives, Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, - Septic tank, - Grey water harvesting,

Primary treatment: Principles, functions and design of sewage treatment units, Screens, Grit Chamber, Primary Sedimentation tanks, Construction, Operation and Maintenance aspects.

Secondary Treatment: Activated Sludge Process and Extended aeration systems, Trickling filters, Sequencing Batch Reactor (SBR), Membrane Bioreactor, UASB, Waste Stabilization Ponds, Other treatment methods, Reclamation and Reuse of sewage, Recent Advances in Sewage Treatment.

*Construction, Operation and Maintenance aspects; Sewer Appurtenances***12 Hours****Unit IV****Design of Ponds and Sludge Disposal**

Effluent Disposal: Standards for Disposal, Methods, dilution, Self-purification of river, Oxygen sag curve, deoxygenation and reaeration, Streeter-Phelps model, Land disposal of Sewage.

Sludge Disposal: Sludge characterization, Thickening, Sludge digestion, Standard rate and High rate digester design, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds,

*Ultimate residue disposal and recent advances; Soil Dispersion System.***12 Hours****Total: 48 Hours**

Text Book (s)

1. B.C. Punmia, Ashok Jain & Arun Jain, Water Supply Engineering, Vol. 1, Wastewater Engineering, Vol. II, 2nd Ed., Laxmi Publications Pvt. Ltd, New Delhi, 2016
2. G.S. Birdi, Water supply and Sanitary Engineering, Revised Ed., Dhanpat Rai & Sons Publishers, 2015
3. K.N. Duggal, Elements of Environmental Engineering, 3rd Ed., S. Chand Publishers, 2010

Reference Books (s)

1. Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering-Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim “Wastewater Treatment Plants”, CRC Press, Washington D.C., 2010
4. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd., New Delhi, 2006.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	70	70	-
Apply	-	-	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Enumerate the components of a water supply scheme.
2. Define coagulation.
3. Define design period.
4. Define potable water.
5. What are the factors governing the selection of a water source?

Understand

1. Explain the need for supplying protected water supply.
2. Differentiate between slow and rapid sand filter with respect to (a). Rate of filtration. (b). loss of head.
3. Explain in detail about various factors affecting the water demand.
4. Explain in detail about water requirement for domestic and public uses.
5. Explain in detail about characteristics of water.

Apply

1. Describe the step involved in the design of septic tank. And also explain the working of a trickling filter with neat sketch.
2. Determine the size of a high rate trickling filter for the following data
Sewage flow= 4.5 million liters per day
Recirculation ratio = 1.5
BOD for raw sewage = 230 mg/l BOD removal in PST = 30%
BOD of treated effluent required = 25 mg/l.
3. The population of 5 decades from 2030 to 2070 is given below in the table. Find out the population of 1, 2, 3 decades beyond the last known decade by using arithmetic increase method.

Year	2030	2040	2050	2060	2070
Population	25000	28000	34000	41900	47000

4. If 2% solution of a sewage sample is incubated for 5 days at 20°C and depletion of oxygen was found to be 5 ppm. Determine the B.O.D. of the sewage.
5. Design a waste treatment plant for a colony having a population of 2 Lakhs and assume the per capita demand of 135 lpcd. Provide additional treatment facility of 30 % for future expansion.

23CE503 Foundation Engineering

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Explain the process of exploration for different types of geotechnical engineering projects.
2. Analyze forces, activities, and various slope failures to estimate and ensure slope stability in diverse conditions.
3. Apply earth pressure theories to determine lateral earth pressures and ensure the stability of various types of retaining walls.
4. Utilize soil properties to compute allowable bearing pressures and load-carrying capacities of shallow foundations.
5. Apply geotechnical principles to determine the allowable bearing pressures and load-carrying capabilities of pile foundations.
6. Make use of concepts of laterally loaded piles and under-reamed piles to analyze their behavior in different soil conditions.

COs – POs Mappings

COs	PO1	PO2	PO3	PO7	PSO2
1	1	3	2	2	3
2	1	3	3	2	2
3	2	3	3	2	2
4	1	3	3	2	2
5	1	3	3	2	2
6	1	3	3	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Soil Exploration

Methods of soil exploration – Boring and Sampling methods – Field tests – Non – invasive tests-planning of Programme - preparation of soil investigation report.

Slope stability: Infinite and finite earth slopes – types of failures – factor of safety of infinite slopes: stability analysis- Swedish Arc Method – Taylor’s Stability Number- Stability of slopes of earth dams under different conditions

Geophysical methods, Stability Analysis by Swedish Arc Method

12 Hours

Unit II

Earth Pressure Theories and Retaining Walls

Earth pressure theories: Rankine’s theory of earth pressure – earth pressures in layered soils – Coulomb’s earth pressure theory – Culmann’s graphical method. Retaining walls: Types of retaining walls – stability of retaining walls

Earth Pressure on inclined back of wall, Modes of Failures of Retaining Walls

12 Hours

Unit III

Shallow Foundations and Settlement Analysis

Shallow foundations: Types - choice of foundation – Location of depth – Safe Bearing Capacity –Terzaghi bearing capacity- IS Methods. Safe bearing pressure based on N- value

Settlement analysis: Allowable bearing pressure; safe bearing capacity and settlement from plate load test – allowable settlements of structures

SBC- Meyerhoff and Skempton Methods

12 Hours

Unit IV

Pile Foundation

Pile foundation: Types of piles – Load carrying capacity of piles based on static pile formulae –Pile load tests. Load carrying capacity of pile groups- settlement of pile groups- Laterally loaded piles- Under reamed piles.

Dynamic pile formulae – Engineering News record formula and Danish Formula

12 Hours

Total: 48 Hours

Textbook (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016
2. K.R.Arora, Soil Mechanics and Foundation Engineering, 7th Ed., Standard Publishers Distributors, Delhi, 2019

Reference (s)

1. Das, B.M., Principles of Foundation Engineering, 9th Ed., Cengege Learning India Pvt. Ltd., 2018
2. Bowles, J.E., Foundation Analysis and Design, 5th Ed., McGraw-Hill Publishing Company, Newyork, 2017
3. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 16th Ed., Tata Mc.Graw Hill Publishing Company, New Delhi. 2013
4. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundations, 17th Ed., Laxmi Publications Pvt. Ltd., New Delhi, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	10	25	-
Understand	40	35	-
Apply	20	10	60
Analyze	30	30	40
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Differentiate Disturbed and Undisturbed soil samples in detail. Explain different procedures for collection of UDS
2. Write a detailed note on “Geophysical Methods” used as part of Geotechnical investigations
3. State and explain the assumptions in Terzaghi’s Bearing Capacity Theory
4. Explain step by step procedure for sinking of a well foundation with a neat sketch
5. What are the functions of well foundations and explain in detail?

Understand

1. Explain how stability of an earthen dam is affected under different seepage conditions, with the help of neatly drawn sketches
2. For adsorption in dilute liquid solutions in stage wise counter current operation, where the Freundlich equation describes the adsorption equilibrium, derive analytical expression in terms of n, m, Y0 and YNp for the minimum adsorbent / solvent ratio when fresh adsorbent is used
3. Differentiate local stability with global stability of the retaining systems
4. What is “Negative skin friction” explain how the same is worked out and taken in to account in the design of piles.
5. Discuss briefly validity of Darcy's law.

Apply

1. Describe how “Culmann’s Graphical method” is used for computation of active earth pressure
2. The following date was obtained from a plate load test carried out on a 60cm square test plate at a depth of 2m below ground surface on a sandy soil which extends up to a large depth. Determine the settlement of a foundation 3.0m X 3.0m carrying a load of 100t and located at a depth of 3.0m below ground surface. Water table is obtained at a large depth from the ground surface.

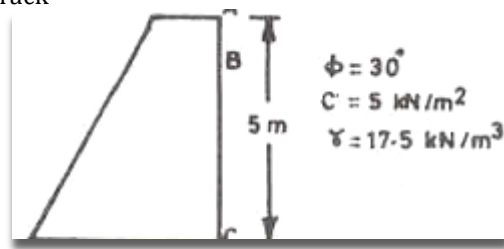
Load intensity, t/m ²	5	10	15	20	25	30	35	40
Settlement, mm	2	4	7.5	11	16.3	23.5	34	45

3. Explain the different types of sampling methods. Mention the types of samples obtained in each and explain the suitability depends on the type of soils.

4. Determine the active pressure by Rankine's theory per unit run for a retaining wall 4m high, with $i=150$, $\phi=300$ and $\gamma=20\text{kN/m}^3$. The back face of wall is smooth and vertical.
5. A 7m high retaining wall is supporting a back fill consisting of two types of soils. The water table is located at a depth of 5m below the top. A capillary raise of 0.90m was found. The properties of soil from 0 to 3m include $c=0 \text{ KN/sqm}$; $\Phi=18^\circ$; $\gamma=16.50\text{KN/cum}$ and those for soil from 3m to 7m include $c=0 \text{ KN/sqm}$; $\Phi=36^\circ$; $\gamma=18 \text{ KN/cum}$, $\gamma_{\text{sub}}=20\text{kN/cum}$. A surcharge of 200 kPa is applied on the top of backfill. Plot the distribution of active earth pressure and determine the magnitude and point of application of total active earth pressure acting on the retaining wall.

Analyze

1. A gravity retaining wall of height 3m with uniform thickness (ie. rectangular in cross section) of 1.20m is constructed in RRM with a unit weight of 24 KN/cum. The average properties of soil from top to bottom of wall include $c=0 \text{ KN/sqm}$; $\Phi=30^\circ$. Subsequently, 1m high fill is placed on top of the existing backfill after constructing a 0.60m thick wall above the existing wall matching with the backfill side face of wall (ie., the offset is provided on the other side of backfill) Analyse the stability of wall against overturning before and after raising the height of backfill.
2. A SPT was conducted at a depth of 3m below the GL. The observations were recorded as 14/18/24. The correction for over burden was read as 1. Apply correction for dilatancy. If a 2m wide square footing is proposed at this level, estimate the allowable bearing pressure for a permissible settlement of 40mm based on the penetration resistance (N'' value) as per IS:6403-1981.
3. Propose an inclination for a filling of 12m high is to be constructed with a factor of safety of 1.25. The soil has $c = 20\text{kN/m}^2$, $\phi = 150$, $\gamma=17.0\text{kN/m}^3$. The stability number for $\phi=120$ is equal to 0.063 when the slope is 300 and 0.098 when the slope is 450
4. A 5m height retaining wall shown in figure. Evaluate the Rankine's active earth pressure on wall
 - a. Before formation of crack
 - b. After formation of crack



5. It is proposed to construct a highway embankment using a $c-\Phi$ soil having $c=20\text{kPa}$; $\Phi=10^\circ$, $\gamma=17 \text{ KN/cum}$. Determine the critical height up to which the embankment can be built with an inclination of 29° with a factor of safety of 1.50.

23CE504 Hydrology

3 0 2 4

Course Outcomes

At the end of the course, student will be able to

1. Explain the interplay between precipitation, abstractions, and runoff processes to analyze and manage water resources effectively.
2. Apply Unit Hydrograph principles, including derivation, superposition, and S-hydrograph techniques, for different durations.
3. Apply the rational and SCS methods to compute runoff, conduct flood analyses, and employ statistical techniques for flood prediction.
4. Apply flood control measures, conduct flood routing using the Muskingum Method, and perform statistical analyses for accurate flood predictions.
5. Demonstrate reservoir management skills, including site selection, capacity determination, and Mass Curve and Demand Curve concepts for yield analysis.
6. Apply knowledge of aquifer types, flow dynamics, and steady/unsteady flow concepts to conduct recuperation tests for sustainable groundwater management.

COs-POs Mappings

COs	PO1	PO2	PO3	PO4	PO7	PSO2
1	3	3	1	2	3	3
2	3	3	2	1	2	3
3	3	3	3	3	1	3
4	3	3	3	3	3	3
5	3	3	3	1	3	3
6	3	3	2	1	3	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Precipitation and Abstractions

Engineering hydrology and its applications, Hydrologic cycle, Types and forms of precipitation, rainfall measurement, types of rain gauges, rain gauge network, average rainfall over a basin, consistency of rainfall data, frequency of rainfall, intensity duration-frequency curves, probable maximum precipitation, evaporation, evapotranspiration, infiltration, infiltration indices.

Practical components

1. Estimation of number rain gauge in a given catchment area.
2. Double Ring Infiltrometer test.
3. Evaporation test using ISI Pan.
4. Lake evaporation using Meyers formula

12+8 Hours

Unit II

Runoff and Hydrograph

Factors affecting runoff, components of runoff, computation of runoff-rational and SCS Methods, separation of base flow, definition of Unit Hydrograph, assumptions, derivation of Unit Hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of UH, Synthetic Unit Hydrograph.

Practical components

1. Design of Unit hydrograph by using Principle of super position
2. Design of Unit hydrograph by using S-hydrograph method
3. Base flow separation.
4. Synthetic unit hydrograph using Snyder’s empirical equations

12+ 8 Hours

Unit III

Floods and Reservoir Routing

Flood Control, Flood flows, Statistical analysis for flood prediction, Flood routing, Channel Routing by Muskingum Method, Reservoir planning ,Types of Reservoir, Selection of Site for a Reservoir, Zones of Storage in a Reservoir, Reservoir Regulation, Reservoir Yield, Mass Curve and Demand Curve, Determination of Reservoir Capacity, Yield From a Reservoir of given Capacity.

Practical components

1. Estimation of frequency of flood.
2. Estimation of Reservoir capacity.
3. Seepage from a reservoir using water budget method
4. Flood risk assessment using RS & GIS

12 + 8 Hours**Unit IV****Groundwater Hydrology**

Groundwater Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, Permeability, transmissivity and storage coefficients, groundwater Flow lines. Steady flow to a well, steady radial flow to a well in confined aquifer and unconfined aquifer, Unsteady radial flow into a confined aquifer, Non equilibrium Theis equation, Theis method of solution, multiple well system. yield of an open well-recuperation test.

Practical components

1. Estimation of Ground water depth
2. Design of well
3. Ground water potential zones identification using RS & GIS
4. Reservoir site selection using RS & GIS

12 +8 Hours**Total: 48+32 Hours****Textbook (s)**

1. K. Subramanya, Engineering Hydrology, 4th Ed., Tata McGraw-Hill Education Private Limited, 2017
2. P.N.Modi, Irrigation Water Resources & Water Power, 11th Ed., Standard Book House, 2019.
3. K.R.Arora, Irrigation, Water Power and Water Resources Engineering, 5th Revised Ed., Standard Publishers, New Delhi, 2018

Reference (s)

1. VenTe Chow, Hand Book of Applied Hydrology, 4th Ed., Tata-McGraw Hill, 2010 (second reprint)
2. P. Jayarami Reddy, A Text Book of Hydrology, 3rd Ed., Laxmi publications Pvt. Ltd., New Delhi, 2016
3. H.M Raghunath, Hydrology: Principles, Analysis & Design, 3rd Ed., New Age International Publishers, 2015.
4. David K Todd, Text book on Groundwater hydrology, 3rd edition John Wiley & Sons, Inc.
5. S.K Garg, Irrigation and Hydraulic structures, 36th Ed., Khanna Publishers, 2018
6. B.C. Punmia & Lal, Irrigation and Water Power engineering, Revised 17th Ed., Laxmi publications Pvt. Ltd., New Delhi, 2021.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments (%)
Remember	15	15	-
Understand	25	25	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)**Remember**

1. Define unit hydrograph.
2. What are the different Types and forms of precipitation?
3. Write importance of the synthetic unit hydrograph
4. Define confined and unconfined aquifers.
5. Define evaporation and evapotranspiration.

Understand

1. Briefly explain the significant features of global water balance studies, also discuss the hydrologic cycle with neat sketch.
2. Explain the rational method for determination of peak of a catchment. Write its advantages and disadvantages. Enumerate its limitations.

3. Differentiate between the Unit hydrograph and Synthetic Unit Hydrograph. Give its limitations and applications.
4. Derive the equation for steady state flow of water in a homogeneous and isotropic condition.

Apply

1. A catchment has five rain-gauge stations and the annual precipitations are 900, 1100, 1750, 950, and 1250 mm respectively. Calculate the extra number required or not if error in estimation is limited to 10 percent.
2. The shape of a catchment is in the form of a pentagon ABCDE. There are 4 rain gauge stations P, Q, R & S inside the catchment. The position coordinates in km are (0,0), B(50,75), C(100,70), D(150,0), E(75,-50), P(50,25), Q(100,25), R(100,-25) & S(50,-25). If the rainfalls recorded at P, Q, R & S are 88, 102, 112, 116mm respectively, determine the average depth of rainfall over the catchment using Thiessen polygon method.
3. In a watershed, the expected one-hour rainfall intensity is 6.25 cm, the watershed area is 50 ha, of which 30 ha is pasture on 7% slope and 20 ha is cultivated on 3% slope, and the length of run is 720 m on a 4% slope. Determine the peak runoff rate for a 10-year recurrence interval, when the type of soil for cultivated crops is silt clay and for pasture it is clay and silt loam. Assuming the value of C for respective soils for cultivated crops on 3% slope is 0.5 and for pasture land on 7% slope is 0.36
4. Given below are the observed flows a storm of 6-hour duration on a stream with a catchment of 600 km². Derive the ordinates of a 6-hour unit hydrograph. Assume the base flow as zero.

Time (min)	0	6	12	18	24	30	36	42	48	54	60
Discharge (m ³ /s)	0	100	190	150	90	60	30	15	10	5	0

5. The elevation of water table in an unconfined aquifer at two locations separated by a distance of 100 m is 1026.2 m and 1025.0 m respectively. If the permeability of the aquifer is 12 m/day and porosity is 15 percent, what is the actual velocity in the aquifer

23CE505 Environmental Engineering Laboratory**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Demonstrate the determination of major characteristics of water and wastewater
2. Illustrate the importance of determining the concentration of various parameters in waste water
3. Implement various equipment/methods available for examining water and wastewater
4. Apply titration methods to accurately determine the concentrations of various parameters.
5. Identify the practical significance of the characteristics and permissible limits for the characteristics of water and wastewater
6. Assess the appropriate methods for determining the various parameters in waste water samples.

COs-POs Mappings

COs	PO3	PO6	PO7	PO9	PO12	PSO2
1	3	3	2	2	3	1
2	3	3	2	2	3	1
3	3	2	2	2	3	1
4	3	2	2	2	2	1
5	3	3	2	2	3	1
6	3	3	2	2	3	1

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

List of Experiments

1. Determination of pH and Electrical Conductivity
2. Determination and estimation of total Hardness
3. Determination of Calcium and Magnesium hardness
4. Determination of Alkalinity
5. Determination of Acidity
6. Determination of chlorides in water.
7. Determination and estimation of total solids, dissolved solids
8. Determination of Iron
9. Determination of Optimum Coagulant dosage
10. Determination of dissolved oxygen with D.O Meter & Winkler 's Method
11. Determination of B.O.D
12. Determination of COD
13. Determination of chlorine demand
14. Determination of Flourides
15. Determination of Sulphate
16. Determination of Phospate

List of Augmented Experiments

1. pH and Electrical Conductivity value of different samples
2. Estimation of total Hardness of bore water
3. Determination of Calcium and Magnesium hardness of bore water
4. Determination of Alkalinity and Acidity of different samples
5. Determination of chlorides in water.
6. Estimation of total solids, dissolved solids in Surface water and sub-surface water sample
7. Determination of dissolved oxygen of pond water with D.O Meter & Winkler 's Method
8. Physical parameters-Temperature, Turbidity
9. B.O.D/COD of different samples
10. Determination of chlorine demand for municipal water
11. Determine the Sulphate and Phosphate nature of the water and wastewater samples

Total: 48 Hours**Reading Materials (s)**

1. Environmental Engineering Lab Manual-Civil Engineering, GMRIT, Rajam
2. Standard Methods for Examination of Water and Waste Water, 23rd Edition, APHA.
3. KVSG Murali Krishna, Chemical Analyses of Water and Soil,3rd Ed., Reem Publications, New Delhi. 2013

23TPX01 Term Paper**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Interpret the literature to link the earlier research with the contemporary technologies
2. Communicate effectively as an individual to present ideas clearly and coherently
3. Review the research findings and its correlation to the latest applications
4. Prepare documents and present the concepts clearly and coherently
5. Inculcate the spirit of enquiry for self-learning
6. Identify interdisciplinary oriented topics

COs – POs Mapping

COs	PO1	PO4	PO10	PO12
1	-	2	-	-
2	-	-	3	3
3	3	-	-	-
4	-	-	3	-
5	-	-	-	3
6	1	-	-	-

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

23ESX02 Employability Skills II

1 0 1 0

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software.
6. Utilize simulation tools for testing.

COs - POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Introduction to Campus Placements: Stages of Campus Placement, Skills assessed in Campus Placements & How to get ready?

Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success)

Resume Preparation: Resume? Templates? Mistakes to be avoided in a Resume, Steps to be followed in preparing it.(with examples)

Group Discussions (Recap): GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? (through Practice Sessions)

Psychometric Tests: Definition, Types of Psychometric Tests: Numerical Computation, Data Interpretation, Verbal Comprehension, Verbal Critical Reasoning and Personality Questionnaires

Exercises related to Communication: Story Writing, TAT etc .

16 Hours

2. Quantitative Aptitude

Square &Cube roots, Partnership, Logarithms, Progressions, Mensuration, Data Sufficiency

16 Hours

Unit II

3. Transport Engineering

Airport Engineering: Airport components, classification, site selection, Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Railway Engineering: Rail components and their Functions - Types of Rails, Joints, Rail Fastenings, Gauges, Coning of Wheels, Creep theory- Sleepers functions, requirements, types - Ballast, depth of ballast, Geometric design of railway Track - Speed and Cant.

Dock and Harbour Engineering: Inland water transportation, Ports and harbour: requirements, classification - Harbour components - breakwaters, jetties, fenders, piers, wharves, dolphins- Navigational aids, types, requirements-Docks- dry docks, wet docks, slipways, lock gates, Dredging - classification, dredgers- Port facilities - general layout, development, planning, facilities, terminals.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

32 Hours

Total 64 Hours

Reference (s)

1. Kadiyali, L. R., Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi, 2016
2. Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, Statistical and Econometric Methods for Transportation Data Analysis, CRC Press, Second Edition, 2010
3. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K. V. Sultanchand.
4. Multivariate Data Analysis –Cootey W.W & Cohens P. R; John Wiley & Sons.
5. Probability Concepts in Engineering, Planning and Design, Vol. I & II by Alfredo H.S. Wilson H. Tang, Wiley International.

23SIX01 Summer Internship I

0 0 0 1

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate the communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs-POs Mapping

COs	PO1	PO2	PO8	PO10	PO12
1	3				
2	3				
3					3
4				3	
5		2			
6			3		

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

23CEC11 Principles of Building Architecture**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Describe the architectural design, layout regulations and site analysis concepts related with the real time projects.
2. Classify the different types of buildings and apply the principles of anthropometry and space standards while designing a building.
3. Integrate building services components, interior design concepts and fire safety standards to create efficient and functional spaces in a building.
4. Apply climate and environmental responsive design strategies to create sustainable buildings that take advantage of natural elements while minimizing negative environmental impacts.
5. Apply the concepts of various passive and active energy control systems for the heating and cooling of buildings, along with green building concepts.
6. Discuss energy resources for buildings and energy rating systems to design and develop the energy efficient buildings.

COs-POs Mappings

COs	PO1	PO2	PO6	PO7	PSO2
1	3	2	2	1	3
2	3	2	2	2	3
3	3	3	2	2	3
4	3	3	3	3	3
5	3	2	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Architectural Design and Site planning**

Architectural Design - Key aspects and concepts – integration of function and aesthetics – Introduction to basic elements and principles of design. Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

Evolution of architectural form and space, Gestalt ideas of visual perception.

12 Hours**Unit II****Building Types**

Residential, institutional, commercial and Industrial – Application of anthropometry and space standards- Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design

Configuration of architectural spaces, Built form and open space relationships

12 Hours**Unit III****Climate and Environmental Responsive Design**

Man and environment interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

Thermal behavior of the building, global climate and greenhouse effect

12 Hours**Unit IV****Energy resources of the buildings**

Energy-Forms of energy, sources, Energy Conservation-Renewable energy-Solar, wind, hydrothermal- Energy use in building-Energy rating of the building-Sustainability issues for the buildings.

Non renewable energy sources, embodied energy

12 Hours**Total: 48 Hours****Textbook (s):**

1. Muthu Shoba Mohan.G.,” Principles of Architecture”, Oxford University Press., New Delhi, 2006
2. Szokolay, Steven V” Introduction to architectural design”,Routledge,Taylor and Francis,2014

3. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., "Climate Responsive Architecture", A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
4. Pramara. V.S. "Design fundamental in Architecture", Somaiya Publications Pvt. Ltd., New Delhi, 1997.

Reference (s):

1. Rangwala. S.C. "Town Planning" Charotar Publishing House., Anand, 2005.
2. De Chiara.J., Michael. J. Crosbie., "Time Saver Standards for Building Types", McGraw Hill Publishing Company, New York, 2001.
3. National Building Code of India., SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2015

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define Architecture.
2. Define space.
3. List the various landscape design elements.
4. Define Anthropometrics.
5. Define green building concepts.

Understand

1. Explain in detail how the aesthetics qualities of scale, balance, symmetry, and rhythm influence a building design.
2. Explain the integration of aesthetics and function in architectural design.
3. Explain with suitable drawing how symmetry and rhythm play a role in Hindu and Islamic religious buildings.
4. Explain the basic principles elements of landscape design with neat sketches.
5. How does scale affect the design of buildings? Establish the importance of scale in designing elevations of building facades.

23CEC21 Geometric Design and Highway Materials**3 0 0 3****Course outcomes**

At the end of the course, student will be able to

1. Summarize various considerations for rural and urban arterials
2. Explain the characteristics and considerations for rotary intersections
3. Describe the optimal characteristics of subgrade soil materials
4. Evaluate the characteristics of bitumen and bituminous mixes
5. Explain durability and quality of flexible pavements
6. Explain the components and the construction of cement concrete pavements

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PSO1	PSO2
1	3	2	1	1	1	3
2	3	3	2	1	1	3
3	3	2	1	3	3	2
4	3	3	2	3	3	3
5	3	3	3	2	3	3
6	3	2	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Geometric Design Considerations**

Geometric design considerations for urban highways, design speeds, volumes, levels of service and other design considerations.

Design of Intersections: Characteristics and design considerations of at-grade intersections; Design of rotary intersection; Interchanges - different types.

*Ribbon development, Ramps***12 Hours****Unit II****Properties of Subgrade Soil and Aggregates**

Subgrade soil –Soil classification for engineering purposes, Soil stabilization - Classification, requirements, properties, tests, alternative materials for soil stabilization.

Aggregates: blending and gradation, characteristics, properties and alternatives.

*Effective CBR, Light weight deflectometer***12 Hours****Unit III****Characteristic of Bitumen and Bituminous Mixes**

Origin, preparation, properties and tests, constituents of bituminous road binders, requirements – Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests. Bituminous Mixes: Mechanical properties – Resilient modulus, dynamic modulus, rutting and fatigue characteristics of bituminous mixes.

*Tar, Flow number***12 Hours****Unit IV****Design of bituminous and cement concrete mixes**

Weathering and Durability of Bituminous Mixes – Performance based Bitumen mix specifications – Marshall and Super pave mix design method. Cement Concrete for Pavement Construction: Requirements, design of mix for CC pavement, joint filler and sealer materials.

*Stresses in CC pavement, Bailey gradation***12 Hours****Total: 48 Hours****Textbook (s)**

1. Partha Chakraborty and Animesh Das, Principle of Transportation Engineering, PHI Learning Private Limited, New Delhi, 2012.
2. S K Khanna and C E G Justo. Highway Engineering. Nemchand Bros., Roorkee, 2017.

Reference (s)

1. Kadiyali, L.R., Principles and practices of Highway Engineering , Khanna Publishers, New Delhi, 2019
2. Alkins and Harold, "Highway Materials Soils and Concretes", Prentice Hall, Pearson, 4th Edition, 2003.
3. Kerbs and Walkes, "Highway Materials", McGraw Hill Book Co. 2007
4. IRC:37-2018 Guidelines for the design of flexible pavements (fourth revision) Indian Roads Congress.
5. IRC:86-2018 Geometric design standards for urban roads and streets, Indian Roads Congress.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	30	30	30
Apply	30	30	40
Analyze	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Differentiate between horizontal and vertical alignment.
2. What is soil stabilization and its classification?
3. What is mean by Super pave mix design method?

Understand

1. What are the alternative materials available for soil stabilization?
2. What do you understand by level of service?
3. Describe how the type of pavement is selected for heavy rainfall areas.

Apply

1. Discuss the relation between resilient and dynamic modulus.
2. The results of Marshall test for five specimens are given below. Find the optimum bitumen content of the mix.

Bitumen Content %	Stability (kg)	Flow	V _v	VFB %	G _m
3	500	9	12.5	34	2.17
4	717	9.6	7.2	65	2.21
5	912	12	3.9	84	2.26
6	767	14.8	2.4	91	2.23
7	662	19.5	1.9	93	2.18

Analyze

1. Compare and contrast the key elements of Superpave mix design and Marshall method to know the stability of asphalt mixtures.

23CEC31 Environmental Sustainability and Climate Resilience

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Apply sustainability concepts to assess environmental challenges.
2. Utilize climate models and data interpretation techniques to analyze climate change trends.
3. Develop strategies for mitigation and adaptation to enhance climate resilience.
4. Apply renewable energy technologies and sustainable design principles to enhance energy efficiency and resilience.
5. Utilize economic and resource management strategies to optimize sustainable production and community resilience.
6. Implement policy mechanisms and governance strategies to support environmental sustainability and climate resilience.

COs-POs Mapping

COs	PO1	PO2	PO3	PO6	PO7	PO8	PO12
1	2	1	1	2	3	1	3
2	2	3	1	1	3	1	3
3	1	1	3	2	3	1	3
4	1	1	1	3	2	3	3
5	1	1	2	1	3	1	3
6	1	1	3	1	3	1	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Introduction to Sustainability

Definitions and the evolution of sustainability - Biodiversity loss, pollution, resource depletion, and ecosystem degradation - Global versus local sustainability challenges - Life cycle analysis, ecological footprints, and circular economy concepts - Comparative analysis of urban and rural sustainability practices - Sustainability initiatives.

Sustainable consumer behaviour and Ethical Consumption

12 Hours

Unit II

Climate Change Science and Its Impacts

The greenhouse effect, energy balance, and role of greenhouse gases- Understanding climate models and prediction techniques- Historical climate records, temperature anomalies, and extreme weather events - Interpreting satellite data, ice core records, and ocean temperature trends - Effects on biodiversity, agriculture, water resources, and ecosystems - Societal impacts: public health, economic challenges, and social inequality - Strategies for reducing greenhouse gas emissions - Adaptive responses to minimize vulnerability and enhance resilience.

Geoengineering and Climate Intervention Strategies- Climate-Induced Migration

12 Hours

Unit III

Strategies, Technologies, and Adaptation for Sustainability

Renewable Energy and Technology Innovations - Smart grids, energy storage technologies, and energy efficiency measures - Green building design, energy-efficient construction, and sustainable transportation - Waste management, water conservation, and green urban development - Economy and Resource Management - Sustainable production processes and the role of innovation in resource efficiency - Ecosystem-based adaptation, disaster risk reduction, and resilient community planning.

Circular Economy and Industrial Symbiosis- AI and IoT for Sustainable Development

12 Hours

Unit IV

Policy, Governance, and Implementation of Sustainability and Resilience

Key international agreements (e.g., Paris Agreement, Kyoto Protocol) and their objectives - National policies and local governance strategies for sustainable development - Role of incentives, taxes, and subsidies in promoting renewable energy and sustainable practices- Corporate social responsibility and

sustainable business models - The role of non-governmental organizations (NGOs), private sector, and civil society - Collaborative approaches to sustainability and resilience planning - Evaluation of policy challenges and strategic implementation techniques.

Carbon Markets and Emission Trading Systems- Ethical and Legal Dimensions of Sustainability

12 Hours

Total: 48 Hours

Textbook (s)

1. Anubha Kaushik, C. P. Kaushik, S. D. Attri, Climate Resilience and Environmental Sustainability Approaches: Global Lessons and Local Challenges, 1st Ed., Springer, 2021.
2. Ayyoob Sharifi (Ed.), Environmental Sustainability and Resilience: Policies and Practices, 1st Ed., Springer, 2023.
3. Bhawana Pathak, Rama Shanker Dubey (Eds.), Climate Change and Urban Environment Sustainability, 1st Ed., Springer, 2023.

Reference (s)

1. Celeste Murphy-Greene, Environmental Justice and Resiliency in an Age of Uncertainty, 1st Ed., Routledge, 2022.
2. David Pogue, How to Prepare for Climate Change: A Practical Guide to Surviving the Chaos, 1st Ed., Simon & Schuster, 2021.
3. Kimberly Etingoff (Ed.), Ecological Resilience: Response to Climate Change and Natural Disasters, 1st Ed., CRC Press, 2015.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	40	40
Understand	35	30	40
Apply	25	30	20
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define sustainability and explain its evolution over time.
2. List the major international agreements focused on climate change and sustainability.
3. Identify key factors contributing to biodiversity loss and ecosystem degradation.
4. What are the primary greenhouse gases responsible for climate change?

Understand

1. Explain the concept of life cycle analysis and its relevance to sustainability.
2. Describe the greenhouse effect and how it influences global temperatures.
3. Compare urban and rural sustainability practices and their respective challenges.
4. Discuss the role of circular economy principles in resource conservation.

Apply

1. Apply the concept of ecological footprints to analyze the environmental impact of a household.
2. Develop a simple plan for an energy-efficient building using green technology.
3. Suggest strategies a local community can use to improve climate resilience.
4. Implement waste management principles to design a sustainable waste disposal system.

23CEC41 Data Analysis and Visualization Using Python

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Apply foundational principles of data analysis and AI/ML techniques to solve real-world challenges and data-driven problems.
2. Implement fundamental statistical methods to analyze data and make predictions within data science applications.
3. Apply probability concepts to perform hypothesis testing for making informed inferential statistical decisions in practical scenarios.
4. Use Python programming to construct and manipulate DataFrames for various data analysis tasks and real-time data processing.
5. Apply diverse data visualization techniques to create effective charts and interpret data in real-time scenarios for better decision-making.
6. Conduct and demonstrate exploratory data analysis (EDA) to prepare high-accuracy, reliable datasets for Machine Learning models and real-world data applications.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO10	PO12
1	3	1	1	1	3	1	3
2	3	3	1	1	3	1	1
3	3	3	1	3	1	1	1
4	3	1	1	1	3	1	3
5	1	1	1	1	3	3	3
6	1	3	3	1	3	1	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Data Science

Data: Types and Categories - Structured and Un-Structured Data – Data Table - Data Science: Need for Data Science - Advantages and Disadvantages– Components

Data Analysis: Types –Process – Data cleaning, Mining and Wrangling – Tools for Data Analysis - Machine Learning and Artificial Intelligence – ML for Data Science

Categorical data, Ordinal Data

12 Hours

Unit II

Introduction to Statistics

Basis Statistics: Data Objects, Attributes and Attribute types – Histogram – Descriptive Statistics: Central Tendency and 3 Ms - Measures of Dispersion, Range and IQR - Standard Deviation - Coefficient of Variation - Boxplot and Five Number Summary - Correlation Analysis

Probability: Meaning and concepts - Rules for Computing Probability - Marginal Probability – Bayes Theorem. Introduction to Inferential Statistics.

Empirical Rule, Chebyshev Rule

12 Hours

Unit III

Python for Data Science

Python Basics: Variables and its types – Looping and Conditional Statements – Functions

Introduction NUMPYs: List, Tuples and Dictionary’s – Arrays and Matrices – Arithmetic Operation in Arrays and Matrices – Accessing and Modifying Arrays, Matrices, List and Dictionary’s

Introduction to Pandas: Series and DataFrames – Accessing – loc and iloc method – Modifying DataFrame – Pandas Functions – Date-Time Module

Info(), Groupby

12 Hours

Unit IV

Data Visualization and Exploratory Data Analysis (EDA)

Data Visualization : Introduction Visualization Libraries - Histogram – Skew – Boxplot – Bar Chart – Line, Scatter Plot and LM plot – Joint and Violin plot – Strip and Swam plot – Cat plot – Heat Map – Pair plot – Plotly – Pie chart - Timeline Charts - Concepts of sub plots

EDA: Sanity Check – Univariate Bivariate and Multivariate analysis – Missing Value Treatment – Outliers detection and Treatment.

Count plot, fillna

12 Hours
Total: 48 Hours

Textbook (s)

1. Daniel J. Denis: Univariate, Bivariate, and Multivariate Statistics Using R: Quantitative Tools for Data Analysis and Data Science, Wiley,2020
2. Mukhiya Suresh Kumar Mukhiya, Ahmed Usman Ahmed: Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt, 2020
3. Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.
4. Downey, Allen. Think stats: exploratory data analysis. " O'Reilly Media, Inc.", 2014.
5. Neil H. Spencer: Essentials of Multivariate Data Analysis, CRC Press,2014

Reference (s)

1. Wes McKinney : Python for Data Analysis 2nd Edition,Wiley,2013
2. Glenn J. Myatt, Wayne P. Johnson: Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition,Wiley,2014
3. 1 Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O'Reilly ,2016 2 OssamaEmbarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems,Apress, 2018
4. Wendy L. MartinezAngel R. MartinezJeffrey L. Solka: Exploratory Data Analysis with MATLAB, 2nd Edition,CRC Press,2011
5. Radhika Datar, Harish Garg : Hands-On Exploratory Data Analysis with R , Packt,20206.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Describe the difference between supervised and unsupervised learning in machine learning
2. What are the primary steps involved in the data science workflow?
3. Define probability and provide an example of how it is used to solve a real-world problem.
4. Define "data" in the context of data science and explain its significance.

Understand

1. How can data visualization aid in understanding complex datasets and making data-driven decisions?
2. What is the purpose of statistics, and how does it differ from data science?
3. Describe the concept of sampling and its importance in statistical analysis
4. Explain the difference between descriptive statistics and inferential statistics, providing examples of each.

Apply

1. Using the Plotly library, build an interactive scatter plot to display the relationship between the age and income of customers in a sales dataset, and enable hovering over data points to reveal additional information.
2. Combine Python libraries such as Pandas, Matplotlib, and Seaborn to explore and visualize a dataset containing information about student grades. Create a bar chart to show the average grade per subject and a box plot to compare the distribution of grades across different schools.

23CE001 Prefabricated Structures**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Describe the principles, types, materials, and the concept of modular coordination in prefabricated structures.
2. Discuss the concept of standardization along with techniques involved in the production, transportation, and erection of prefabricated structures.
3. Choose the appropriate prefabricated components suitable for various building demands.
4. Discuss the different manufacturing methods of precast elements, including their dimensional tolerances and accelerated concrete hardening techniques.
5. Apply techniques for the safe and efficient erection of various precast members, such as beams, columns, slabs, and wall panels
6. Design and implement various types of prefabricated joints for different prefabricated components.

COs-POs Mappings

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	2	3
2	3	2	1	2	3
3	3	2	2	2	3
4	3	3	2	2	3
5	3	3	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction**

Need for prefabrication – Principles –Types of prefabrication- site and plant prefabrication - Materials – Economy of prefabrication- Modular coordination – Standardization – Systems – Production – Transportation – Erection.

Light weight prefabricated components, Scope for prefabrication construction

12 Hours**Unit II****Prefabricated Components**

Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Prefabricated chajja, Prefabricated beams

12 Hours**Unit III****Production and Hoisting Technology**

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns

Vacuum lifting pads, Errors in construction

12 Hours**Unit IV****Structural Joints and Design Principles**

Joints for different structural connections – Dimensions and detailing – Design of expansion joints. Disuniting of structures- Design of cross section based on efficiency of material used – Design Principles - Allowance for joint deformation.

Design of abnormal loads, Equivalent load design

12 Hours**Total: 48 Hours****Textbook (s)**

1. Pradeep kumar.M” Prefabricated structures” Shanlax Publications,2016
2. CBRI, Building materials and components, India, 1990
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994

Reference (s)

1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List out the limitations of prefabrications.
2. List the advantages and disadvantages of prefabrication system.
3. What is Shear wall?
4. What is the classification of precast concrete walls?
5. List out the different types of construction joints.

Understand

1. Explain the classifications of prefabricated systems?
2. What are the principles of prefabrication techniques and explain in detail and also mention its advantages and disadvantages.
3. Elaborate the process of disunity of prefabricated structures for an earthquake resistant building with their merits and demerits.

23CE002 Construction Techniques**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Demonstrate knowledge of substructure and superstructure construction techniques.
2. Explain the classification and functioning of earthwork equipment.
3. Plan and optimize the use of construction plant and mechanized equipment through maintenance strategies, time-motion studies, and queueing models for effective project management.
4. Discuss and demonstrate the erection of steel structures and bridge decks using various hoisting and lifting equipment while ensuring operational safety and efficiency.
5. Describe mechanized equipment, advanced materials and methods for cast in-situ and precast concrete works.
6. Verify and integrate underwater concreting techniques, considering parameters like flow zones and pumping pressures for practical applications.

COs-POs Mapping

COs	PO1	PO2	PO7	PO11	PO12	PSO2
1	3	2	2	1	2	2
2	3	2	2	1	1	1
3	2	2	3	3	3	1
4	3	1	1	1	1	2
5	3	3	2	1	2	2
6	3	3	1	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Substructure and Superstructure Operations**

Drilling and blasting method and equipment – Pile driving techniques and equipment – Well foundations: Well Caissons, Pneumatic Caissons, sinking of wells – Tunneling methods – Diaphragm Walls – Dewatering methods, Pumps and working principles – Earth Moving Operations: Digging, dredging, trenching, grading, and levelling.

Cofferdam (Wall and Sheet pile) - Grouting (soft and hard soils)

12 Hours**Unit II****Earthwork Equipment and Management**

Trucks, Crawlers, Augers, Graders, Scrapers, Dozers, Rollers, Trenchers, Excavators, Power shovels, Backhoe, Dragline and Clamshells – Need for mechanization of construction – planning and financing construction plant and equipment, Equipment Maintenance and Repair, Productivity and Estimation of the number of units required, Time and Motion studies, Process charts, Single Server-Single Phase (SS – SP) M/M/1/K finite population queueing model application.

Tractors – Trailers

12 Hours**Unit III****Erection of Construction Units**

Erection of steel structures – Types of Scaffolding – Shoring – Mechanized methods of erection of Buildings and installations – Hoisting equipment: Winches, Chains, Pulleys, and Hooks and Slings – Types of cranes: tower crane, mobile crane, derrick crane, overhead crane, aerial crane, floating crane etc., their characteristics, safe lifting capacities and working ranges, load charts – Precast and prefabricated construction.

Bridge deck erection and Equipment - performance and safety in operation

12 Hours

Unit IV

Concrete Mixing Equipment and Placing Techniques

Mechanized methods of concrete works for cast in-situ and precast constructions: Concrete mixers, truck mixers, hydraulic concrete pump, pneumatic concrete placer, boom placer, concrete vibrators, Vacuum dewatering of concrete floor, Shotcreting and Slipforming – Underwater concreting: Tremie, Pumping, and Bucket Placing methods – Concrete Pumpability: Flow Zones (lubrication layer, sheared concrete and plug) and Variation of flow parameters across pipe sections, Pumping Pressure: Estimation by ACI method.

Polymer Modified Concrete - Formwork

12 Hours
Total: 48 Hours

Text Book (s):

1. Peurifoy, R.L., Construction Planning, Equipment and Methods, 9th Ed., Tata McGraw-Hill Edu., 2018.
2. Seetharaman, S., Construction Engineering and Management, 5th Ed., Umesh Publ., New Delhi, 2018.
3. Sharma, S., C., Construction Equipment & Management, Revised Edition (1st Ed.), Khanna Pub., 2019.
4. Sarkar, S. K. and Saraswati, S., Construction Technology, Illustrated Ed., Oxford Univ. Press, 2008.

Reference (s):

1. ACI 304.2R-17., Guide to Placing Concrete by Pumping Methods, American Concrete Institute, 2017.
2. Kultermann, E. and Spence, W. P., Construction Materials, Methods and Techniques (Building for a Sustainable Future), 4th Ed., Delmar Cengage Learning, 2016.
3. Schaufelberger, J. E., and Migliaccio, G. C., Construction Equipment Management, 2nd Ed., Routledge, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	15	-
Understand	35	50	30
Apply	50	35	70
Analyze	-	-	-
Evaluate	-	-	-
Create	5	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What do you mean by grading?
2. What do you mean by design mix?

Understand

1. Explain the Tremie Concreting technique.
2. Distinguish between centrifugal and displacement pumps.

Apply

1. Application of queuing or wait line models.
2. Applications of Time and Motion Study
3. Determine the Safe Working Load of a Crane using Manufacturer Load Chart.
4. Estimate pumping pressure of concrete as per ACI methodology.

Create

1. Create a Process chart for the operations involved in the earthwork excavation.
2. Create a Process chart for the operations involved in Concreting, Pumping and Placing.

23CE003 Airport, Railways and Harbour Engineering**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Explain the principles of airport planning, including site selection, runway orientation, taxiway design, and air traffic control to ensure efficient airport operations.
2. Analyze the functions of permanent way components, rail fastenings, and sleeper density to assess their impact on railway track stability and performance.
3. Apply geometric design principles such as gradients, cant, degree of curve, and crossings to optimize railway track alignment and safety.
4. Explain the fundamental concepts of shore structures, including harbors, ports, docks, tides, and site selection criteria for efficient coastal infrastructure planning.
5. Analyze the design and functional aspects of coastal structures such as breakwaters, piers, wharves, and quays to evaluate their impact on port and harbor stability.
6. Apply construction and maintenance techniques for docks, harbors, and navigational aids to ensure the longevity and operational efficiency of coastal transport systems.

COs-POs Mappings

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	1	2
2	3	3	2	1	3
3	3	3	2	2	3
4	3	2	1	1	2
5	3	3	2	2	3
6	3	2	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Airport Planning and Design: Airport site selection, Airport classification-Runway orientation-Wind rose diagram-Runway length - Taxiway design-Terminal area and Airport layout -Visual aids and Air traffic control.

Hanger, Runway marking

12 Hours**Unit II**

Introduction to Railway Engineering: Permanent way components -Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast -Rail Fastenings -Creep of Rails- Adzing of Sleepers- Sleeper density.

Geometric Design of Railway Track: Gradients- Grade Compensation- Cant and Cant Deficiency -Degree of Curve - Crossings and Turn outs.

Negative Super elevation, Alternative ballast materials

12 Hours**Unit III**

Planning of Shore Structures: Definition of Terms - Harbors, Ports, Docks, Tides and Waves, Littoral Drift, Sounding, Locks and lock gates, Site Selection & Considerations- Proximity to Towns/Cities, Utilities, Construction Materials, Coast Lines, Ports-Requirements and Classification of Harbors.

Light house, Dredging

12 Hours**Unit IV**

Construction and Maintenance of Docks & Harbours: Coastal Structures- Piers, Breakwaters, Wharves, Quays, Fenders, Inland Water Transport and Container Transportation. Pipe Ways, Rope Ways, Maintenance of Ports and Harbors - Navigational aids.

Jetties, Dolphins

12 Hours**Total: 48 Hours****Textbook (s)**

1. Airport Engineering- Khanna & Arora- Nemchand Bros, New Delhi, 1999
2. Airport engineering Virendra kumar , Dhanpathi Rai Publishers, New Delhi, 1999
3. Docks and Harbour Engineering, Bindra S.P- Dhanpathi Rai & Sons, New Delhi, 2012

Reference (s)

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA, 2011.
2. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India, 1999.
3. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
4. Srinivasan, R., Harbour, Dock and Tunnel Engineering, Charotar Publishing House, Anand, India, 1209.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	50	50	19
Apply	30	30	50
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Differentiate between basic and design runway length.
2. What are the design factors to be considered for determining the thickness of airport pavements?
3. What is mean by permanent way?

Understand

1. What are the functions of taxiway and hanger in airport layout?
2. What do you understand by littoral drift?
3. Describe how the optimum runway orientation is determined.

Apply

1. On a broad gauge route involving high speed, a 100 m transition curve has been provided and a super elevation of 80mm has been managed. The degree of curve is 10 and the maximum sanctioned speed for the curved section is 170 kmph. Determine maximum permissible speed on the curve.
2. The length of a runway under standard conditions is 2100m. The airport is to be provided at an elevation of 500 m above mean sea level. The airport reference temperature is 19 °C. The construction plan provides gradients of +1.00 %, -0.5%, +0.5%, +0.4 % and -0.1% at chainages 300, 800, 1190, 1600 and 1900 to 2500 m from one end. Determine the actual length of runway to be provided based on ICAO recommendations.
3. Determine the maximum permissible speed on a curve of high speed B. G track having the following particulars: (i) Degree of curve =19 (ii) Amount of Superelevation = 75mm (iii) Length of transition curve = 140meters (iv) Maximum speed of the section likely to be sanctioned = 153 kmph.

Analyze

1. Design a runway pavement section for a wheel load of 27000kg with a tire pressure of 11kg/cm². For this purpose the plate bearing test with 75cm diameter was carried out on soil subgrade and the plate yielded a pressure of 2kg/cm² at 0.5cm deflection after ten load repetitions.

23CE004 Construction Economics and Finance**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Illustrate the basic principles of engineering economics
2. Describe time value of money and inflation, and its impact on capital budgeting
3. Interpret the cash flow patterns for a construction project
4. Prepare simple financial statements for measuring the financial performance of a firm
5. Evaluate investment proposals through various capital budgeting methods
6. Understand the cost control in construction projects

COs-POs Mapping

COs	PO2	PO3	PO10	PO11	PO12
1	1	2	2	3	2
2	2	2	2	3	3
3	1	2	1	3	3
4	2	2	3	3	2
5	2	2	3	3	3
6	1	2	1	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Introduction to Economics**

Concept of Engineering Economics – Equivalence – Cash flow Diagram – Single Payment present worth factor (SPPWF) – Uniform series compound amount factor – Cash flow involving arithmetic gradient payment of receipts – Arithmetic Gradient – Cash flow involving geometric gradient series – Comparison of alternatives – Present worth method - Future worth method – Annual worth method – Rate of return – Incremental rate of return – Net Present Value – Benefit – Cost analysis – Break-even Analysis
Incremental benefit-cost ratio analysis, and breakeven analysis for two and more alternatives

12 Hours**Unit II****Depreciation and Inflation**

Classification of Costs – Time value of money – Depreciation and amortization – Capital Budgeting: Meaning, Need and Techniques of Capital Budgeting – Capital Budgeting Methods – Different Depreciation methods – Inflation
Payback period, profitability index

12 Hours**Unit III****Cost Estimating and Finance**

Cost Estimating – Types of Estimates – Approximate Estimates – Parametric Estimates – Cost Planning Techniques – Cost Control during Design and Construction stages – Sources of Finance – Infrastructure Financing – Lifecycle costing
Methods of construction costing, Escalation clause

12 Hours**Unit-IV****Financial Statement Analysis**

Financial management – Chart of Accounts - Balance sheet and Profit and Loss accounts – Ratios analysis – Fund Flow Statement – Cash Flow Statement – Financial ratios - Working Capital management – Financial Control
Profit-loss account, credit, and debit statements

12 Hours**Total: 48 Hours****Textbook (s)**

1. Pravin Kumar, Fundamentals of Engineering Economics, Wiley India Pvt. Ltd. New Delhi, 2015
2. Rajeev M Gupta, Project Management, 2nd Edition, PHI Learning Pvt. Ltd. New Delhi, 2014

Reference (s)

1. Patil, B. S., Civil Engineering Contracts and Estimates, Universities Press (India) Private limited, 2006.

2. Kwaku, A., Tenah, P. E., Jose M. Guevara, P. E., Fundamentals of Construction Management and Organization, Printice Hall, 1985.
3. Peterson, S. J., Construction Accounting and Financial Management, Pearson Education, Upper Saddle River, New Jersey, 2005
4. Panneer Selvam. R, Engineering economics, 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Gould, F. E., Managing the Construction Process, 2nd Edition, Prentice Hall, Upper Saddle River, New Jersey, 2002.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	10	20	20
Apply	70	60	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Explain Single payment present worth factor
2. Explain the concept of the time value of money
3. What is the basic classification of costs associated with construction activities
4. What is depreciation and explain with an example
5. List cost planning techniques

Understand

1. Explain the basic difference between net present value, payback period, internal rate of return, and the annual rate of return
2. What is inflation and how does it affect the cash flow patterns
3. Explain the capital budgeting techniques
4. Demonstrate the methods of costing with an example.
5. Summarize the process of preparing a balance sheet for a construction project.

23CES11 Fundamentals of IoT for Civil Engineering**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply IoT concepts and architecture to civil engineering applications, focusing on smart infrastructure solutions and project designs.
2. Implement IoT communication protocols such as MQTT, CoAP, and HTTP for efficient data transfer in civil engineering projects.
3. Apply sensor calibration techniques to ensure accurate real-time data collection for infrastructure health monitoring.
4. Integrate various actuators with sensors to automate construction processes and infrastructure management systems.
5. Develop IoT applications using Arduino and Raspberry Pi by interfacing sensors for real-time civil engineering applications.
6. Apply data transmission and visualization techniques for IoT system development, focusing on secure and efficient data management.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO12
1	3	2	3	1	2	3
2	2	3	2	2	3	2
3	3	2	1	3	2	2
4	2	3	3	2	3	3
5	3	2	3	3	3	3
6	3	3	2	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Introduction to IoT**

Overview of IoT: Definition and scope of IoT, Evolution of IoT technology, IoT applications in Civil Engineering. IoT Architecture and Components: Basic components of IoT systems, Layers of IoT architecture, Data flow in IoT systems. IoT Protocols and Communication Technologies: Introduction to IoT protocols (MQTT, CoAP, HTTP), Communication technologies (Wi-Fi, Bluetooth, Zigbee, LoRaWAN). Role of IoT in: Transportation and bridges, Smart water and waste management, urban planning and smart cities.

*Layers of IoT architecture, Data flow in IoT systems.***12 Hours****Unit II****Sensors and Actuators**

Types of Sensors: Temperature, humidity, and pressure sensors, Vibration and displacement sensors, Proximity, infrared, and ultrasonic sensors. Working Principles and Applications: Sensor calibration and maintenance, Applications in civil infrastructure projects. Types of Actuators: Electrical, hydraulic, and pneumatic actuators, Actuator selection criteria for civil projects. Sensor-Actuator Integration: Real-time sensor-actuator communication, Case studies of sensor-actuator systems in construction.

*Applications in civil infrastructure***12 Hours****Unit III****IoT Hardware Platforms**

Arduino for IoT: Introduction to Arduino boards, Programming Arduino with C/C++, Hands-on: Basic sensor interfacing with Arduino. Raspberry Pi for IoT: Raspberry Pi OS and hardware overview, Python programming for Raspberry Pi, Hands-on: IoT project with Raspberry Pi and sensors. Comparison of IoT Platforms: Arduino vs. Raspberry Pi for Civil Engineering applications, IoT development kits and tools.

*IoT development kits and tools, Arduino vs. Raspberry Pi for Civil Engineering applications.***12 Hours****Unit IV****IoT System Development and Data Transmission**

IoT System Design: Stages in IoT system development, Prototyping and testing IoT solutions. Data Transmission Protocols: Communication between sensors and cloud platforms, Role of MQTT and HTTP in

IoT data transfer. Data Visualization and Analysis: Real-time data monitoring dashboards, Tools for IoT data visualization. Security and Privacy Considerations: Common IoT vulnerabilities, Best practices for securing IoT system.

Security and Privacy Considerations: Common IoT vulnerabilities, Best practices for securing IoT system

12 Hours

Total: 48 Hours

Textbook(s)

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything," Apress, 2013
2. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things," Wiley, 2013

Reference(s)

1. Jan Holler et al., "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence," Academic Press, 2014.
2. Pethuru Raj, "Internet of Things (IoT): Technologies, Applications, Challenges and Solutions," CRC Press, 2017 .
3. Olivier Hersent, David Boswarthick & Omar Elloumi, "The Internet of Things: Key Applications and Protocols," Wiley, 2012.
4. Arshdeep Bahga & Vijay Madisetti, "Internet of Things: A Hands-on Approach," Universities Press, 2014.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. List four primary IoT communication protocols used in civil engineering.
2. Identify three types of sensors commonly used in infrastructure monitoring.
3. Define the term "actuator" and give two examples where they are used in civil engineering.
4. Name two popular hardware platforms for developing IoT applications in civil engineering.

Understand

1. Explain the concept of IoT architecture and its relevance to civil engineering.
2. Illustrate how sensors and actuators are integrated within a smart infrastructure project.
3. Describe the role of MQTT in IoT data transmission and why it is favored in certain applications.
4. Summarize the steps involved in calibrating a vibration sensor for use in bridge monitoring.

Apply

1. Develop a simple IoT system using Arduino to monitor environmental conditions at a construction site.
2. Design a schematic for integrating Raspberry Pi with sensors to manage water levels in smart city applications.
3. Implement a basic data visualization dashboard for real-time monitoring of a civil engineering project.
4. Create a flowchart illustrating the data flow from IoT devices through various communication protocols to a central server.

Analyse

1. Compare and contrast the use of Arduino versus Raspberry Pi in terms of their suitability for different civil engineering applications.
2. Analyze the impact of sensor calibration on the accuracy of data collected in infrastructure health monitoring.
3. Discuss the implications of using Wi-Fi versus LoRaWAN in urban versus rural civil engineering projects.
4. Differentiate between the uses of MQTT and HTTP in terms of efficiency and data security.

Evaluate

1. Evaluate the potential of IoT to enhance efficiency in construction management and infrastructure maintenance.
2. Assess the security challenges in IoT deployments in civil engineering and propose mitigation strategies.
3. Critically appraise the integration of IoT systems in the lifecycle management of civil engineering projects.
4. Determine the effectiveness of real-time data visualization tools in decision-making processes in civil engineering.

23CES21 Fundamentals of Data Science and Statistics

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Apply data science concepts and workflows to real-world problems in Civil, Mechanical, and Electrical Engineering by selecting appropriate tools and data types.
2. Apply descriptive statistical methods to analyze and summarize engineering datasets using measures of central tendency and dispersion.
3. Utilize probability theory and probability distributions to model uncertainties in engineering applications and perform sampling techniques.
4. Apply hypothesis testing techniques and regression analysis to draw meaningful conclusions from engineering data and support decision-making.
5. Implement data preprocessing techniques to clean and transform raw engineering data for further analysis.
6. Apply data visualization techniques using Python and business intelligence tools to interpret and present engineering data insights effectively.

COs-POs Mapping

COs	PO1	PO2	PO3	PO5	PO12
1	3	2	2	3	2
2	3	3	2	3	2
3	3	3	2	2	2
4	3	3	2	3	2
5	3	2	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Data Science

Overview of Data Science: Definition, Scope, and Applications. Role of Data Science in Civil, Mechanical, and Electrical Engineering. Data Types: Structured, Semi-structured, and Unstructured Data. Data Science Workflow: Data Collection, Cleaning, Analysis, and Visualization. Tools and Technologies in Data Science: Python, R, Excel, and Jupyter Notebook.

Ethical concerns in Data Science, Role of cloud computing.

12 Hours

Unit II

Basics of Statistics

Descriptive Statistics: Measures of Central Tendency (Mean, Median, Mode). Measures of Dispersion: Variance, Standard Deviation, Range, IQR. Probability Theory: Basic Probability, Conditional Probability, Bayes' Theorem. Probability Distributions: Normal, Binomial, Poisson, Uniform Distributions. Sampling Techniques: Random Sampling, Stratified Sampling, Systematic Sampling

Law of Large Numbers & Central Limit Theorem, Impact of probability distributions

12 Hours

Unit III

Inferential Statistics

Hypothesis Testing: Null and Alternative Hypotheses. p-value, Confidence Intervals, and Significance Levels. Parametric Tests: t-Test, Z-Test, ANOVA. Non-Parametric Tests: Chi-square Test, Mann-Whitney Test, Kruskal-Wallis Test. Correlation and Regression Analysis: Pearson, Spearman Correlation

Parametric vs. Non-parametric tests, Effect of multicollinearity in regression

12 Hours

Unit IV

Data Handling and Visualization

Data Preprocessing: Handling Missing Values, Outliers, Encoding Categorical Data. Introduction to Data Visualization: Importance and Techniques. Plotting using Matplotlib and Seaborn: Line Plot, Bar Chart, Scatter Plot, Histogram. Dashboarding using Tableau/Power BI (Basic Overview). Case Studies on Statistical Applications in Engineering

Importance of feature scaling, Role of interactive dashboards in analytics.

12 Hours
Total: 48 Hours

Textbook (s)

1. Steven S. Skiena - "The Data Science Design Manual" - Springer - 2017
2. Rachel Schutt & O'Neil - "Doing Data Science" - O'REILLY - 2013

Reference (s)

1. Joel Grus - "Data Science from Scratch" - 2015
2. Gareth James - Daniela Witten - Trevor Hastie - Robert Tibshirani - "An Introduction to Statistical Learning with Applications in R" - 2013
3. Jure Leskovec - Anand Rajaraman - Jeffrey Ullman - "Mining of Massive Datasets" - Cambridge University Press - 2014
4. Roger D. Peng - "R Programming for Data Science" - LeanPub - 2015
5. "Data Science for Engineers" - NPTEL Course

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	10	-
Understand	40	40	-
Apply	50	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Data Science and explain its significance.
2. List different stages in the Data Science process.
3. What is Datafication? Provide an example.
4. Identify the key properties of data used in Data Science.

Understand

1. Explain the difference between descriptive statistics and inferential statistics.
2. How does data cleaning impact the accuracy of a model?
3. Describe the concept of Z-score normalization and its importance in ranking techniques.
4. How do visualization techniques help in data analysis and decision-making?

Apply

1. Apply the data science process to analyze a given real-world dataset.
2. Use probability and statistical techniques to explore customer purchase patterns.
3. Implement data preprocessing techniques to clean messy datasets.
4. Develop an interactive data visualization for analyzing stock market trends.

23CES31 Entrepreneurship Theory and Practice**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Develop an understanding of the nature of entrepreneurship.
2. Identify opportunities (problems), develop creative solutions and build a viable business model around these.
3. Identify and understand the driving forces of new venture success and to develop skills in innovation and business planning for entrepreneurial ventures.
4. Implement the ethical and legitimacy challenges that face entrepreneurs with new ventures.
5. Manage and grow their business in terms of jobs and revenues.
6. Apply risk reduction strategies in the business.

COs-POs Mapping

COs	PO1	PO2	PO4	PO11	PO12
1	3	2	3	2	3
2	3	2	3	1	3
3	2	2	3	2	2
4	3	2	2	2	3
5	2	1	2	1	3
6	3	1	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**The entrepreneurial perspective**

Evolution, Characteristics, Nature, Types, Functions of Entrepreneur , Distinction between an Entrepreneur and a Manager, Concept, Growth of Entrepreneurship in India, The entrepreneurial perspective, the entrepreneurial decision process, Types of start ups, role of entrepreneurs i economic development, the future of entrepreneurs, entrepreneurial process, manager vs entrepreneur decision making, intrapreneurship.

*Entrepreneurial Ethics and Social Responsibility***12 Hours****Unit II****The individual Entrepreneur**

Entrepreneurial feelings, entrepreneur background and characteristics, motivation role models and support systems, male versus female entrepreneurship, entrepreneurs versus inventors, the nature of international entrepreneurship, international versus domestic entrepreneur.

*Entrepreneurial Leadership and Emotional Intelligence:***12 Hours****Unit III****Theories of entrepreneurship**

Entrepreneur, Theories of entrepreneurship: Economic, Classical, Neo Classical, Austrian Market process, Psychological, Personality Traits, Need for achievement, Sociological, Anthropological entrepreneurial, Opportunity based Entrepreneurship theory, Resource based Entrepreneur, Financial Capital/ Liquidity, Social Capital or Social Network Theory, Types of entrepreneurs.

*Institutional and Environmental Influences on Entrepreneurship***12 Hours****Unit IV****Creating and starting the Venture**

Sources of new Idea, methods of generating ideas, creative problem solving, opportunity recognition, product planning and development, opportunity recognition, Business Structure, Creating a Business Plan, Market Size Analysis, E-commerce and start ups, financial support for Business Plan, Regulations to set up a and Laws, Legal issues in setting up the organization, patents, business methods patents, trademarks, copyrights, risk reduction strategies for new entry exploitation, growth strategies, Sustaining a Business, Managing cash flows, Employee Buy in, Government Incentives and Resources through Entrepreneurship institutions.

*Digital Marketing and Social Media Strategies for Startups***12 Hours****Total: 48 Hours**

Text Books

1. Hisrich, Robert. Michael Peters and Dean Shepherd, Mathew. (2014). Entrepreneurship. New Delhi: Tata McGraw-Hill Education.
2. Poornima M(2014), Entrepreneurship Development and Small Enterprise, Pearson Education.
3. Hatten, Timothy S. (2011). Small Business Management: Entrepreneurship and Beyond, Mason: Cengage Learning.

References

1. Scarborough, N. M. (2011), “Essentials of Entrepreneurship and Small Business Management”, 6th Edition. New Jersey: Prentice Hall.
2. Verstraete, T. and Jouioson-Laffitte, E. (2012), “A Business Model for Entrepreneurship”, Cheltenham: Edward Elgar Publishing Ltd.
3. Poornima Charantimath, (2007)“Entrepreneurship Development-Small Business Enterprise”, Pearson Education.
4. Rober D Hisrich, Michael P Peters, Dean A Shepherd, (2007),Entrepreneurship, (6 ed.), The McGraw-Hill companies.
5. Allen, K. R. (2011),“Launching New Ventures: An Entrepreneurial Approach”, 6th Edition. Mason, Ohio: South-Western Cengage Learning.
6. Kuratko, Donald F. Entrepreneurship: (2010) Theory, Process, Practice 9th Edition. Mason, Ohio: South-Western Cengage Learning.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is entrepreneurship, and how does it differ from intrapreneurship?
2. List any three characteristics of a successful entrepreneur.
3. Name two different types of startups and briefly describe them.
4. Identify three major theories of entrepreneurship.
5. What are the four main types of intellectual property rights relevant to startups?

Understand

1. Explain the entrepreneurial decision-making process and its importance.
2. How does an entrepreneur differ from an inventor in terms of business impact?
3. Discuss the role of entrepreneurial ethics and social responsibility in modern startups.
4. How do institutional and environmental factors influence entrepreneurship? Provide examples.
5. Why is a business plan important for a startup? Explain its key components.

Apply

1. Given a local market problem, propose a new business idea and outline its potential success factors.
2. Choose a well-known entrepreneur and analyze their success based on one entrepreneurship theory.
3. Design a short training module on entrepreneurial leadership and emotional intelligence for startup founders.
4. Create a basic financial support strategy for a startup, considering funding sources and risk reduction methods.
5. Consider an ethical dilemma a startup founder might face. How should they address it while maintaining business integrity?

23CES41 Principles of Safety Management**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Describe the functions and activities of safety engineering department.
2. Explain a safety audit and prepare a report for the audit.
3. Prepare an accident investigation report.
4. Estimate the accident cost using supervisors report and data.
5. Evaluate the safety performance of an organization from accident records.
6. Identify various agencies, support institutions and government organizations involved in safety training and promotion

COs-POs Mapping

COs	PO4	PO6	PO8	PO10	PO12
1	2	2	1	3	2
2	2	3	2	3	2
3	3	3	2	3	2
4	3	3	3	3	2
5	3	3	2	3	2
6	3	3	1	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Safety: Concepts and Techniques**

History of Safety movement –Evolution of modern safety concept- planning for safety for optimization of productivity -productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

*Human Factors in Industrial Safety- Economic Impact of Workplace Accidents***12 Hours****Unit II****Safety Audit**

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

*Behavior-Based Safety Audits- Safety Audit Compliance in Different Industries***12 Hours****Unit III****Accident Investigation and Reporting**

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

*Role of Insurance in Workplace Safety and Compensation- Ethical Considerations in Accident Reporting***12 Hours****Unit IV****Safety Performance Monitoring and Training**

Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems. Importance of training-identification of training needs-training methods – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training.

*Role of Artificial Intelligence in Safety Monitoring- Crisis Management and Emergency Preparedness***12 Hours****Total: 48 Hours**

Textbook(s)

1. "Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 13th Edition 2009.
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 3rd Edition 2000.

References(s)

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
3. John Ridley, "Safety at Work", Butterworth and Co., London, 1983
4. Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2nd edition, 1990.
5. Relevant Indian Standards and Specifications, BIS, New Delhi.
6. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the definition of safety in an industrial context?
2. Who are the key contributors to the evolution of modern safety concepts?
3. What are the primary components of a safety audit?
4. Define reportable and non-reportable accidents.
5. What are the different types of accident disabilities considered in safety performance monitoring?

Understand

1. Explain how safety planning can optimize productivity in an industry.
2. Describe the role of line and staff functions in ensuring workplace safety.
3. How does an audit checklist help in identifying safety hazards?
4. Explain the significance of the domino sequence in accident causation.
5. Describe the importance of safety training in reducing workplace accidents.

Apply

1. Given a workplace scenario, apply the Incident Recall Technique (IRT) to analyze a safety incident.
2. Create a basic safety audit checklist for a manufacturing shop floor.
3. Using a hypothetical accident report, analyze the causes and propose preventive measures.
4. Calculate the accident frequency rate for a company given relevant workplace injury data.
5. Design a training module for employees on safe practices in a hazardous environment.

23CES51 Introduction to Smart Cities**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Illustrate the concept, evolution, and key components of smart cities.
2. Explore the role of technology and infrastructure in smart city development.
3. Analyze governance models, policies, and financial aspects of smart cities.
4. Evaluate the social, economic, and environmental impacts of smart city initiatives.
5. Examine global and Indian smart city case studies to identify best practices.
6. Develop basic solutions for urban challenges using smart city principles.

COs - POs Mappings

COs	PO1	PO6	PO7	PO11	PO12
1	3	1	2	1	1
2	3	1	2	1	1
3	2	3	1	2	2
4	1	3	3	2	2
5	1	2	3	3	1
6	1	1	2	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Fundamentals of Smart Cities**

Definition and concept of Smart Cities, History and evolution of urbanization and smart cities, Key components of a smart city ,Global examples of smart cities,Challenges and opportunities in smart city development, Overview of the Smart Cities Mission in India,Goals and objectives of the Indian Smart Cities Mission.

*Micro-Mobility Solutions and Their Role in Smart Cities***12 Hours****Unit II****Technologies and Infrastructure in Smart Cities**

Role of Information and Communication Technology (ICT) in Smart Cities, Internet of Things (IoT) and its Applications in Urban Planning, Smart Infrastructure: Transportation, Energy, Water, Waste Management, Smart Buildings and Sustainable Architecture, Artificial Intelligence (AI), Data Analytics, and Blockchain for Smart Cities,Smart Health & Smart Education Initiatives, Cyber security and Privacy in Smart Cities.

*Benchmarks for Smart Cities, 5G & Smart Connectivity for Urban Development.***12 Hours****Unit III****Governance and Policy for Smart Cities**

Policy frameworks for smart city development,Governance models and stakeholder engagement,Public-private partnerships (PPPs),Regulatory and ethical considerations,Financing smart city projects, Implementation framework of the Smart Cities Mission in India, Role of Urban Local Bodies (ULBs) and Special Purpose Vehicles (SPVs)

*Disaster Management and Emergency Response in Smart Cities***12 Hours****Unit IV****Social and Economic Impacts of Smart Cities**

Impact on urban mobility and transportation, Economic Growth and Job Creation in Smart Cities, Social inclusion and equity, Environmental Sustainability and Resilient Urban Planning.Future trends and innovations in smart cities, Impact assessment of Indian Smart Cities Mission initiatives, Best practices and lessons learned from Indian smart cities with case studies, Developing a Conceptual Smart City Plan.

*Circular Economy in Smart Cities***12 Hours
Total: 48 Hours****Textbook (s)**

1. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); "Remaking the city: Social science perspective on urban design"; State University of New York Press, Albany (ISBN: 0-87395-678-8)
2. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li

3. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by NicosKomninos

Reference (s)

1. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science
2. Mission statement & guidelines on Smart City Scheme". Government of India - Ministry of Urban Development [http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines\(1\).pdf](http://smartcities.gov.in/upload/uploadfiles/files/Smart%20City%20Guidelines(1).pdf)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	50	50	70
Apply	20	20	30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define smart city.
2. List out any four features of smart cities.
3. Define Environmental Sustainability.
4. Differentiate smart and green concepts.

Understand

1. Explain the core infrastructure elements of smart cities.
2. Describe the key components of smart city infrastructure.
3. Explain the process of water management in smart cities.
4. Illustrate the Implementation framework of the Smart Cities Mission in India.

Apply

1. Identify the challenges in adopting smart transportation initiatives from global smart cities.
2. Suggest the areas of improvement for a choosen case study of smart city in india.
3. Analyze the role of AI and blockchain in optimizing urban services.
4. Develop a conceptual smart city plan for a selected urban area.

23CE601 Problem Solving Using OOPS**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Implement object oriented concepts to the problems
2. Implement applications using different types of inheritances
3. Develop user defined packages
4. Identify and recover runtime exceptions arise in the applications.
5. Demonstrate parallel processing applications using threads
6. Design interactive applications using Hibernate and spring Framework

COs-POs Mappings

COs	PO1	PO2	PO3	PO5	PO12
1	1	3	1	2	3
2	1	3	1	2	3
3	1	2	2	2	2
4	1	2	1	2	2
5	1	2	2	2	3
6	1	3	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Java Fundamentals**

Overview of Object Oriented Programming principles, Importance of Java to the Internet, Byte code, Data types, arrays, control statements, Classes and Objects– constructors, methods, call_by_value, call by reference, access control, this keyword, Static keyword, overloading methods and constructors, garbage collection, Strings in java, string tokenizer, string builder.

Features of object oriented programming–Java History–Computer Programming Hierarchy–Role of Java Programmer in Industry

12 Hours**Unit II****Inheritance, Packages & Interface**

Inheritance: Hierarchical abstractions, Base class and subclass, Benefits of inheritance, super keyword, final keyword with inheritance, polymorphism, abstract classes Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, Member access rules

Interface: Defining an interface, differences between classes and interfaces, implementing interface, variables in interface and extending interfaces, Nested–Inner Class & Anonymous Classes

Generic Class Types

12 Hours**Unit III****Exception Handling & Multithreading**

Exception handling: Concepts and benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built-in and User Defined Exceptions

Multithreading: Definition thread, thread life cycle, creating threads, synchronizing threads, Demon threads.

Inter Communication of Threads– methods used, Deadlock

12 Hours**Unit IV****Event Handling**

The AWT class hierarchy, user interface components labels, buttons, text components.

Event Handling: Events, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes, compare basic AWT components with swing components, more user interface components – canvas, scroll bars, check box, choice, lists panels – scroll pane, dialogs, menu bar, layout managers.

Java.util package, Anonymous Inner classes a Short-cut to Event Handling.

12 Hours**Total: 48 Hours**

Textbook (s)

1. H. Schildt, Java: The complete reference, 7th Ed., TMH, 2016
2. T. A. Budd, An Introduction to Object-Oriented Programming, 3rd Ed., Addison Wesley Longman, 2012

Reference (s)

1. Dietal & Dietal, Java: How to Program, 8th Ed., PHI, 2010
2. E. Balaguruswamy, Programming with Java A Primer, 4th Ed., Tata McGraw Hill Companies, 2009
3. C. S. Horstmann and G. Cornell, Core Java, Vol 1. Fundamentals, 7th Ed., Pearson Education, 2014
4. C. Horstmann, BIG JAVA Compatible with Java 5 & 6, 3rd Ed., Wiley Publishers, 2008

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. List out 6 different java buzz words
2. List the three OOP principles
3. Define Inheritance
4. List the 5 keywords used in exception handling

Understand

1. Summarize the OOP principles
2. Illustrate the procedure for creating a user defined package
3. Interpret the Thread Life cycle
4. Interpret the Applet Life cycle
5. Define Encapsulation

Apply

1. Implement a java program that read an integer between 0 and 1000 and adds all the digits in the integer
2. Implement an abstract base class shape with two members base and height, a member function for initialization and a function to compute area (). Derive two specific classes Triangle and Rectangle which override the function area (). Use these classes in a main function and display the area of a triangle and a rectangle.
3. Demonstrate an applet that receives two numerical values as input from the user and then displays the sum of these numbers on the screen.
4. Given are two one dimensional arrays A and B which are sorted in ascending order. Develop a program to merge them into a single sorted array C that contains every item from arrays A and B, in ascending order.
5. Implement a Java program for creating one base class for student personal details and inherit those details into the sub class of student Educational details to display complete student information.

Analyze

1. Compare and Contrast between procedure oriented and object oriented programming.
2. Analyze the concurrent programming using threads.
3. Differentiate method overloading and method overriding.
4. Differentiate sleep and suspend.
5. Analyze platform independency of java with the help of JVM.

Evaluate

1. Judge whether Hybernate and spring frameworks are better for java database connectivity.
2. Asses the performance of threads

3. Determine the importance of run time polymorphism
4. Ramesh's house is located at a junction from which the places of his four friends are located at two coordinate points each. He must be at either one of their houses at the same time. Help him choose which house to go to by finding out the one with the nearest distance from his place. The coordinates of their houses are as follows:

Name	Coordinates
Ramesh	(3,2)
Friend A	(2,3)
Friend B	(0,0)
Friend C	(5,8)
Friend D	(1,4)

6. Write a java to have the solution of above problem. Open Book Exam (For Open Book Examination and not for semester end examination).
7. Rakesh is participating in a Hackathon and it requires him to make a Login page. Help him out by writing a java program to create the page. It should look as follows

The image shows a Java Swing window titled "Login page". The window has a standard title bar with minimize, maximize, and close buttons. The main content area is light gray and contains the following elements:

- A label "Username:" followed by a white text input field.
- A label "Password:" followed by a white text input field.
- A blue "Submit" button centered below the two input fields.

23CE602 Design of Steel Structures**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Classify properties of steel sections; and design and analyze welded structural connections, including butt and fillet welds, and eccentric beam-to-beam, and beam-to-column joints, in compliance with IS code provisions.
2. Analyze different modes of failure in tension members, including gross section yielding, net section rupture, and block shear, and determine their design strength as per IS code provisions.
3. Design compression members, including built-up sections such as laced and battened columns, by evaluating effective length, slenderness ratio, and permissible stresses.
4. Design simple and compound beams considering allowable stresses, deflection, shear, buckling, and bearing, in compliance with IS code provisions.
5. Analyze and design column bases, including slab base, gusset base, and grillage foundation, while adhering to IS code requirements.
6. Design plate girders and gantry girders without stiffeners, considering load specifications, structural elements, and temperature effects in accordance with IS code provisions.

COs-POs Mappings

COs	PO1	PO2	PO3	PO4	PO12	PSO2
1	3	3	3	2	3	3
2	3	3	3	2	3	3
3	3	3	3	2	3	3
4	3	3	3	2	3	3
5	3	3	3	2	3	3
6	3	3	3	2	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Design of Welded Connections**

Introduction to Structural Steel: Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications. Welded Connections: Advantages and disadvantages of welding- Strength of welds-Butt and fillet welds: Permissible stresses – IS Code requirements, Lap and Butt Connections, Design of fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints, eccentric beam to beam and beam to Column welded connections only.

*Light gauge steel sections, IS code provisions for Bolted connections***12 Hours****Unit II****Design of Tension Members and Compression Members**

Tension members: Introduction to different modes of failures – gross section yielding, Net Section rupture and block shear failure, Determines the design strength due to yielding of gross section, rupture of critical section and block shear. Design procedure of tension members.

Compression Members: Effective length of columns, Slenderness ratio, permissible stresses, Design procedure of compression members - Design of built-up sections (Laced and Battened welded Columns)

*Tension Member Splice connection, Tension Member Subjected to UDL along the Longitudinal Axis***12 Hours****Unit III****Beams and Column bases**

Beams: Allowable stresses, design requirements as per IS Code-Design of simple and compound beams, check for deflection, shear, buckling, check for bearing, laterally supported beams.

Column bases: Slab base, Gusset base.

*Grillage foundation, IS code provisions for laterally unsupported beam,***12 Hours****Unit IV****Plate Girder and Gantry Girder**

Introduction: Elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (only introduction), design of plate girder without stiffeners

Gantry Girders: Introduction, various loads, specifications, design of gantry girder without stiffeners

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Stiffener design concepts, Temperature Effect on Plate Girder and Gantry Girder

12 Hours
Total: 48 Hours

Note:

IS 800-2007, General Construction in Steel — Code of Practice and Steel tables are permitted to use in classroom and examinations.

Textbook (s)

1. S.K. Duggal, Limit State Design of Steel Structures, 3rd Ed., Tata McGraw Hill, New Delhi, 2019.
2. N. Subramanian, Design of Steel Structures (Limit States Method), Oxford University Press, 2nd Ed., 2017.
3. S.S. Bhavikatti, Design of Steel Structures by Limit State Method as per IS: 800-2007, 5th Ed., Wiley-Dreamtech India Pvt. Ltd., 2019.
4. N. Subramanian, Steel Structures (Design & Practice), Oxford University Press, 2011.

Reference Books (s)

1. S. S. Kanthimathinathan, Limit State Design of Steel Structures: As per IS: 800 / 2007, Wiley-Dreamtech India Pvt. Ltd., Noida, 2022.
2. V.L. Shah and Veena Gore, Limit State Design of steel structures as per IS: 800-2007, 4th Ed., Structures Publications, Pune, 2016.
3. Sai Ram, Design of Steel Structures, 2nd Ed. (Revised), Pearson Publications, New Delhi, 2015.
4. M.R Shiyekar, Limit State Design in Structural Steel, 3rd Ed., PHI learning private limited, New Delhi, 2017.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	5	5	-
Understand	10	10	-
Apply	85	85	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

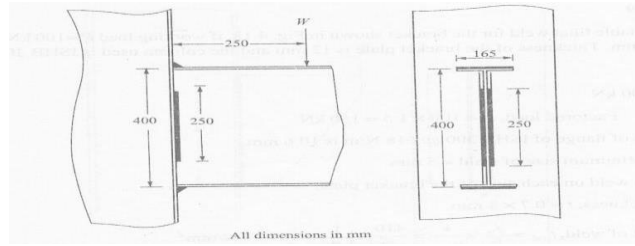
1. What are the partial safety factors of materials?
2. What are the various types of tension members?
3. What is meant shear lag?
4. State the possible failure modes of axially loaded column.
5. What are the types of stiffeners used for welded girders?

Understand

1. Enumerate the differences between structural steel and reinforcement steel.
2. What is the use of providing column bases?
3. Why do compression flanges require lateral support?
4. Why are rolled I-sections widely used as beam members?
5. What are the various parameters influencing the compressive strength of a member?

Apply

1. An I section bracket is connected to a column by welds as shown in figure. Determine the load which can be safely carried. The size of the web weld is 5 mm while the size of the flange weld is 10 mm. Assume field welds.



2. Design a suitable angle section to carry a tensile force of 250 KN. The angle is to be connected to a gusset plate through one of its leg by fillet welding. $f_y=250 \text{ N/mm}^2$, $f_u=410 \text{ N/mm}^2$. Also design the Welded Connection.
3. Design a simply supported beam of 6m span carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The total UDL is made up of 80kN load plus 120 KN imposed load (assuming a stiff bearing length of 65-100 mm). (Hint: ISMB or ISMC). (For Open Book Examination and not for semester end examination)
4. Design a suitable tension member to carry a tensile force of 250 KN. The member is to be connected to a gusset plate through one of its leg by welding. $f_y=250 \text{ N/mm}^2$, $f_u=410 \text{ N/mm}^2$. Also design the Welded Connection. (Hint: Assume type of section, type of welding).
5. Design a suitable column base for the column 2 ISMB300 placed at 300 mm c/c carrying a factored load of 3400 KN. The column is to be supported on concrete pedestal built with M20 concrete. (Hint: Slab base or Gusset base, type of welding connecting base with column).

23CE603 Estimation and Costing

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Determine the cost of various construction items by integrating both material and labor costs, utilizing standard and detailed specifications and rate analysis.
2. Prepare reinforcement bar bending schedules and quantify steel reinforcement needs for different structural elements.
3. Evaluate the current market value of buildings and infrastructure, considering depreciation to support valuation and investment decisions.
4. Perform detailed estimation of building structures using various methods.
5. Apply legal frameworks and ethical practices in contracts, tenders, and transactions, ensuring compliance with environmental and societal regulations.
6. Develop procurement strategies using basic engineering principles and methodologies.

COs-POs Mappings

COs	PO1	PO2	PO3	PO11	PSO2
1	2	2	3	1	2
2	2	3	3	2	2
3	2	2	3	1	2
4	1	2	2	1	1
5	1	1	2	2	2
6	2	3	3	2	2

3-Strongly linked | 2-Moderately linked 1-Weakly linked

Unit I

Specification and Analysis of Rates

Estimates, types of estimates – approximate and detailed estimate. Specifications – general and detailed specifications. Analysis of rates for various items of works.

Prime cost, Schedule of rates

12 Hours

Unit II

Reinforcement bar Bending Schedules and Valuation of Buildings

Reinforcement bar bending and bar requirement schedules. Valuation of various components of buildings
Scrap value of buildings for different materials, Depreciation

12 Hours

Unit III

Detailed Estimates of Buildings

Estimation of Buildings by using Separate or individual wall method and center line method.

Standard measurement forms, Revised Estimate

12 Hours

Unit IV

Contracts and Tenders

Different types of contracts, their relative advantages and disadvantages, Elements of tender operation, Evaluation of tenders and Award of work. Disputes and arbitration. Legal aspects related to land acquisition,

Tender notice, Responsibility of Engineer

12 Hours

Total: 48 Hours

Textbook (s)

1. B.N. Dutta, Estimating and Costing, 28th Revised Edition, UBS Publishers, 2020.
2. M Chakraborti, Estimating, Costing, Specification & Valuation, Chakraborti Publishers, 2006

Reference (s)

1. Standard Schedule of Rates and Standard data Book, Public Works Department.
2. IS 1200 (Parts I to XXV - 1992/ method of measurement of building and Civil Engineering works - B.I.S.)
3. National Building Code.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	--
Understand	20	20	--
Apply	60	60	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down the unit of 12mm thick plastering work and reinforcement.
2. Enumerates the list of labor required for reinforcement concrete work.
3. Write down the expression related to expected time duration calculation in PERT.
4. Write down the basic essential to draw a network diagram.
5. What do you mean by latest event time?

Understand

1. Analyze the rate for 2.5 cm thick cement concrete flooring with (1:4:8). unit 1 sq.m, take 100 sq.m.
2. Explain general item of work in building and write down its unit.
3. What is the main objective of construction costing and management?
4. What do you mean by analysis of rate? Write down its objectives?
5. 5. With the use of longwall and short wall method find out the quantity of earthwork in excavation in foundation, cement concrete foundation, brickwork in foundation and plinth, 2.5cm thick DPC, brickwork in super structure of a single room building. For calculate the quantity draw the plan and elevation with suitable assumptions?

Apply

1. What is an estimate? Draw the standard measurement form for detail and abstract estimate & also write down the requirements for estimation.
2. Explain general item of work in building and write down its unit.
3. Analyze the rate for 12mm thick cement plastering with (1:6) . unit 1sq.m, take 100 sq.m. With the use of center line method find out the quantity of earthwork in excavation in foundation, cement concrete foundation, brickwork in foundation and plinth, 2.5cm thick DPC, brickwork in super structure of a 2BHK room building. For calculation of quantity, sketch the plan and elevation with suitable assumptions (OBE Test should contain only questions related to Higher Order Thinking (HOT) Skills).
4. A room 300cmx400cm has a flat. There is one T beam in the center(c/s below the slab 20cmx40cm) and the slab is 12cm thick. Estimate the quantity required for reinforcement from the data given below: Main bars (8-19mmØ in 2 rows of 4 each (all 4 in bottom being straight and other bent)), stirrups (8mmØ and 18cm c/c throughout), Anchor bars (2-12mmØ bar).
5. A RCC rectangular beam 25cm widex40cm deepx4.5m overall length is reinforced with 3-20mmØ two outer bar straight and L hooked at ends and inner bar bent up at 45 degree at appropriate places with L hooked ends. At top two outer hanger bars are 16mmØ straight and L hooked at ends. Stirrups are 8mm in Ø and spaced at 180mm c/c.

23CE604 Programming Language Laboratory**00315****Course Outcomes**

At the end of the course, student will be able to

1. Make use of JAVA SDK environment to create debug and run java programs
2. Create applications based on code reusability
3. Develop programs using threads
4. Develop and debug real time problems using exception handling
5. Using IDE, create interactive application as using event handling mechanisms
6. Design Graphical User Interface using AWT components and Swing

CO-PO Mapping

COs	PO1	PO2	PO3	PO5	PO12
1	1	2	2	2	1
2	1	3	3	2	2
3	1	2	2	2	1
4	1	2	2	2	1
5	1	2	3	2	2
6	1	3	2	2	1

3-Strongly linked | 2-Moderately linked 1-Weakly linked

List of Experiments Write Java programs to:

1. Demonstrate the basics of Java using various data types, classes, methods and objects.
2. Demonstrate Call_by_value, Call_by_reference (object reference) methods.
3. Demonstrate overloading methods and constructors methods.
4. Demonstrate Sting handling function in java.
5. Demonstrate the different types of inheritance concept,
6. Demonstrate inheritance concept using method overriding, super & final keywords and runtime polymorphism.
7. Demonstrate the concept of multiple inheritance through interfaces.
8. Implement matrix operations One dimensional, multidimensional arrays.
9. Create a User define package which has classes and methods nad access the package in another package.
10. Extracting tokens using String Tokenizer, String Bulider.
11. Handle checked and unchecked exceptions using try-catch, finally, throw and throws keywords
12. Handle user-defined Exceptions.
13. Demonstrate the concept of multithreading
14. Design a Job Application/ Student Admission Form using awt and applet.
15. Handle simple event to display cut/copy/paste events using Swings.
16. Evaluate the swing components by creating a registration form.

List of Augmented Experiments

1. New Patient Registry Management System
2. Restaurant Billing Management System
3. Library Management System
4. ATM Management System
5. S. Bus Ticket Booking Management System
6. Movie Ticket Booking Management System
7. Queuing Management System
8. Attendance Management System
9. Medical Store Billing Management System
10. Text Editor Projects in java
11. Google e Search Engine Filter
12. Electronic voting System
13. Day Planner
14. Library management System
15. Personal Finance Management System

Total: 48 Hours

23MPX01 Mini Project**0 0 3 1.5****Course Outcomes**

At the end of the course, student will be able to

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation
6. Execute the project in a collaborative environment

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	3	2	-	-	-	-	-	3	3
2	3	3	-	-	3	-	-	-	-	-	-	-	3	3
3	3	3	3	2		-	-	-	-	-	2		3	3
4	-	-	-	-	-	-	-	-	-	3	-	2	3	3
5	-	-	-	-	-	-	-	3	-	-	-	-	3	3
6	-	-	-	-	-	-	-	-	3	-	-	-	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

23ESX02 Employability Skills II

1 0 1 2

Course Outcomes

At the end of the course, student will be able to

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3-Strongly linked | 2-Moderately linked| 1-Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Resume (Recap): Resume? Templates? Mistakes to be avoided in a Resume and Steps to be followed in preparing it.

Group Discussions (Recap) & Practice: GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD?

Practice sessions and sharing Feedback. (Screening sample Videos)

Interview Skills: Interview? Types of Interview, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel? How to handle the Typical Interview Questions? (with Examples)

Mock Interviews: Practice sessions with Feedback.

Exercises related to Communication: Email Writing, Voice Versant, etc.

16 Hours

2. Quantitative Aptitude

Time and Distance, Problems on Trains, Blood relations, Ratio and Proportions, Calendars, Clocks.

16 Hours

Unit II

3. Structural Modeling and Design Lab

- a. Analysis and Design of Simply Supported Beam
- b. Analysis and Design of Cantilever Beam
- c. Analysis and Design of Continuous beam
- d. Analysis and Design of fixed beam
- e. Analysis and Design of 2D RCC and Steel Portal Frame

32 Hours

Total 64 Hours

Reference (s)

1. Shellito, Bradley A., Discovering GIS and ArcGIS, New York, NY : W. H. Freeman : Macmillan Learning, 2017.
2. Mesev, Victor, Integration of GIS and remote sensing, Chichester, England; Hoboken, NJ : Wiley, 2007.

Audit Course**0 0 0 0****Course Outcomes**

At the end of the course, student will be able to

1. Interpret the meaning of values and select their goals by self- Investigation based on personal values activity
2. Interpret the major events and issues related to a period in Indian history
3. Assess the benefits and limitations of science and its application in technological developments towards human welfare
4. Check the awareness regarding basic human rights and to uphold the dignity of every individual
5. Assess the individual and group behaviour, and understand the implications of organizational behaviour on the process of management
6. Determine the appropriateness of various leadership styles and conflict management strategies used in organizations

COs – POs Mapping

COs	PO12
1	3
2	3
3	3
4	2
5	3
6	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

23CEC12 Building Services**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Explain the principles of lighting and design guidelines of natural ventilation.
2. Illustrate the fundamentals of electrical and allied installations.
3. Discuss the HVAC systems and the concepts of sound insulation and noise control.
4. Describe the various plumbing services.
5. Infer the fire safety measures and firefighting systems.
6. Demonstrate the basics of lift, escalators, landscape development and signage structures.

COs-POs Mappings

COs	PO1	PO5	PO8	PO12	PSO2
1	3	3	3	2	2
2	3	3	3	2	2
3	3	3	3	2	2
4	3	3	3	2	2
5	3	3	3	2	2
6	3	3	3	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Lighting, and Natural Ventilation and Electrical Installations**

Lighting and Natural ventilation: Principles of lighting - Measurement of light - Daylighting - Types of Lighting - Design considerations for natural ventilation. Electrical Allied Installations: Basic terminologies - Electrical sources - General Requirements - Planning- Single and Three-phase power supply - Distribution of Supply - Cabling - Wiring - Earthing.

Practical Components:

1. Creating structural model including foundation, column, beam and floor
2. Adding rebar to the foundation and column
3. Adding rebar to the beam and slab
4. Material takeoff and Rebar schedule

12+8 Hours**Unit II****HVAC systems, Acoustics, Sound Insulation and Noise Control**

HVAC Systems: Heating - Heat transfer mechanism - Types of heating. Mechanical Ventilation - Objectives - Types of mechanical ventilation. Air Conditioning: basic refrigeration cycle and its components -Design considerations - Types of air conditioning systems. Acoustics, Sound Insulation and Noise Control: Definition and terminologies - Planning against outdoor and indoor noise - Sound absorbing materials.

Practical Components:

1. Applying diffuser and VAV system
2. Creating duct work for supply system
3. Applying return diffuser with duct work
4. Applying exhaust and AHU with chiller

12+8 Hours**Unit III****Plumbing Services**

Water supply systems: Basic principles - water supply requirements of buildings - water sources and quality - water treatment layout - Water distribution system - Pipe materials. Drainage and Sanitation systems: Different drainage pipe systems - Types of sanitary appliances - Bio-toilet. Solid Waste management: Types of solid waste - SW management systems - Assessment -Treatments. Gas Supply systems, and its regulations.

Practical Components:

1. Applying plumbing fixture
2. Creating water supply systems
3. Creating waste water system
4. Plumbing Schedule

12+8 Hours

Unit IV

Fire safety and miscellaneous services

Fire Safety: Fire Prevention - Grouping of building – Fire Zones – Type of Construction – General requirements. Life Safety: Egress Components. Fire Fighting systems - Installations of Lifts, Escalators and Moving Walks - Information and communication-enabled installations – Landscape planning, Design and development – Signs and outdoor display structures.

Practical Components:

1. Calculating lux value and schedule
2. Applying lighting fixture and switches
3. Creating power system
4. Conduit routing and cable tray designing.

12+ 8 Hours
Total: 48+ 32 Hours

Textbook (s)

1. National Building Code of India 2016-Volume-2, Bureau of Indian Standards.
2. National Building Code of India 2016-Volume-1, Bureau of Indian Standards

Reference (s)

1. Susan Dawson, Architect’s Working Details (Volume 1-10), E- Map Construct; 2004.
2. Landscape Construction, Delmar publisher, 2000.
3. Richardson Dietruck, Big Idea and Small Building, Thames and Hudson, 2002.
4. Nelson L Burbank, House Carpentry Simplified, Simmons-Board- McGraw Hill Publishing Corporation, New York, 1986.
5. Francis. D. K. Ching, Building Construction Illustrated, John Wiley & Sons, 2011.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Recall the principles of good lighting.
2. Relate the concepts of Natural ventilation and sustainability.
3. Define MEP.
4. List the selection criteria of lifts.
5. What is hybrid ventilation?

Understand

1. Demonstrate the various types of escalators.
2. Illustrate heating, ventilation and air conditioning systems.
3. Explain the different water supply and drainage systems.
4. Illustrate the different safety standards against fire prevention.
5. Elaborate different AC Systems.

Apply

1. Build a relation between orientation of building and daylighting.
2. Discuss the requirements of electrical and allied installations of a building.
3. Organize heating systems requirements of a building.
4. Plan AC system requirements of a building.
5. Experiment with water supply and drainage system requirements of a building.

23CEC22 Highway Design and Simulation

3 0 2 4

Course Outcomes

At the end of the course, student will be able to

1. Analyze the design aspects related to expressways.
2. Identify and evaluate the parameters involved in pavement design.
3. Apply the design procedure for high and low-volume flexible pavements as per IRC and low-volume rigid pavements as per IRC.
4. Develop rigid pavement designs for high-volume roads and white-topping overlays according to the latest codes.
5. Describe different types of special pavements and their applications.
6. Plan and design drainage facilities for pavements.

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PSO1	PSO2
1	3	2	3	2	1	3
2	3	3	2	2	2	3
3	3	3	3	3	3	3
4	3	3	3	3	3	3
5	3	2	3	2	2	3
6	3	2	3	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Geometric Design of Expressways: IRC Specification for geometric design of expressways, types and specifications for interchanges , IRC standards and guidelines for design of hill roads.

Practical components

1. Calculation of geometric features of Expressway for 120 kmph design speed.
2. Plotting Marshall curves to find out optimum bitumen content.
3. Calculation of Vehicle Damage Factor for a particular based on traffic load data given.

12+8 Hours

Unit II

Black top pavement design: Road pavements and pavement layers - types, functions, choice, factors affecting design, loads – axle load distribution, ESWL, EWL, VDF due to varying loads. Design of flexible pavements by IRC & AASHTO. Design of flexible pavements for low volume roads.

Practical components

1. To plot the Hand-held GPS coordinates in the Google earth software
2. Plotting gradation curves for single size aggregate gradation for cement concrete pavement according to MoRTH.
3. Plotting gradation curves for single size aggregate gradation for bituminous concrete pavement according to MoRTH.

12+8 Hours

Unit III

White top pavement analysis and design

Types of stresses and causes; Introduction to Westergaard’s equation for calculation of stresses in rigid pavements due to wheel loads and temperature; Considerations in rigid pavement analysis, wheel load stresses, warping stresses, frictional stresses, combined stresses. Design of rigid pavements by IRC procedure. Design of rigid pavements for low volume roads

Practical components

1. Design of flexible pavement according to IRC-37-2001.

IRC-58-2015 Design of flexible pavement

2. To estimate the effective subgrade modulus for flexible pavement design.
3. Design Example to check the Adequacy of Granular Sub-base thickness
4. Design of Bituminous concrete Pavement with Granular Base and Sub-base
5. Computation of Cumulative Fatigue Damage in Cement Treated Base(CTB) Layer
6. Design of Bituminous Pavement with Reclaimed Asphalt Pavement (RAP) material treated with Foamed Bitumen/Bitumen Emulsion and Cemented Sub-base
7. Design of Bituminous concrete Long-life Pavement

12+8 Hours

Unit IV

Special Pavements and drainage

Introduction to Concrete block pavements and design, Semi rigid pavements, perpetual pavements, porous pavements. Significant failures in pavements. Design of Pavement Drainage: Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geo-textiles, pipes. Estimation of inflow, determination of drainage capacity.

Practical components

1. Back calculation of Resilient modulus of the pavement layers from the FWD deflection data using IITKGPBACK-IRC-115-2014.
2. Design of Rigid pavement according to the code IRC-58-2002.
3. Design of Rigid Pavement according to the code IRC-58-2015.

**12+8 Hours
Total: 48+32 Hours**

Textbook (s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019
3. IRC: SP: 99 (2013), Manual of specifications and standards for expressways.

Reference (s)

1. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
2. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
3. IRC: 58 (2015), Guidelines for the design of plain jointed rigid pavements
4. IRC: 37 (2018), Guidelines for the design of flexible pavements
5. IRC: SP 62 (2014), Guidelines for the design and construction of cement concrete pavement for rural roads
6. IRC: SP 72 (2015), Guidelines for the design of flexible pavements for low volume roads

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	20	20	-
Understand	30	30	-
Apply	30	30	100
Analyze	20	20	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List the special considerations for hill roads.
2. What are the effects of temperature on CC pavements?
3. What are methods of flexible pavements design?
4. What are perpetual pavements?

Understand

1. Outline the geometric considerations for urban arterials.
2. Explain VDF and the concept in the determination of the equivalent wheel load.
3. Explain the factors governing the design of flexible pavements for low volume roads.
4. Classify various types of special pavements with their applications.

Apply

1. Determine the EWLF or VDF value of the following two axle loads in terms of the standard axle load of 8.16 t (a) LCV with rear axle load of 1.8t (b) HCV with rear axle load of 16.0 t
2. Design a Bituminous pavement with

3. Granular base and sub-base
4. Cemented base and sub-base with SAMI layer over CT-Base course
Data:
 - a. 4-lane divided carriageway
 - b. Initial traffic in each direction in the year completion of construction = 5500 CV/day
 - c. Design life = 15 years
 - d. Design CBR of subgrade soil = 5%
 - e. Traffic growth rate = 5%
 - f. Vehicle damage factor = 4.5

Analyze

1. Determine the warping stresses at interior, edge and corner of a 26 cm thick cement concrete pavement with transverse joints at 4.50 m interval and longitudinal joints at 3.50 m interval. The modulus of subgrade reaction, K is 20 kg/cm^3 and radius of loaded area is 14 cm. Assume maximum temperature differential during day to be 0.60°C per cm slab thickness (for warping stresses interior and edge) and maximum temperature differential of 0.40°C per cm slab thickness during the night (for warping stress at the corner). Additional data are: $e = 1 \times 10^{-5}/^\circ\text{C}$, $E = 3 \times 10^5 \text{ kg/cm}^2$ and $\mu = 0.13$.
2. The traffic studies and axle load distribution studies carried out during project preparation indicated that there are (i) 9500 vehicles per day with rear axle loads in the range of 2500 to 3500 kg and growth rate of 6.50% per annum and (ii) 1900 heavy vehicles with rear axle loads in the range 11000 to 13000 kg and growth rate of 4.00% per annum. The road pavement is expected to be constructed in a period of 2.50 years after this study and the flexible pavement structure is to be designed for a life of 12 years. Determine value of cumulative standard axles (CSA) used for design.

23CEC32 Environmental Data Analytics and IoT for Smart Monitoring**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Interpret Environmental data fundamentals
2. Apply IoT technologies for environmental monitoring
3. Design and deploy IoT systems for smart monitoring
4. Utilize data analytics and AI for environmental applications
5. Develop data visualization and decision support systems
6. Apply IoT and data analytics to real-world environmental challenges

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO7	PO8	PO11
1	3	2	3	3	3	2	2
2	3	3	3	3	3	2	2
3	3	1	3	3	3	2	2
4	3	1	3	3	3	2	2
5	3	1	3	3	3	2	2
6	3	3	3	3	3	2	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Fundamentals of Environmental Data Analytics and IoT**

Introduction to Environmental Monitoring & Data Analytics: Importance of environmental Monitoring- Overview of environmental parameters (air, water, soil, climate). Basics of IoT in Environmental Monitoring: IoT architecture for environmental Monitoring-Sensors and actuators used in environmental Applications -Case studies: Smart air quality and water quality monitoring. Data Collection & Preprocessing: Sensor data acquisition Techniques-Data storage: Local, Edge, and Cloud Storage.

Practical Components

1. Understand environmental parameters (air, water, soil, climate) and identify appropriate sensors.
2. Interface environmental sensors with microcontrollers and log real-time data.
3. Transmit sensor data using MQTT and HTTP protocols.
4. Store IoT sensor data and clean it for analysis.

12+8 Hours**Unit II****IoT System Design for Smart Monitoring**

Wireless Sensor Networks & IoT Communication: Wireless Sensor Networks (WSN) in environmental Monitoring- Edge vs. Cloud computing for IoT applications. IoT Cloud Platforms & Data Management- Introduction to cloud platforms: AWS IoT, Azure IoT, Google Cloud IoT-IoT data pipeline: Data ingestion, processing, and storage. Security & Ethical Considerations in IoT: Security risks in IoT-based environmental Monitoring-Regulatory policies and compliance (GDPR, environmental regulations)

Practical Components

1. Design a wireless sensor network (WSN) using IoT communication protocols.
2. Upload IoT sensor data to cloud platforms for remote monitoring.
3. Understand data privacy, encryption, and ethical concerns.
4. Execute a Carbon Foot Print analysis using any IoT Sensors

12+8 Hours**Unit III****Data Analytics and AI for Environmental Applications**

Data Analytics Techniques for Environmental Data: Descriptive, predictive, and prescriptive Analytics- Time-series analysis for environmental Data. Machine Learning & AI in Smart Environmental Monitoring: Supervised and unsupervised learning for environmental Applications-Clustering and regression models for air/water quality Prediction-Deep learning for pattern recognition in climate data. Data Visualization & Decision Support Systems: Geographic Information Systems (GIS) and Mapping-Data visualization tools: Power BI, Tableau.

Practical Components

1. Apply statistical techniques to analyze environmental datasets.
2. Build an ML model to detect environmental anomalies.
3. Predict future environmental trends in climate change using time-series analysis.
4. Visualize environmental data on a Geographic Information System (GIS) platform

12+8 Hours

Unit IV

Real-World Applications and Future Trends

IoT-Based Environmental Monitoring Applications: Smart air quality monitoring (PM2.5, CO2, NOx sensors)-Water quality assessment (pH, turbidity, conductivity sensors). Disaster Management & Climate Change Analytics: IoT for flood prediction and early warning systems-AI-driven forest fire Detection. Future Trends in Environmental IoT & Big Data: Blockchain for environmental data security-Role of 5G and Edge AI in environmental IoT.

Practical Components

1. Develop an end-to-end IoT system for environmental air and water quality monitoring.
2. Use AI models to predict disasters (floods, forest fires).
3. Implement block chain for tamper-proof environmental data logging.
4. Prepare an ESG analysis for a corporate companies using datasets.

12+8 Hours

Total: 48+32=80 Hours

Textbook (s)

1. Aliev R. A, and Aliev Rashad, "Soft Computing and its Applications", World Scientific Publications Co. Pte. Ltd. Singapore, 2017.
2. Chepra S. C. and Canele R. P., "Numerical Methods for Engineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2018.
3. Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.
4. Mathews J. H. and Fink K.D. "Numerical methods using MATLAB", Pearson Education 2018.

Reference (s)

1. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
2. 2)OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
3. Vijay Madiseti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
4. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
5. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment (%)
Remember	10	10	-
Understand	10	10	-
Apply	80	80	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the key environmental parameters monitored in environmental data analytics?
2. Define IoT in the context of environmental monitoring.
3. List the different types of data storage used in IoT-based environmental monitoring.
4. Name three cloud platforms commonly used for IoT applications.
5. What are the major risks associated with IoT based environmental monitoring

Understand

1. Explain the importance of environmental monitoring in data analytics.
2. How does IoT architecture support environmental monitoring?
3. Compare Edge computing and Cloud computing in IoT-based environmental monitoring.
4. Describe the role of machine learning in predicting air and water quality.
5. How can Geographic Information Systems (GIS) help in environmental data visualization?

Apply

1. Use IoT sensors to design a basic system for monitoring air quality in an urban area.
2. Implement a data pipeline for environmental monitoring using a cloud platform like AWS IoT or Google Cloud IoT.
3. Apply time-series analysis to predict temperature variations based on climate data.
4. Develop a machine learning model to classify water quality based on pH, turbidity, and conductivity data.
5. Utilize GIS tools to visualize pollution levels across different regions in a city.

Analyse

1. Compare the effectiveness of cloud and edge computing for real-time environmental monitoring.
2. Analyze the impact of different machine learning models on the accuracy of air quality predictions.
3. Examine the security risks associated with IoT-based environmental monitoring and suggest mitigation strategies.
4. Evaluate the role of GIS and data visualization tools in environmental decision-making.
5. Assess the benefits and challenges of using blockchain for environmental data security.

23CEC42 ML for Civil Engineering**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Apply popular machine learning algorithms by leveraging their mathematical foundations to solve real-world problems effectively.
2. Implement supervised learning algorithms in Python using fundamental machine learning libraries (such as scikit-learn, TensorFlow, and PyTorch) for practical applications.
3. Apply ensemble learning strategies to solve complex real-world problems, demonstrating the advantages of model combination techniques like Bagging, Boosting, and Stacking.
4. Use mathematical concepts underlying unsupervised learning algorithms to apply clustering and dimensionality reduction techniques in real-world scenarios.
5. Demonstrate the ability to solve interdisciplinary problems through hands-on applications of unsupervised algorithms, including K-Means, Hierarchical Clustering, and PCA.
6. Apply hyperparameter tuning techniques and select appropriate ML models using methods such as Grid Search, Random Search, and Cross-Validation to address diverse domain-specific challenges.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO10	PO12
1	3	1	1	1	3	1	3
2	3	2	2	1	3	1	3
3	3	3	2	1	3	1	2
4	3	2	2	2	3	1	2
5	2	3	3	2	3	1	2
6	3	3	3	2	3	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**ML Introduction and Supervised Learning**

Introduction to Machine Learning - Supervised and unsupervised learning - Regression and Classification problems - Introduction to Machine Learning - Linear Regression - Multiple Variable Linear Regression - Logistic Regression - Naive Bayes Classifiers - Solving civil Engineering case-studies/problems using Supervised Learning.

Practical Components

1. Take a dataset with missing values or inconsistencies and demonstrate the steps involved in cleaning and integrating the data. Apply techniques such as data imputation, outlier detection, and data standardization to preprocess the dataset
2. Select a dataset with numerical quantities and perform linear regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, MSE or RMSE.
3. Select a dataset and perform Logistic Regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Naive Bayes Classifiers to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours**Unit II****Ensemble Techniques**

k-NN Classification – Normalization and Standardization - Support Vector Machines - Decision Trees - Bagging - Random Forests - Boosting - Solving civil Engineering case-studies/problems using Ensemble Techniques.

Practical Components

1. Select a dataset and perform k-NN Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
2. Select a dataset and perform Support Vector Machines Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
3. Select a dataset and perform Decision Trees to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Bagging and Boosting to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours

Unit III

Unsupervised Learning

K-means Clustering - Hierarchical Clustering - Dimension Reduction - PCA - Solving civil Engineering case-studies/problems using Unsupervised Learning

Practical Components

1. Select a dataset and apply the k-means clustering algorithm to perform clustering for classification purposes. Use evaluation metrics such as silhouette coefficient, cohesion, and separation to assess the quality of the clustering results.
2. Select a dataset and apply the Hierarchical Clustering (Agglomerative) algorithm to perform clustering for classification purposes.
3. Select a dataset and apply the Hierarchical Clustering (Divisive) algorithm to perform clustering for classification purposes.
4. Select a dataset and apply the Principal Component Analysis (PCA) is to reduce the dimensionality of a dataset.

12+8 Hours

Unit IV

Featurisation, Model Selection & Tuning

Feature Engineering - Model Selection and Tuning - Model Performance Measures - Regularising Linear Models - ML Pipeline - Bootstrap Sampling - Grid Search CV - Randomized Search CV - K Fold Cross-validation - Solving civil Engineering case-studies/problems using above method.

Practical Components

1. Select a dataset and perform parameter tuning using Grid Search CV for various ML algorithms.
2. Select a dataset and perform parameter tuning using Randomized Search CV for various ML algorithms.
3. Select a dataset and perform parameter tuning using K Fold Cross-validation for various ML algorithms.
4. Select a data related to Civil Engineering and perform parameter tuning using Grid Search CV and K Fold CV algorithms.

12+8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition

Reference Book (s):

1. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition.
2. Christopher M. Bishop Pattern Recognition and Machine Learning - Springer, 2nd edition
3. Trevor Hastie, Robert Tibshirani, and Jerome Friedman - The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Springer, 2nd edition.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is Machine Learning, and how does it differ from traditional programming?
2. Explain the main types of machine learning paradigms, with a focus on supervised learning.
3. Describe bagging and boosting techniques, and provide an example of when each might be beneficial.
4. Describe the purpose of cross-validation and how it helps in model evaluation.
5. What is feature engineering, and why is it important in machine learning?

Understand

1. How does Random Forest differ from a single Decision Tree, and what are the advantages of using Random Forest?
2. How does clustering work, and what are some common clustering evaluation metrics?
3. Describe three techniques for handling categorical variables during featurization.
4. How do hyperparameters affect a machine learning model's performance, and what are some techniques to tune them effectively?

Apply

1. Use the Random Forest algorithm to classify handwritten digits in the MNIST dataset. Perform model selection by tuning hyperparameters such as the number of trees in the forest and the maximum depth of each tree. Compare the performance of different models using cross-validation and select the best one.
2. Apply K-means clustering to group customers based on their purchasing behavior using an e-commerce dataset. Visualize the clusters and interpret the results to identify distinct customer segments for targeted marketing.

23CE005 Pre Engineered Buildings**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Choose the materials used for Pre Engineered Building
2. Outline the difference between Conventional steel and Pre Engineered building
3. Discuss the primary and secondary main frame system of building components
4. Explain the design of Pre Engineered frame
5. Discuss the influence of various loads on the Pre-Engineered buildings
6. Explain the PEB components and design methodology

COs - POs Mappings

COs	PO1	PO3	PO4	PO12	PSO2
1	2	2	2	3	3
2	2	2	2	3	3
3	2	2	2	3	3
4	2	2	2	3	3
5	2	2	2	3	3
6	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Pre-Engineered Buildings**

Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Practical Components

1. Modeling steel columns
2. Parametric changes in steel columns
3. Column connections
4. Columns schedules

12+8 Hours**Unit II****Pre-Engineered Building Components**

Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal.

Practical Components

1. Modeling steel beams
2. Parametric changes on steel beams
3. Beam connections
4. Beam schedules

12+8 Hours**Design Loads on Pre-Engineered Buildings**

Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code.

Practical Components

1. Modeling PEB building
2. Applying Loads
3. Analysis of PEB buildings
4. Analysis report generation

12+8 Hours**Unit IV****Additional PEB Components and Design Methodology**

Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases.

Guidelines for PEB design, Design codes, Structural design Process loop, optimal structural design

Practical Components

1. Modeling bracings in PEB buildings
2. Modeling sheeting and cladding
3. Modeling Ventilators
4. Modeling staircases

12+8 Hours
Total: 48 + 32 Hours

Textbook (s)

1. L. Mokka, "Prefabricated Concrete for Industrial and Public Structures," Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin, 1971.

Reference (s)

1. B. Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, New York, 1998.
2. Structural Design Manual, Precast Concrete Connection Details, Society for the
3. Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.
4. Hass, A.M. Precast concrete design and Applications, Applied Science Publishers, 1983

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	40	40	50
Understand	60	60	50
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the meaning of Pre Engineering buildings?
2. What are disadvantages of Pre Engineering buildings?
3. List out the technical parameters of PEB?
4. List out the application of PEB.

Understand

1. Explain the different components of Pre Engineering buildings.
2. Explain the different process flow of Pre Engineering buildings.
3. Distinguish the pre-engineered buildings and conventional steel buildings.
4. Explain the various design steps of PEB.

23CE006 Engineering Geology**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Acquire knowledge of the topographical formation, interior earth, earth process, and weathering.
2. Interpret the various types of minerals and assess their physical, mechanical, and engineering properties.
3. Interpret the various types of rocks and assess their physical, mechanical, and engineering properties.
4. Determine geological structures and their relevance to civil engineering projects.
5. Analyze subsurface geological features using geophysical investigation and applications pertinent to civil engineering projects.
6. Application of remote sensing to examine the geological characteristics of a site's viability for civil engineering structures.

CO-PO Mapping:

COs	PO1	PO2	PO6	PO7	PSO1
1	2	2	2	2	1
2	3	2	2	1	1
3	3	3	2	2	2
4	1	3	1	1	1
5	3	2	2	1	3
6	3	2	1	1	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Physical Geology**

Geology in civil engineering – branches of geology – structure of earth and its composition - weathering of rocks – scale of weathering – Earth processes – Work of wind, rivers and sea and their engineering importance. Plate tectonics – Earthquakes – Seismic zones in India.

Practical components

1. **Physical Properties of Minerals:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc...
2. **Physical Properties of Minerals:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc...
3. **Megascopic Identification:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc...
4. **Megascopic Identification:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc.

12+8 Hours**Unit II****Mineralogy and Petrology**

Mineralogy: Definition of mineral, Importance of study of minerals, Physical properties of minerals - Role of study of physical properties in their identification, Study of physical properties of different rock forming mineral groups.

Petrology: Geological classification of rocks - igneous, sedimentary and metamorphic rocks, Different methods of formation of igneous, sedimentary and metamorphic rocks. Description, occurrence, engineering properties, distribution and use of following rocks Granite, Syenite, Diorite, Basalt, Sandstone, Limestone, Conglomerate, shale, Quartzite, Marble, Slate, Gneiss.

Practical components

1. **Megascopic Description and Identification of Rocks:** Igneous Rocks: Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Porphery, Basalt, etc...
2. **Megascopic Description and Identification of Rocks:** Sedimentary Rocks: Sandstone, Ferruginous Sandstone, Limestone, Shale, Laterite, Conglomerate, etc...
3. **Megascopic Description and Identification of Rocks:** Metamorphic Rocks: Biotite, Granite Gneiss, Slate, Muscovite & Biotite Schist, Marble, Khondalite etc...
4. Identification of economic minerals.

12+8 Hours

Unit III

Structural Geology and Geophysical Methods

Attitude of beds – out crop - geological maps – study of structures – folds, faults and joints their bearing on engineering construction. Geophysical methods – Seismic and electrical methods for subsurface investigations

Practical components

1. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
2. Geological cross sections and study of geological maps.
3. Simple strike and dip problems.
4. Simple Structural Geology problems.

12+8 Hours

Unit IV

Application of Geological Investigations

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings – Hydrogeological investigations and mining – Coastal protection structures. Investigation of Landslides, causes and mitigation.

Practical components

1. Simple Problems on Electrical Resistivity.
2. Simple Problems on Seismic Refraction Prospecting.
3. Study of models of geological structures.
4. Study of models of out crops patterns of different types of rocks and land forms.

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. Subinoy Gangopadhyay, Engineering Geology, 1st Edition, Oxford University Press, New Delhi, 2013
2. A.Parthasaradhy, V.Panchapakesan, R.Nagarajan, Engineering Geology, 1st Edition, Wiley Private India Limited, New Delhi, 2013

Reference (s)

1. N Chenna Kesavalu, Text Book of Engineering Geology, 2nd Edition, Trinity Press, Hyderabad, 2014.
2. HalukSucuoglu, SinanAkkar, Basic Earthquake Engineering, 1st Edition, Springer International Publishing, 2014.
3. David George Price, Engineering Geology: Principles and Practice, 2nd Edition, Springer International Publishing, 2009
4. Engineering Geology Lab Manual-Civil Engineering- GMRIT, Rajam

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	20	20	-
Understand	40	40	50
Apply	40	40	50
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is earth structure and its composition.
2. Explain geological classification on earth.
3. Illustrate folds.

Understand

1. Describe remote sensing applications in civil engineering.
2. Illustrate the hydrological investigations on mining.
3. Demonstrate the seismic zones in India.

23CE007 Irrigation and Water Resources Engineering**3 0 2 4****Course Outcomes**

At the end of the course, student will be able to

1. Apply the principles to design lined and unlined canals.
2. Implement the design concepts of diversion headworks and their components.
3. Apply the principles of selection, design, and failure analysis of earth dams.
4. Use design principles to analyze various gravity dams and spillways.
5. Apply the selection criteria of canal outlets, modules, and water conveyance structures.
6. Apply design principles for canal regulators and cross-drainage works.

COs-POs Mappings

COs	PO1	PO2	PO3	PO7	PSO1
1	3	2	2	2	3
2	3	2	3	2	3
3	3	3	3	2	3
4	3	2	3	2	3
5	3	2	3	2	3
6	3	2	3	2	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I**Soil-Water-Plant Relationship and Design of Canals**

Irrigation: Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, water logging and drainage, standards of quality for Irrigation water, principal crops and crop seasons, crop rotation. Vertical distribution of soil moisture, soil moisture tension, Consumptive use, estimation of consumptive use, factors affecting duty, depth and frequency of Irrigation, irrigation efficiencies. Classification of canals, design of canals by Kennedy's and Lacey's theories, canal lining.

Practical Components

1. Design of canal using Kennedy theory.
2. Design of canal using Lacey's theory.
3. Design of lined canal.
4. Design of canal drop.

12+8 Hours**Unit II****Diversion Head Works and Earth Dams.**

Types of Diversion head works-diversion and storage head works, weirs and barrages, layout of diversion head works. Types of dams, merits and demerits, factors affecting selection of type of dam, factors governing selecting site for dam. Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage.

Practical Components

1. Draw the diversion head works with components parts
2. Design and draw the earth dam with main features.
3. Design of tank surplus weir.
4. Design of Tank sluice with tower head.

12+8 Hours**Unit III****Gravity Dams and Spillways**

Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a low gravity dam, stability analysis, drainage galleries. Types of spillways, design principles of Ogee spillways, types of spillway gates.

Practical Components

1. Design and draw the gravity dam with all important features
2. Draw the longitude section and cross section of spillway.
3. Draw the ogee spillways
4. Design of canal regulator and river regulator

12+8 Hours

Unit IV

Canal Falls & Regulation Works and Cross-Drainage Works

Types of falls and their location, design principles of Sardar type fall, trapezoidal notch fall and straight glacis fall. Head regulator and cross regulator, design principles of Cross regulator and head regulators, canal outlets, types of canal modules, proportionality, sensitivity and flexibility. Types, selection of site, design principles of aqueduct, siphon aqueduct and super passage.

Practical Components

1. Draw the layout of cross regulator and head regulator with parent channel
2. Design and draw the cross section and longitudinal section of Aqueduct.
3. Draw the cross section and longitudinal section of super passage.
4. Draw the layout of siphon aqueduct.

12+8 Hours
Total: 48+32 Hours

Textbook (s)

1. S.K Garg, Irrigation Engineering and Hydraulic Structures, 36th Ed., Khanna publishers 2018.
2. K.R.Arora, Irrigation, Water Power and Water Resources Engineering, 5th Revised Ed.2018 , Standard Publications, New Delhi
3. R.K. Sharma and T.K. Sharma, Irrigation Engineering, 1st Ed., S. Chand Publishers, 2017.

Reference (s)

1. G.L. Asawa, Irrigation and Water Resources Engineering, 1st Revised Ed., New Age International Publishers, 2017
2. Varshney, Gupta & Gupta, Theory and Design of Hydraulic Structures, 4th Ed., Nem Chand & Bros, 2007.
3. Satyanarayana Murthy. Challa, Water Resources Engineering, 2nd Ed., New Age International Publishers, 2019

Internal Assessment Pattern

Cognitive Level	Int.Test1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	15	15	-
Understand	20	30	-
Apply	40	30	50
Analyze	25	25	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the importance of the irrigation?
2. Name the components parts of diversion head works.
3. Label the functions of diversion headworks.
4. Select suitable site for diversion head work.
5. Define piping.

Understand

1. Explain Typical Cross-section of gravity dam.
2. Explain Forces Acting on Gravity Dam.
3. Indicate Classification based on purpose.
4. Indicate Classification based on control.
5. Indicate Classification based on prominent feature.

Apply

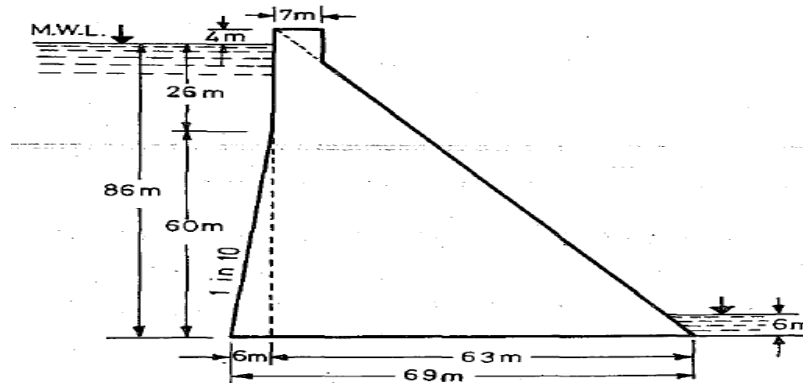
1. Relate Construction of Galleries in Gravity Dams.
2. Examine Gravity Method or Two Dimensional Stability Analysis
3. Relate Functions and Types of Galleries in Dams.
4. An impervious floor of a weir on permeable soil is 16 m long and has sheet piles at both the ends. The upstream pile is 4 m deep and the downstream pile is 5 m deep. The weir creates a net head of 2.5 m. Neglecting the thickness of the weir floor, calculate the uplift pressures at the junction of the inner

faces of the pile with the weir floor, by using Khosla's theory.

5. A concrete gravity dam having the data, maximum allowable compressive stress in concrete is 3000 KN/m^2 , maximum reservoir level 190 m , R.L. of bottom of dam 100 m , specific gravity of concrete 2.4 and unit weight of water 9.8 KN/m^3 . Determine whether the gravity dam is low or high.

Analyze

1. Analyze overturning (or rotation) about the toe.
2. Analyze crushing and development of tension in gravity dams.
3. Analyze shear failure called sliding in gravity dam.
4. Examine the stability of the dam section given in below. Also state that the magnitude of maximum compressive stress and maximum shear stress that may develop under any conditions of loading in the dam and also state whether tension is developed anywhere or not.



5. Compute the suitable cross drainage work for the given data.
 Canal: Full supply level=R.L.213.5, canal bed level=R.L.212.0m, canal water depth=1.5m. Drainage: High flood level 210.0m, high flood depth=2.5m, general ground level=212.5 m.

23CES12 IoT Applications in Building Automation**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply IoT architecture and energy management concepts for smart building automation systems.
2. Implement wireless sensor networks and automation protocols for efficient building management systems.
3. Integrate IoT platforms with BMS for real-time monitoring and cloud-based automation solutions.
4. Apply IoT solutions for occupancy monitoring, fire safety, and water management in smart buildings.
5. Develop IoT-based sustainable solutions, including energy optimization and predictive maintenance systems.
6. Design and evaluate IoT-enabled smart room automation systems for energy-efficient buildings.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO12
1	3	2	3	1	2	3
2	3	3	2	2	3	3
3	2	3	3	3	3	3
4	3	2	2	3	3	3
5	3	3	3	3	3	3
6	3	2	3	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Introduction to Building Automation Systems (BAS)**

Concept and Scope of Building Automation: Definition and importance of building automation, Evolution of building automation technologies, Applications of building automation in residential and commercial buildings. Role of IoT in Smart Buildings: IoT architecture for smart buildings, Real-time monitoring and control of building systems, Integration of IoT with traditional building systems. IoT-Enabled Energy Management Systems: Energy consumption patterns in buildings, IoT-based energy monitoring solutions, Demand-side energy management using IoT. Smart Lighting, HVAC, and Security Systems : IoT applications in lighting control systems, IoT-based HVAC optimization, Security and access control using IoT-enabled systems.

IoT-based HVAC optimization, Security and access control using IoT-enabled systems.

12 Hours**Unit II****IoT-Based Building Management Systems (BMS)**

Architecture and Components of BMS: Overview of BMS architecture, Key components, sensors, controllers, and actuators, Role of cloud computing in BMS. Integration of IoT with BMS: Challenges in integrating IoT with existing BMS, IoT platforms for BMS applications, Case studies on IoT-integrated BMS, Wireless Sensor Networks for Building Automation: Types of wireless sensors used in building automation, Network design considerations for large buildings, Real-time data acquisition and control. Automation Protocols: BACnet, Modbus, KNX, Overview of key automation protocols, Comparison of BACnet, Modbus, and KNX in terms of performance and compatibility, Protocol selection for specific building automation scenarios.

Comparison of BACnet, Modbus, and KNX, Protocol selection for specific building automation scenarios.

12 Hours**Unit III****Smart Building Applications**

Occupancy Monitoring and Space Utilization: Techniques for occupancy detection using IoT, Space optimization strategies based on IoT data, IoT-based smart scheduling and room allocation systems. IoT-Enabled Fire and Safety Systems: Fire detection technologies integrated with IoT, Emergency response

automation using IoT networks, IoT for building evacuation and disaster management. Water Management and Leak Detection Systems: IoT-enabled smart water metering, Leak detection algorithms and real-time notifications, Automated water distribution control systems. Case Studies: Smart Homes, Smart Campuses, and Commercial Buildings : Analysis of successful IoT implementations, Challenges and solutions in scaling IoT solutions, Lessons learned from real-world projects

Case Studies: Smart Homes, Smart Campuses, and Commercial Buildings, Analysis of successful IoT implementations, Challenges and solutions in scaling IoT solutions.

12 Hours

Unit IV

IoT for Sustainable and Green Buildings

IoT Applications for Energy-Efficient Building Design: Strategies for reducing energy consumption, IoT-enabled renewable energy integration, Case studies on zero-energy buildings, Predictive Maintenance Using IoT: Predictive analytics for building maintenance, Role of AI and ML in IoT-based maintenance systems, Case studies on cost savings through predictive maintenance. Role of IoT in LEED Certification and Green Rating Systems: LEED certification process and criteria, How IoT helps achieve green building certifications, IoT for continuous performance tracking in certified buildings. Hands-On: Designing an IoT-Based Smart Room Automation System: Project planning and hardware selection, Programming IoT devices for room automation, Testing, deployment, and performance evaluation of the designed system.

Role of IoT in LEED Certification and Green Rating Systems: LEED certification process and criteria.

12 Hours

Total: 48 Hours

Textbook(s)

1. Wendell Odom, "Building Automation Systems A to Z: How to Survive in a World Full of BAS," 1st Ed., CreateSpace Independent Publishing Platform, 2019.
2. Shengwei Wang, "Intelligent Buildings and Building Automation," 1st Ed., Spon Press, 2009 .

Reference(s)

1. Panagiotis Demestichas, "IoT for Smart Buildings: Applications, Architectures, and Technology," Elsevier, 2021
2. Raj Pandya, "Mobile and Wireless Network for IoT Applications," Springer, 2020 -
3. Dean Anthony Gratton, "Building Smart Homes with Raspberry Pi Zero," Packt Publishing, 2016
4. Daniel Watzenig and Martin Horn, "Automated Driving Safer and More Efficient Future Driving," Springer, 2016 .

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. List three primary functions of IoT in smart building automation.
2. Identify four common IoT-enabled systems used in commercial buildings.
3. Define Building Management Systems (BMS) and its purpose in modern infrastructure.
4. Name two widely used automation protocols in building automation.

Understand

1. Explain how IoT architecture facilitates energy management in smart buildings.

2. Illustrate the integration of IoT with traditional building management systems.
3. Describe the role of wireless sensor networks in building automation.
4. Summarize the benefits of using Modbus protocol over BACnet in specific scenarios.

Apply

1. Develop a simple IoT solution for monitoring and managing HVAC systems in a commercial building.
2. Design a network layout using wireless sensors for a large residential building to enhance security and safety.
3. Create a system diagram that integrates IoT platforms with a cloud-based building management system.
4. Implement a basic data analysis tool for predicting energy consumption patterns in smart buildings.

Analyze

1. Compare the effectiveness of Zigbee and Wi-Fi technologies in the context of large-scale building automation.
2. Analyze the impact of real-time occupancy monitoring on energy efficiency in office buildings.
3. Discuss the advantages and potential challenges of integrating IoT with existing BMS in old buildings.
4. Differentiate between reactive maintenance and predictive maintenance in the context of IoT applications.

Evaluate

1. Evaluate the potential of IoT-based systems to improve LEED certification scores for commercial buildings.
2. Assess the role of IoT in enhancing fire safety and emergency response mechanisms in high-rises.
3. Critically appraise the use of IoT in water management systems for reducing overall water usage.
4. Determine the feasibility of zero-energy building projects supported by IoT-enabled devices.

23CES22 Database Management Systems for Data Science (SQL & Oracle)

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Apply fundamental SQL operations, including queries, joins, and aggregate functions, to manage and retrieve structured data efficiently.
2. Implement constraints, indexing, and transaction control mechanisms to optimize database performance and ensure data integrity.
3. Develop and execute PL/SQL programs, including stored procedures, triggers, and error-handling techniques, for robust database applications.
4. Apply NoSQL database techniques using MongoDB and Big Data storage frameworks like HDFS to handle unstructured and large-scale datasets.
5. Implement ETL processes using SQL for data extraction, transformation, and loading to support decision-making in data warehousing.
6. Utilize cloud-based database solutions (AWS RDS, Google BigQuery, Azure SQL) for scalable and distributed data management in real-world applications.

COs-POs Mapping

COs	PO1	PO2	PO3	PO5	PO12
1	3	2	2	3	2
2	3	3	2	3	2
3	3	3	3	3	2
4	3	2	3	3	2
5	3	2	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Databases and SQL

Fundamentals of Databases: RDBMS vs NoSQL. Database Design: Schema, Tables, Primary and Foreign Keys, Basics of SQL: SELECT, INSERT, UPDATE, DELETE Statements. SQL Joins: INNER, LEFT, RIGHT, FULL Joins. Subqueries and Aggregate Functions (COUNT, SUM, AVG, MIN, MAX).

RDBMS vs. NoSQL in modern applications, Importance of normalization in database design.

12 Hours

Unit II

Advanced SQL and Oracle

Constraints and Indexing in SQL. Stored Procedures, Functions, and Triggers. Transactions and Concurrency Control. Oracle SQL: PL/SQL Introduction, Anonymous Blocks, Cursors. Error Handling in SQL and PL/SQL

Role of indexing in query optimization, Differences between SQL Transactions and ACID properties

12 Hours

Unit III

NoSQL Databases and Big Data Storage

Introduction to NoSQL: Key-Value, Document, Column-Family, Graph Databases. MongoDB Basics: CRUD Operations, Indexing, Aggregation Framework. Comparison of SQL vs NoSQL in Data Science Applications. Basics of Big Data Storage: HDFS, Apache Hive, Apache HBase

Use cases of different NoSQL database types, Scalability challenges in Big Data storage

12 Hours

Unit IV

Data Warehousing and ETL

Concept of Data Warehousing and OLAP. ETL Process: Extract, Transform, Load. Data Cleaning and Transformation Using SQL. Basics of Cloud Databases (AWS RDS, Google BigQuery, Azure SQL). Case Studies on DBMS Applications in Engineering.

Significance of OLAP in business intelligence, Comparison of cloud databases

12 Hours

Total : 48 Hours

Textbooks

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts," 7th Edition, McGraw-Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems," 7th Edition, Pearson, 2015.

Reference Books

1. Ben Forta, "SQL in 10 Minutes, Sams Teach Yourself," 5th Edition, Pearson, 2020.
2. Mick Thompson, "SQL and NoSQL: Managing Data in the Cloud," O'Reilly, 2016.
3. Kristina Chodorow, "MongoDB: The Definitive Guide," 3rd Edition, O'Reilly, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	10	-
Understand	40	40	-
Apply	50	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. Define SQL and list its key features.
2. What are the different types of database models?
3. Describe the difference between a primary key and a foreign key.
4. List different types of SQL joins with examples.
5. What are aggregate functions in SQL? Provide examples.

Understand

1. Explain the differences between RDBMS and NoSQL databases.
2. How do constraints improve database integrity? Provide examples.
3. Explain the working of stored procedures and their advantages.
4. Discuss the role of indexing in SQL databases.
5. How does MongoDB differ from relational databases?

Apply

1. Write an SQL query to retrieve all employees earning more than the department average salary.
2. Implement a PL/SQL stored procedure to update a customer's order status.
3. Develop a MongoDB query to find all products with a price greater than \$100.
4. Use SQL to perform data cleaning by removing duplicate records from a table.
5. Implement a simple ETL process using SQL to extract and transform data for reporting.

23CES32 Design Thinking and Innovation Management**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply the processes involved in idea productization.
2. Play the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
3. Ability to create and coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
4. Analyse, synthesize and evaluate financial and other related information for decision making in an entrepreneurial context.
5. Personal transferable skills in analysis and reasoning, teamwork and project reporting.
6. Identify key drivers of growth in a venture and develop a growth mind set.

COs-POs Mapping

COs	PO2	PO3	PO5	PO11	PO12
1	2	3	3	3	3
2	2	1	1	3	3
3	2	1	2	3	3
4	2	2	2	3	3
5	1	1	3	3	3
6	1	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Design Thinking**

Meaning of Design Thinking, The rise of Design Thinking Market Research, Practical insights into conducting marketing research, , Design thinking for competitive advantage. Power of Design Thinking in Entrepreneurship - The Need for Creative and Design, Thinking Mental Models of Creativity, Design Thinking in Entrepreneurship, Why design needs entrepreneurial mindset, combining entrepreneurial and design thinking, The seven steps of design thinking, Creative Thinking. Open Innovation, creative solutions to issues facing organizations, Company culture and architecture, from design thinking to funding.

Human-Centered Design (HCD)- Cognitive Biases and Their Impact on Creative Thinking

12 Hours**Unit II****Design Thinking Paradigm for Strategic Innovation**

Strategies for creating value - Increment Value or True value creation, Design Thinking as a paradigm for innovation strategy, Design Research for understanding the needs of our users and clients, Theories of Innovation, Technology Forecasting, Conducting analysis - Economic justification, First Mover and late mover Advantage, Organizations and Innovation Process, Diffusion of Innovation. Case studies - How Indra Nooyi Turned Design Thinking Into Strategy P&G, Pfizer, IDEO – SHIMANO.

Blue Ocean Strategy- Systems Thinking and Its Integration

12 Hours**Unit III****Productizing Startup Ideas - Product / Service Business Model Design**

Lean start-up techniques for the design and refinement of business models. Customer Experience Strategy. From the Design of Services to Business Design. Customer Discovery & Validation. Business Model Canvas. How to create a winning Business Model Design & Lean Startup. Canvas Value Proposition. Lean Startup Machine. Hambrick and Fredrickson Strategy and Prototyping. Design thinking process in new product development, Three Box Model solution: strategy for innovation, Case study discussion - Vijay Govindrajan's - Reverse Innovation.

Agile Methodology for Product Development- Behavioral Economics

12 Hours

Unit IV

Design Thinking Framework

Conducting market research for new a product offering, Levels of Product / Service, Identifying stakeholder needs for Product/service innovation. obtaining Insights, personal techniques and Foresight of Future Scenarios. Concept generation, Identifying new business opportunities based on market needs – from product to service design, Designing and testing breakthrough concepts. Assign Teams and Introduce Small projects with Design Thinking framework – empathize, define, ideate, prototype and test.

Neuroscience of Creativity- Sustainable Design Thinking

12 Hours

Total: 48 Hours

Text Books

1. Jeanne Liedtka, Andre King, and Kevin Bennett (2013), Solving Problems with Design Thinking, Columbia Business School Publishing.
2. Shrutin N Shetty, (2018), Design the Future: Simplifying Design Thinking to Help You, Notion Press

Reference Books

1. Madhavan Ramanujam, Georg Tacke
2. The Three-Box Solution: A Strategy for Leading Innovation By Vijay Govindarajan
3. Design Thinking: New Product Development Essentials from the PDMA, By Abbie Griffin, Michael G. Luchs, and Scott Swan
4. Harvard Business Review case studies, <https://hbr.org/store/case-studies>
5. Case Centre, <https://www.thecasecentre.org/main>
6. Sketching User Experiences: Getting the Design Right and the Right Design, Bill Buxton.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the meaning of Design Thinking, and why is it important?
2. List the seven steps of Design Thinking and briefly describe each.
3. What are the key differences between incremental value creation and true value creation in innovation?
4. Define the Business Model Canvas and list its components.
5. What are the major theories of innovation used in strategic design thinking?

Understand

1. Explain how Design Thinking can be used as a tool for gaining a competitive advantage in entrepreneurship.
2. Describe the role of company culture and architecture in fostering open innovation.
3. Compare and contrast first-mover advantage and late-mover advantage with examples from industry.
4. How does customer discovery and validation impact the success of a startup business model?
5. Discuss how the Design Thinking framework (empathize, define, ideate, prototype, and test) helps in new product development.

Apply

1. Given a new product idea for an eco-friendly water bottle, apply the Design Thinking framework to develop the product.
2. Conduct an economic justification analysis for launching an innovative food delivery service in a rural area.
3. Identify an existing business challenge in an e-commerce company and propose a design thinking-based solution to improve customer experience.
4. Develop a Lean Startup Canvas for a mobile healthcare application that monitors elderly patients remotely.
5. Using Vijay Govindarajan's Reverse Innovation model, propose an innovative low-cost medical device for emerging markets

23CES42 Safety in Construction

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Identify the causes of accidents in construction and apply safety management systems to mitigate risks.
2. Analyse various hazards in construction activities and implement preventive measures to ensure worker safety.
3. Evaluate safety protocols for specialized construction tasks, such as tunnelling, blasting, and high-rise building construction.
4. Implement fall protection measures and safety protocols for working at heights in construction projects.
5. Assess safety requirements for the selection, operation, and inspection of construction machinery such as cranes, hoists, and earth-moving equipment.
6. Apply safety standards and best practices in handling portable electrical tools and heavy construction equipment to prevent accidents.

COs-POs Mapping

COs	PO1	PO2	PO6	PO8	PO12
1	2	2	1	1	2
2	2	3	3	2	2
3	2	2	2	1	2
4	3	1	3	1	2
5	3	2	2	2	3
6	3	3	2	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Accidents Causes and Management Systems

Problems impeding safety in construction industry - causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident - construction regulations, contractual clauses -Pre contract activates, preconstruction meeting - design aids for safe construction - permits to work - quality assurance in construction – compensation - recording of accidents and safety measures - education and training.

Behavior-Based Safety (BBS) in Construction- Emergency Response Planning in Construction

12 Hours

Unit II

Hazards of Construction and Prevention

Excavations, basement and wide excavation, trenches, shafts - scaffolding , types, causes of accidents, scaffold inspection checklist - false work - erection of structural frame work, dismantling - tunneling - blasting, pre blast and post blast inspection- confined spaces - working on contaminated sites - work over water - road works - power plant constructions – construction of high rise buildings.`

Safety in Demolition Activities- Fire Safety in Construction Sites

12 Hours

Unit III

Working at Heights

Fall protection in construction OSHA 3146 - OSHA requirement for working at heights, Safe access and egress - safe use of ladders - Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps - fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems - working on fragile roofs, work permit systems, height pass - accident case studies.

Use of Advanced Fall Protection Systems- Weather-Related Risks in Working at Heights

12 Hours

Unit IV

Safety in Construction Machinery

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist -builder’s hoist, winches, chain pulley blocks - use of conveyors - concrete mixers, concrete vibrators - safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes - use of conveyors and mobile cranes -manual handling.

Automation and AI in Construction Safety- Noise and Vibration Hazards in Construction Machinery

12 Hours

Total: 48 Hours

Textbook (s)

1. Rita Yi Man Li, Sun Wah Poon, Construction Safety, Springer Heidelberg New York, Dordrecht London, First Edition,2013.
2. Safety Handbook for the Building and Construction, Incolink (Australian construction association), Australia, First Edition, 2013.
3. Charles D. Reese and James V. Edison, Handbook of OSHA Construction safety and health, CRC press, UK, Second Edition, 2006.

Reference (s)

1. Jnathea D. Sime, Safety in the Build Environment, London, Second Edition, 1988.
2. Davies, V.J., and Thomas, K., Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
3. Hudson, R., Construction hazard and Safety Hand book, Butter Worth’s, New Delhi, Second Edition, 1985.
4. J. Uma Maheswari, Professor, Department of Civil Engineering, IITD, Safety in Construction, NPTEL Course, <https://archive.nptel.ac.in/courses/105/102/105102206/>

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question(s)

Remember

1. What are the primary causes of fatal accidents in the construction industry?
2. Define scaffolding and list its types used in construction.
3. What are the OSHA requirements for working at heights in construction?
4. List different types of construction machinery used in high-rise building projects.

Understand

1. Explain the importance of pre-construction safety meetings in accident prevention.
2. How do scaffolding inspection checklists help in ensuring workplace safety?
3. Describe the role of safety belts, nets, and fall arrestors in preventing falls from heights.
4. Explain the significance of crane inspection checklists in construction machinery safety.

Apply

1. Given a case study of a construction site accident, analyze the possible human and environmental factors contributing to the incident.
2. Design a step-by-step safety protocol for excavation work to prevent hazards.
3. Develop a fall protection plan for workers engaged in roof construction activities.
4. Demonstrate the correct safety procedures for operating mobile cranes on a construction site.

23CES52 Sustainable Urban Planning and Development**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Explain the principles of sustainable urban planning, urbanization, and environmental justice.
2. Assess the effectiveness of smart growth, resource management, and sustainable city models in managing urban sprawl and energy use.
3. Apply assessment tools, green building frameworks, and transportation strategies to develop resilient urban spaces.
4. Assess urban heat islands, extreme weather, and vulnerabilities, and identify resilience strategies.
5. Identify sustainable practices like the 3Rs, non-conventional energy, and compact city models to reduce environmental impact.
6. Examine global and local urban sustainability policies governance frameworks, and emerging AI-driven innovations to develop resilient and smart cities for sustainable urban development.

COs-POs Mapping

COs	PO1	PO2	PO3	PO5	PO6	PO7	PO12
1	3	2	1	1	2	3	3
2	3	2	2	3	3	2	3
3	2	2	3	3	1	3	3
4	3	2	3	2	2	2	3
5	2	1	2	2	2	3	3
6	3	1	3	3	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Foundations of Sustainable Urban Development**

Introduction to Sustainable Urban Development – Definition, concepts, and principles; Trends in Urban Population – Urbanization trends, growth of mega-cities, and regional differences; Measuring Sustainability in Cities – Sustainability indicators and assessment; Principles of Sustainable Planning – Three pillars of sustainability, walkability, connectivity, and community integration; New Sustainable Cities and Future Directions – Case studies of sustainable city models.

Environmental Justice & Social Sustainability – Environmental health risks, vulnerable populations, and urban equity

12 Hours**Unit II****Sustainable Urban Growth and Resource Management**

Urban Sprawl and Smart Growth – Causes, trends, and strategies for controlling sprawl; Sustainable Energy in Cities – Energy consumption trends, alternative energy sources, and policy frameworks; Sustainable Use of Materials & Waste Management – Waste production, eco-efficiency, and circular economy principles; Sustainable Water Use & Management – Water treatment, scarcity, pollution, sanitation, case studies; Green Buildings & Urban Design – LEED framework, energy-efficient buildings, role in sustainability.

Sustainable Transportation – Urban mobility, public transport, air pollution

12 Hours**Unit III****Climate Change and Urban Resilience**

Climate Change and Urban Impact – Urban heat islands, extreme climate events, vulnerability of cities, climate change impact on cities (sea-level rise, extreme weather, temperature shifts); Low Carbon Urban Development Strategies – 3Rs concept, non-conventional energy, compact cities, mobility solutions; Urban Environmental Management – Human activity impact, greenhouse gases, ecological footprint analysis; Carrying Capacity-Based Planning – Concept, parameters, and sustainability indicators.

Pollution Control Measures – Air, water, industrial waste, and noise pollution management

12 Hours

Unit IV

Policy, Governance, Reforms and Future Trends in Sustainable Urbanism

Global and Local Urban Sustainability Policies – Kyoto Protocol, IPCC, UN-Habitat, Reforms in Urban Planning Capacity in India, SDGs; Intergovernmental and National Frameworks – UNEP, Clean Development Mechanism, Indian Network on Climate Change; Strategic Environmental Assessment for Urban Areas – Environmental impact assessment, life cycle analysis; Resilient and Smart Cities – Use of AI, IoT, big data for sustainable urban governance.

Future Trends in Sustainable Development – Innovations, AI-driven sustainability; Regenerative cities

12 Hours

Total: 48 Hours

Textbook (s)

1. Pattanaik, B. K. (2020). Introduction to Urban Development and Planning. SAGE Publications Incorporated.
2. Sen, J. (2013). Sustainable urban planning. The Energy and Resources Institute (TERI).
3. Rao M. P. (2019). Urban planning: Theory & Practice. New Delhi: CBS Publishers.

Reference (s)

1. Vaidya, C. (2009). Urban issues, reforms, and way forward in India. Department of Economic Affairs, Ministry of Finance.
2. Aayog, N. I. T. I. (2021). Reforms in Urban Planning Capacity in India. Sustainable urban planning. Government of India (GoI).

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define sustainable urban development
2. What is urban sprawl?
3. List the factors contributing to urban heat islands.
4. What are SDGs related to urban sustainability?
5. Identify key factors contributing to urbanization.

Understand

1. Explain the principles of walkability and connectivity.
2. Discuss why sustainability indicators are essential in urban planning.
3. Describe the importance of circular economy principles.
4. Explain the 3Rs concept in urban development.
5. Discuss the role of IoT in smart city development.

Apply

1. Develop a sustainable waste management plan for a small urban locality.
2. Develop a checklist for evaluating urban sustainability.
3. Design a sustainable pollution control plan for an industrial zone.
4. Propose a policy intervention to improve resilience in a coastal city.
5. Apply the 3Rs principle to a residential area.

23PWX01 Project Work

0 0 16 8

Course Outcomes

At the end of the course, student will be able to

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended.
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation.
6. Execute the project in a collaborative environment.

COs -POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				3	2						3	3
2	3	3			3								3	3
3	3	3	3	2							2		3	3
4										3		2	3	3
5								3					3	3
6									3				3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

23SIX02 Summer Internship II**0 0 0 1****Course Outcomes**

At the end of the course, student will be able to

1. Demonstrate communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs -POs Mapping

COs	PO1	PO2	PO5	PO6	PO10	PO12
1					3	
2	3	1				
3	3					
4	3	1	3			2
5	3	1	3	3		1
6	3	1	3			1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

23CEC13 Building Information Modeling

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Implement the AEC business model and apply BIM processes in real-world scenarios.
2. Utilize different BIM dimensions with appropriate software tools for project applications.
3. Apply facility management systems to meet stakeholder requirements effectively.
4. Demonstrate BIM applications for efficient construction management.
5. Use life cycle assessment techniques to evaluate sustainability in construction projects.
6. Integrate life cycle assessment with BIM to enhance decision-making and project efficiency.

COs-POs Mapping

COs	PO1	PO2	PO5	PO12	PSO1
1	1	3	2	2	3
2	2	2	3	1	3
3	1	3	2	2	2
4	1	2	3	2	3
5	2	3	3	1	2
6	1	2	3	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to BIM

The Current AEC Business Model - New Tools and New Processes in BIM - BIM as a Lifecycle Platform - Benefits of BIM - Challenges in BIM – The concept of different dimensions - Core Technologies and Software- Collaboration and Interoperability.

Benefits of BIM; Impacts of BIM in design; Hardware system requirements.

12 Hours

Unit II

Facility Management System

BIM for owners: owner’s role in BIM project – Cost and Time management – BIM implementation on project – Barriers and issues in implementation BIM on projects. BIM for Architects and Engineers: BIM use in design process – Building models and libraries. BIM for contractor, sub-contractors and fabricators.

Facility and Information Asset Management; Visualization and Coordination.

12 Hours

Unit III

BIM for Construction Management

Value – Role – Scheduling and controlling schedules– Logistics – Estimating cost and controlling cost – Constructability – Analyzing data in BIM – Material management- Tracking equipment – Managing facilities – Level of development - Model-based coordination.

BIM 360 document management; Common data environment.

12 Hours

Unit IV

Life Cycle Assessment and BIM

Introduction of LCA – History of LCA – Methodology – life cycle impact assessment – Life cycle interpretation analysis - LCA on construction and demolition waste management – Integrating LCA and BIM – SWOT analysis on integration – The relation between LCA and BIM for sustainable construction- Calculate the CO₂ and GWP emissions of construction materials.

Embodied energy; the relation between CO₂ emission and LCA

12 Hours

Total: 48 Hours

Textbook (s)

1. Rafael Sacks, Charles Eastman, Ghang Lee, Paul Teicholz (2011). BIM handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers. Third Edition, John Wiley & Sons.
2. Brad Hardin, Dave McCool (2015). BIM and construction management: proven tools, methods, and

workflows. Second Edition, John Wiley & Sons.

Reference (s)

1. Paul Teicholz, BIM for Facility Managers, John Wiley & Sons (2013).
2. Raja. R.A. Issa, Svetlana Olbina, Building Information Modeling: Application and Practices, ASCE publications (2015).
3. Laura Alvarez Antón, Joaquín Diaz, Integration of LCA and BIM for Sustainable Construction, World Academy of Science, Engineering and Technology, International Journal of Civil and Environmental Engineering Vol:8, No:5, 2014.
4. Mark Kyeredey Ansah, Xi Chen, Hongxing Yang, Lin Lu a, Patrick T. I. Lam, Developing an automated BIM-based life cycle assessment approach for modularly designed high-rise buildings, Environmental Impact Assessment Review 90 (2021) 106618.
5. Ruben Santos, Antonio Aguiar Costa, Jose D. Silvestre, Thomas Vandenberg, Lincy Pyl, BIM-based life cycle assessment and life cycle costing of an office building in Western Europe, Building and Environment 169 (2020) 106568.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	40	-
Understand	60	60	100
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Explain the AEC model.
2. What is a facility management system?
3. Give your opinion on controlling schedules.
4. Illustrate the concept of life cycle assessment.
5. Infer the concept of interoperability.

Understand

1. Demonstrate the different dimensions of BIM.
2. Describe the different libraries in BIM.
3. Illustrate the concept of level of development.
4. Summarize the integration process of LCA and BIM for G+5 story residential building.
5. Examine the facility management system for an assumptive commercial building.

23CEC23 Highway Project Formulation and Economics**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply the concepts of economic evaluation and prepare a detailed project report.
2. Evaluate the computation of road user costs for assessing highway projects.
3. Analyze the basic methods of economic analysis used in transportation engineering projects.
4. Assess the feasibility of transportation projects using economic, toll, and financial methods.
5. Explain the significance of Environmental Impact Assessment (EIA) in transportation engineering projects.
6. Identify key environmental impact assessment factors for highway projects.

CO-PO Mapping

COs	PO1	PO2	PO6	PO12	PSO1
1	3	2	1	1	2
2	3	2	2	1	2
3	3	3	3	1	2
4	3	2	2	1	2
5	3	2	2	1	2
6	3	2	1	1	3

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Project Formulation and Preparation of DPR**

Requirements in project formulation; Criteria fixation; Components of project; Non-monetary and monetary Criteria in formulation of project; Decision making Criteria input in Project formulation. DPR – Guidelines; Transport Projects and development of cash flow diagrams; Cost and benefit components; Discounting criteria; Preparation of Project; Highway Planning; Traffic infrastructure; Project formulation; Road Network project development; Need for Economic Evaluation; Principles of economic evaluation; Welfare economics; Social costs, Vest change, Rate of return.

*Road network in India. EMI, Compound Interest***12 Hours****Unit II****Road user costs**

Value of Travel time Savings; Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs; Components of VOC, Road User Cost study in India; Accident costs; Methodologies for economic evaluation of an accident; Factors involved, Basic methods of economic analysis.

*EEE measures to reduce accidents, Travel time reliability.***12 Hours****Unit III****Basic methods of economic and financial analysis**

Equivalent Uniform Annual Cost Method; Present worth of cost method; Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method; Applications of these methods to highway projects; Project appraisal by shadow pricing with case studies. Toll system analysis, Financial analysis; Budgeting.

*Rate of Interest, Inflation, Salvage value, Monopoly***12 Hours****Unit IV****Environmental impact assessment**

Basic Concepts, Objectives, Transportation Related Environmental Impacts; Vehicular Impacts; Safety and Capacity Impacts; Roadway Impacts; Construction Impacts; Environmental Impact Assessment; Environmental Impact Statement, Environment Audit, Typical case studies.

*Distinguish EIA and SEA (Strategic Environmental Assessment)***12 Hours****Total: 48 Hours****Textbook (s)**

1. Transportation Engineering Economics by Heggie. I. G.; Mc Graw Hill Publishers, 1972.
2. Economic Analysis for Highways by Winfrey. R; International Textbook; 1st edition, 1969

Reference (s)

1. Traffic Engineering and Transport Planning by L.R Kadiyali, Khanna Publishers, 2000
2. Road User Cost Study, CRRRI
3. IRC: SP: 30-1993, Manual on Economic Evaluation of Highway Projects in India, IRC Publications, New Delhi.
4. IRC: SP: 19; 2001, Manual for Survey, Investigation & Preparation of Road Projects, IRC Publications, New Delhi.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	60	60	20
Apply	30	30	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)**Remember**

1. What is project formulation?
2. Define DPR.
3. List out any four DPR requirements.
4. What is cashflow diagram?
5. What is EIA?

Understand

1. Distinguish between monetary and non-monetary benefits.
2. Differentiate between Economical and financial analysis.
3. Explain the difference in the Shadow pricing and salvage value.
4. Explain the concept of budgeting.
5. Discuss shadow pricing with suitable case studies.

Apply

1. What is the amount of Rs.1000, compounded at (a) 6% per annum (b) 6% per every quarter, for 10 years?
2. What is the effective interest rate, when a sum of money is invested at a nominal interest rate of 10% per annum, compounded annually, semi-annually, quarterly, monthly and daily?
3. If the interest is 5% per annum, what sum would accumulate after 6 years, if Rs.1000 were invested at the end of each year for 6 years?
4. A parent wishes to establish college amount for a new born child. The parent estimates the education will cost Rs. 4,00,000, 18 years from now. If the interest on the account is guaranteed at 8% indefinitely, how much money must be invested today to have 4lakhs rupees on the child 18th birthday.
5. A realtor buys a house for Rs. 2,00,000 and spends Rs.1000per year on maintenance for the next 8 years. For how much should he sell the property to make a profit Rs.40,000. Assume $i=12%$ per annum.

23CEC33 Pollution Control and Waste Management**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Identify major sources of pollution and assess their effects on human health and ecosystems.
2. Assess various methods for removing pollutants from gaseous effluents and particulate matter.
3. Evaluate the Role of Regulatory Bodies in Pollution Control
4. Classify various types of handling hazardous waste
5. Plan suitable treatment facility for handling hazardous wastes
6. Identify various components of Regulatory and legal frameworks in Waste Management

COs-POs Mapping

COs	PO3	PO6	PO7	PO8	PO12
1	1	1	2	2	2
2	2	2	3	2	2
3	2	2	3	3	3
4	2	2	3	3	2
5	2	1	2	3	2
6	2	1	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to pollution and its removal**

Definition and types of pollution (air, water, soil, noise, thermal, radioactive)-Sources and effects of pollution on human health and ecosystems-Global and regional pollution concerns-Concept of sustainability and pollution prevention strategies- Methods for removal of pollutants from gaseous effluents; particulate matter, waste water treatment Activated sludge process. Removal of Nitrogenous pollution, Removal of nitrogen; physico-chemical processes; biological method of pollution control. Analytical methods of small amount of the metal pollutants; removal and recovery techniques of heavy metals.

Role of Nanotechnology in Pollution Control-Phytoremediation:

12 Hours**Unit II****Regulatory Aspects and legislations**

Industrial Emissions Liquids and gasses; pollution caused by various chemical industries and its overall effect on quality of human life and the environment, water quality management in India-Role of regulatory bodies (Central Pollution Control Board - CPCB, State Pollution Control Boards - SPCBs, Ministry of Environment, Forest and Climate Change - MoEFCC)- MINAS for sugar industries, distilleries, pesticides industry and mercury from caustic soda industry, , Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, National and International conventions and agreements on environment.

Extended Producer Responsibility (EPR) in Waste Management-Environmental Regulations

12 Hours**Unit III****Solid waste Management**

Sources and types of municipal solid waste – Waste generation rates- Methods of sampling- Elements of solid waste management – Municipal solid waste rules – Role of NGO's, EPA- Source reduction of waste – Reduction, Reuse, Recycling and Recover – Segregation of wastes at source – Onsite storage methods- Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation- Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas – Landfill bioreactor.

Smart Waste Management Technologies-Plastic Waste Management

12 Hours

Unit IV**Hazardous waste management**

I

Introduction Definitions and identification, Sources and characteristics, Impacts, transportation – modes and regulations, control, minimization – compatibility, handling and storage and recycling. Biomedical wastes – Types – handling – control of biomedical wastes-Disposal methods. Chemical wastes – Sources Industrial - Inorganic pollutants – effects – Need for control – Treatment and disposal techniques – Physical, chemical and biological processes – Health and environmental effects. The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001.

Radioactive Waste Management-Impact of micro plastics

12 Hours**Total: 48 Hours****Textbook (s)**

1. O.P.Gupta, “Elements of Environmental Pollution Control”, Big book, 2019
2. George Tchobanoglous and Frank Kreith., “Handbook of Solid waste management”, McGraw Hill, New York, 2002
3. John Pitchel., “Waste Management Practices-Municipal, Hazardous and industrial”, CRC Press, Taylor and Francis, New York, 2014

Reference (s)

1. C.S. Rao, “Environmental Pollution Control Engineering”, New age International Publishers, 2006.
2. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation”, Government of India, New Delhi, 2014
3. William, A. Worrell., P. Aarne Vesilind., “Solid Waste Engineering”, Cengage Learning, 2012
4. Ramachandra, T. V., “Management of Municipal Solid Waste”, TERI Press, New Delhi, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	70	70	100
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)**Remember**

1. What is thermal pollution?
2. What is MINAS
3. What are the main sources of solid waste?
4. Name two methods for leachate management in landfills.
5. Name the five main waste management rules in India.

Understand

1. Describe the major global and regional pollution concerns with examples.
2. Compare and contrast the physico-chemical and biological methods of nitrogen removal.
3. Explain the role of the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) in pollution management.
4. Explain the impact of international environmental conventions on national pollution control policies.
5. Explain the four R's (Reduce, Reuse, Recycle, Recover) and their role in solid waste management.

23CEC43 AI for Civil Engineering**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply TensorFlow and Keras to design, implement, and optimize neural networks for solving various real-time applications, including classification, regression, and anomaly detection tasks.
2. Implement core operations of Convolutional Neural Networks (CNNs) such as convolution, pooling, and padding to develop and apply image recognition models for practical computer vision tasks.
3. Apply major transfer learning architectures (such as VGG, ResNet, Inception, and EfficientNet) to solve diverse computer vision tasks, making informed decisions based on model performance and computational efficiency.
4. Implement advanced computer vision techniques, including object detection, instance segmentation, semantic segmentation, and face recognition, to solve complex real-world visual perception problems.
5. Apply fundamental Natural Language Processing (NLP) techniques such as stop words removal, tokenization, stemming, lemmatization, and the Bag of Words model and Word Vectorization to analyze and process text data for real-world applications.
6. Apply advanced sequential data processing techniques by implementing Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks to solve challenges like vanishing and exploding gradients for effective processing of sequential data in NLP applications.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO10	PO12
1	3	2	3	2	3	1	3
2	3	2	3	1	3	1	3
3	3	3	2	1	3	1	3
4	3	3	3	2	3	1	3
5	3	2	2	1	3	2	3
6	3	3	3	2	3	1	3

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Introduction to Neural Networks and Deep Learning**

Introduction to Perceptron & Neural Networks - Activation and Loss functions - Gradient Descent - Batch Normalization - TensorFlow & Keras for Neural Networks - Hyper Parameter Tuning.

*Loss Function, Normalization***12 Hours****Unit II****Computer Vision I**

Introduction to Convolutional Neural Networks - Introduction to Images - Convolution, Pooling, Padding & its Mechanisms - Forward Propagation & Backpropagation for CNNs - CNN architectures like AlexNet, VGGNet, - InceptionNet & ResNet.

*Generative Adversarial Networks (GANs) for Image Generation, Transfer Learning and Fine-tuning Pretrained Models***12 Hours****Unit III****Computer Vision II**

Transfer Learning - Object Detection - YOLO, R-CNN, SSD - Semantic Segmentation - U-Net - Face Recognition using Siamese Networks - Instance Segmentation.

*One-Shot Learning, , Inception.***12 Hours****Unit IV****NLP (Natural Language Processing)**

Introduction to NLP - Stop Words - Tokenization - Stemming and Lemmatization - Bag of Words Model - Word Vectorizer - Introduction to Sequential data - RNNs and its Mechanisms - Vanishing & Exploding gradients in RNNs - LSTMs - Long short-term memory

*GRUs - Gated Recurrent Unit, LSTMs Applications***12 Hours****Total: 48 Hours**

Textbook (s)

1. Nikhil Buduma, "Fundamentals of Deep Learning", ORELLIY, 1st Edition, 2017.
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2004.
3. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep Learning." An MIT Press book in preparation, 2015

Reference (s)

1. Satish Kumar, "Neural Networks: A Classroom Approach" Tata McGraw Hill Education, 2004.
2. Simon Haykin, "Neural networks and Learning Machines", Prentice Hall, 2008
3. Josh Patterson and Adam Gibson "Deep Learning A Practitioner's Approach" O'Reilly Media, Inc. 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)**Remember**

1. List out the various applications of AI?
2. What are the stages of learning AI?
3. What is the difference between Strong AI and Weak AI?
4. What is A* Search Algorithms in AI?
5. Explain Markov's Decision Processes in Artificial Intelligence?

Understand

1. Explain in detail how the object detection done using AI?
2. Explain the methods used to avoid overfitting in neural networks?
3. Enumerate the real-world examples of K-means?
4. Explain in details the advantages and components of an expert system?
5. Enumerate the significance of NLP?

Apply

1. Discuss how AI can be used to analyze soil and geotechnical data to assess the stability of foundation structures and predict potential risks, aiding in better foundation design.
2. How can AI-driven systems be employed to optimize energy consumption in large buildings, utilizing smart sensors and predictive analytics to regulate heating, cooling, and lighting?
3. How can AI algorithms be applied to optimize traffic signal timings at busy intersections to reduce congestion and improve traffic flow, taking into account real-time traffic data?

23CE008 Ground Improvement Techniques**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Interpret the principles and suitable techniques of dewatering
2. Summarize the principles and methods of grouting techniques
3. Describe diverse in situ densification methods, encompassing surface and subsurface techniques for ground improvement
4. Illustrate the principles and suitability of various stabilization techniques
5. Implement the methods for improve the expansive soils
6. Analyse different geosynthetics and their field applications

COs - POs Mappings

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	3	2	2
2	3	2	3	2	3
3	3	3	3	3	3
4	3	3	3	3	3
5	3	3	3	3	3
6	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Dewatering and Grouting**

Methods of de-watering - sumps and interceptor ditches- single, multi stage well points - vacuum well points- Horizontal wells-foundation drains-blanket drains- criteria for selection of fill material around drains - Electro- osmosis.

Grouting: Objectives of grouting- grouts and their properties- grouting methods - ascending, descending and stage grouting- hydraulic fracturing in soils and rocks- post grout test.

Design Steps for Dewatering Systems, Applications of Grouting

12 Hours**Unit II****In Situ Densification Methods in Cohesion less and Cohesive Soils**

Vibration at the ground surface, Impact at the Ground Surface, Vibration at depth, Impact at depth. Preloading or dewatering, Vertical drains - Sand Drains, Sand wick geodrains - Stone and lime columns - thermal methods

Compaction Quality Control, Selection of Field Compaction Procedure

12 Hours**Unit III****Stabilization and Expansive Soils**

Methods of stabilization mechanical cement lime bituminous - chemical stabilization with calcium chloride sodium silicate and gypsum

Expansive Soils: Problems of expansive soils - tests for identification - methods of determination of swell pressure - Improvement of expansive soils. Foundation techniques in expansive soils - under reamed piles.

Chemical Stabilization Using Natural and Synthetic Polymers

12 Hours**Unit IV****Geosynthetics and Reinforced Earth**

Geotextiles- Types, Functions and applications - geogrids and geomembranes - functions and applications.

Reinforced Earth: Principles - Components of reinforced earth - factors governing design of reinforced earth walls - design principles of reinforced earth walls.

Properties of Geosynthetics, purpose of different components of reinforced earth

12 Hours**Total: 48 Hours****Textbook (s)**

1. Purushotham Raj, Ground Improvement Techniques, 2st Ed., Laxmi Publications, New Delhi, 2016
2. Hausmann M.R., Engineering Principles of Ground Modification, McGraw-Hill International Edition, 2015

Reference (s)

1. Moseley M.P, Ground Improvement, 2nd Ed., Blackie Academic and Professional, Boca Taton, Florida, USA,2004
2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A , Ground Control and Improvement, John Wiley and Sons, New York, USA, 1994

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	50	50	-
Apply	20	20	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What do you mean by grouting?
2. List out the methods of ground improvement.
3. What is an expansive soil? Give one example.
4. What are the requirements of soil stabilization?
5. Define swell pressure.

Understand

1. Write the sequence to be followed in jet grouting with neat sketch.
2. Explain briefly the role of geosynthetics as a separator with the help of neat sketches.
3. Explain how the stone columns are installed using vibro-flotation technique with the help of neat sketch and also write the uses of stone columns.
4. Discuss the components of the reinforced earth wall with the help of a neat sketch.

Apply

1. Illustrate any two methods of in-situ densification for cohesion less soils.
2. List out the various dewatering methods. What are the dewatering methods available for fine grained soils and explain any one of the method with a neat sketch.

Analyze

1. A soil profile has an active zone of expansive soil of 3 m. The liquid limit and average natural moisture content during the construction are 54% and 19% respectively. What measures you will take before you start constructions in an expansive soil? Explain in brief.

23CE009 Advanced Reinforced Concrete Design**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Design and Detail the components of a retaining wall as per the recommendations of IS Code.
2. Design & Detail the staircase as per the recommendations of IS Code.
3. Design & Detail the flat slab as per the recommendations of IS Code.
4. Design & Detail the combined footing as per the recommendations of IS Code.
5. Design & Detail the pile Foundation as per the recommendations of IS Code.
6. Design & Detail the Rectangular and circular overhead tank as per the recommendations of IS Code.

COs-Pos Mapping

COs	PO1	PO2	PO3	PO4	PO12	PSO2
1	2	3	3	3	3	3
2	2	3	3	3	3	3
3	2	3	3	3	3	3
4	2	3	3	3	3	3
5	2	3	3	3	3	3
6	2	3	3	3	3	3

3-Stronglylinked|2-Moderatelylinked|1-Weakly linked

Unit I**Retaining Walls**

Introduction – Types of retaining walls –Active and passive earth pressure-Design principles of cantilever retaining walls with horizontal back fill- Design principles of Counter fort retaining walls with horizontal backfill-Reinforcement detailing and bar bending schedule.

The design of the counter-fort retaining walls, detailing of counter-fort retaining walls

12 Hours**Unit II****Staircases and Flat Slabs**

Introduction- types- dog-legged staircases – Design of flat slabs – Types – Design methods, IS code recommendations–Reinforcement details.

Exterior panel design, detailing of dog-legged staircases

12 Hours**Unit III****Combined Footings and Pile Foundations**

Design of combined footing - rectangular and trapezoidal footing. Types of piles–Load carrying capacity of piles – Group action in piles – Structural design of RC piles – Design of pile cap for 2 or 3 piles – Reinforcement detailing and bar bending schedule.

Trapezoidal footing, detailing of trapezoidal footing

12 Hours**Unit IV****Liquid Retaining Structures**

Design of rectangular and circular water tanks- both below and above ground level- Design of overhead water tank (AsperIS3370(Part I-III))

Design of underground rectangular tank, Design of over head rectangular tank

12 Hours**Total: 48 Hours****Text Book(s)**

1. N. Krishna Raju, Structural Design and Drawing (Concrete and Steel) 3rd edition, University press publications, 2005.
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1stedition, New age International Publishers, 2009.

Reference(s)

1. S.N Sinha, Reinforced concrete Design 2nd edition, Tata Mc.Hill publications, 2002.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced concrete design '1stedition, Laxmi publications, 2016.

- Punmia B.C., Ashok Kumar Jain & Aurn Kumar Jain, Reinforced concrete structures, volume I, 5th Edition, Laxmi publications Pvt. Ltd., 2008.
- Varghese P.C., Limit State Design of Reinforced Concrete Structures, 3rd Edition, Prentice Hall of India, 2005.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	20	20	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

- What is a retaining wall?
- What is a flat slab?
- What is a combined footing?
- What is pile foundation and discuss its types?
- Name three liquid retaining structures?

Understand

- Explain about types of retaining walls and on what basis that type is selected by the designer?
- Discuss the types of stair cases & in what situation we adopt that stair case?
- What is the need to use combined footing?
- In what situation, the designer will adopt Pile foundation?
- For what stresses we design liquid retaining structures?

Apply

- A combined rectangular footing is to be designed for two columns spaced at 6m c/c. Face of one of the columns of section 400 mm x 400 mm coincides with the property line and subjected to a load of 1500kN at service state and other column section 500 mm x 500 mm and subjected to load of 2500 kN at service state. Use concrete of grade M-20 and steel Fe-415. Design the combined footing, having a central beam joining the columns. Draw the reinforcement details of transverse and longitudinal sections?
- Design a rectangular RC water tank (resting on the ground) with an open top for a capacity of 80,000litres. The inside dimension of the tank may be taken as 6 m x 4 m. Design the side walls of the tank using M-20 and Fe- 250 grade-1 steel. Permissible stresses should comply with IS: 456:2000, and IS:3370(Part-II)-1965. Sketch cross section of the elevation and plan of the tank showing reinforcement details in the tank.
- Design a cantilever retaining wall to retain an earth embankment with a horizontal top of 4 m above the ground level. Density of earth = 18 kN/m³. Angle of internal friction $\phi = 30^\circ$. SBC of soil= 200kN/m². Coefficient of friction between soil and concrete =0.5. Use M-20 and Fe-415. Sketch the C/S of retaining wall showing the reinforcement details and also sketch the longitudinal section curtailment.
- A R.C.C. retaining wall with counter forts is required to support earth to a height of 7 m above the ground level. The top surface of the backfill is horizontal. The trial pit taken at the site indicates that soil of bearing capacity 220 kN/m² is available at a depth of 1.25 m below the ground level. The weight of earth is 18kN/m³ and angle of repose is 30°. The coefficient of friction between concrete and soil is 0.58. Use concrete M20 and steel grade Fe415. Design the retaining wall.
- Design a pile cap for a group of two files spaced 1.5 m apart. The piles are 400 mm diameter and the column transmits a factored load of 1000 kN and is of size 500 mm × 500 mm. Adopt M-20 grade concrete and Fe-415 grade HYSD bars. Sketch the details of reinforcement.

23CE010 Construction Methods and Equipment

3 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Analyze equipment ownership and operating costs to optimize financial planning.
2. Compute earthwork quantities and determine equipment requirements for efficient project execution.
3. Evaluate soil stabilization techniques and identify suitable equipment for different soil conditions.
4. Choose appropriate construction equipment based on specific project needs and activities.
5. Assess equipment productivity and associated costs to enhance project efficiency.
6. Estimate and schedule construction activities by integrating equipment productivity and cost analysis.

COs-POs Mapping

COs	PO1	PO2	PO5	PO11	PSO2
1	3	2	2	3	3
2	3	3	2	2	3
3	3	3	3	1	3
4	3	2	3	2	3
5	3	3	3	3	3
6	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Equipment Economics and Planning for Earthwork Construction

Equipment records, Cost of Capital, Elements of ownership cost, Operating cost, Replacement Decisions, Rent and Lease Considerations

Earthwork planning, Graphical Presentation of Earthwork, Earthwork Quantity, Mass Diagram

Pricing Earthwork Operations, Reduced levels for earthwork estimation

12 Hours

Unit II

Compaction and Stabilization Equipment

Compaction of Soil and Rock, Types of Compacting Equipment, Dynamic Compaction, Stabilizing Soils with Lime, Cement Soil Stabilization, Mobile Equipment Power Requirements, Required Power, Available Power, Usable Power, Performance Charts

Geotextiles and geogrids for soil stabilization, lime for soil stabilisation

12 Hours

Unit III

Excavating, Hauling, and Finishing Equipment

Introduction, Performance Characteristics of Dozers, Pushing Material, Land Clearing, Scraper types, Operation, Performance Charts, Production Cycle, Hydraulic Excavators, Shovels, Hoes; Trucks, Productivity, Performance Calculations, Graders, Trimmers

Types of cranes and uses, Gradal uses

12 Hours

Unit IV

Asphalt and Concrete Mix Production and Placement

Asphalt Mixing Plant, Hauling, Paving Equipment, Concrete mixers, Types, Agitators, Transit mixers, Placement, Finishing

Placement of dowel bars in concrete pavement construction, Finishing and tining in rigid pavement construction.

12 Hours

Total: 48 Hours

Textbook(s)

1. Peurifoy, R. L., Schexnayder, C. J., Schmitt, R. L., and Shapira, A. Construction Planning, Equipment, and Methods, 9th Edition, McGraw Hill LLC, 2018.
2. Gransberg, D. D., and Rueda-Benavides, J. A., Construction Equipment Management for Engineers, Estimators, and Owners, 2nd Edition, CRC Press, 2020.

Reference (S)

1. Sharma, S. C., Construction Equipment and Management, 1st Edition, Khanna Publishers, New Delhi, India, 2019.
2. Schaufelberger, J. E., and Migliaccio, G. C., Construction Equipment Management, 2nd Edition, Routledge, London, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	15	15	20
Understand	85	85	80
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

SAMPLE QUESTION(S)

Remember

1. What are the elements of ownership and operating costs?
2. What are the various types of equipment used for earthwork-related activities?
3. List the types of scrapers and their use
4. What are the steps followed in the asphalt mix production process?
5. What are the types of hauling and trucking equipment used in construction?

Understand

1. What is the difference between dozers, scrapers, and trucks?
2. Why soil stabilization is performed?
3. Discuss the production cycle of a crane.
4. What are the types of excavators and explain their cycle time and production with an example
5. Discuss the productivity of Side Drum Truck of 5T capacity.

23CE011 Basics of Dynamics and Earthquake Engineering**3 0 0 3****Course outcomes**

At the end of the course, student will be able to

1. Determine the response of Single Degree of Freedom (SDOF) and Multi-Degree of Freedom (MDOF) systems under free vibration for both damped and undamped conditions.
2. Analyze the response of SDOF and MDOF systems subjected to forced vibrations for both damped and undamped conditions.
3. Apply the principles of seismic engineering to understand earthquake phenomena, including causes, plate tectonics, elastic rebound theory, earthquake characteristics, and measurement techniques.
4. Investigate the potential causes of structural failure in poorly designed buildings under earthquake loading and suggest remedial measures.
5. Compute earthquake forces acting on structures using IS:1893 – 2002 provisions.
6. Implement the design methodology for earthquake-resistant structures following IS codal provisions.

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	3	3	2	3
2	2	3	3	2	3
3	2	3	3	3	3
4	3	3	3	3	3
5	2	3	3	2	3
6	2	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Theory of vibrations and multiple degree of freedom system**

Static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom system – Formulation of Equations of motion of SDOF system - D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Two degree of freedom system – formulation of equations of motion of multi degree of freedom (MDOF) system - Eigen values and Eigen vectors – Response to free and forced vibrations - damped and undamped MDOF system – Modal superposition methods.

*Consequences of vibration, Vibration control in the design of structures***12 Hours****Unit II****Elements of seismology**

Elements of Engineering Seismology - Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristics of Earthquake-Measurement of Earthquake– Estimation of earthquake parameters - Magnitude and intensity of earthquakes – Spectral Acceleration.

*Types of Earthquake, Tsunami.***12 Hours****Unit III****Response of structures to earthquake**

Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 - Response Spectra – Lessons learnt from past earthquakes.

*Effect of Earthquake on Steel concrete composite structures and Water retaining structures***12 Hours****Unit IV****Design Methodology**

Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Later load analysis – Design and detailing as per IS:13920 – 1993.

*Special Construction features of Earthquake resistant structures, Seismic strengthening of RC structures***12 Hours****Total: 48 Hours**

Textbook(s)

1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 5th Edition, Pearson Education, 2020.
2. Damodarasamy S R, Kavitha S., "Basics of structural Dynamics and Aseismic Design", PHI Learning Private Limited, 2013.

Reference(s)

1. Agarwal. P and Shrikhande. M., "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd. 2017.
2. Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill Book Co., New York, 1964.
3. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, London, 2019.
4. Paz, M. and Leigh.W. "Structural Dynamics – Theory & Computation", 4th Edition, CBS Publishers & Distributors, Shahdara, Delhi, 2016.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	30	30	40
Apply	40	40	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. What is underdamped system and overdamped system?
2. What are the consequences of vibration?
3. Write orthogonal principles in two degrees of freedom.
4. List out any four recent Indian earthquakes with year and magnitude of occurrence
5. What is meant by frequency ratio?

Understand

1. State and prove orthogonality property of mode shapes.
2. Explain briefly plate tectonic theory.
3. Describe faults and types of earthquake.
4. Explain briefly about elastic rebound theory.
5. Write the characteristics of strong ground motion.

Apply

1. A vibratory system consist of 1000kN and a spring of 80kN/m. The damped ratio of two successive amplitude is 1,0.85.Determine the a) Logarithmic decrement b) Damped frequency c) Damping ratio d) Ratio of two successive amplitudes.
2. Determine the natural frequencies and mode shapes of the system shown in Figure

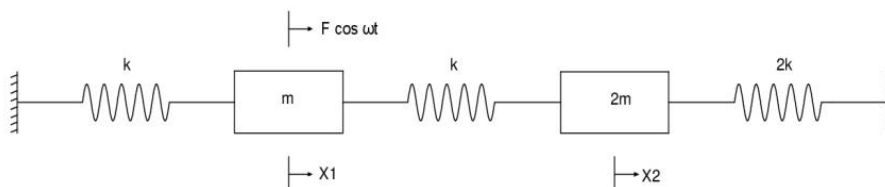


Figure .1

3. Determine the natural frequencies shown in Figure .2.

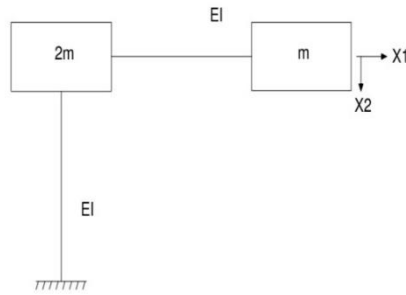


Figure.2

4. A three storeyed symmetrical RC school building situated at Bhuj with following data:
 Plan dimension: 7 m
 Storey height: 3.5 m
 Total weight of beams in a storey: 130 kN
 Total weight of slab in a storey: 250 kN
 Total weight of columns in a storey: 50 kN
 Total weight of walls in a storey: 530 kN
 Live load : 130 kN Weight of terrace floor : 655 kN
 The structure is resting on hard rock. Determine the total base shear and lateral loads at each floor level for 5% of damping using seismic coefficient method
5. A four-storey reinforced concrete frame building as shown in Figure.3 is situated at Roorkee. The height between the floors is 3 m and total height of building is 12 m. The dead load and live load is lumped at respective floor. The soil below the foundation is assumed to be hard rock. Assume building is intended to be used as a hospital. Determine the total base shear as per IS1893 (PART1): 2002. Distribute the base shear along the height of the building.

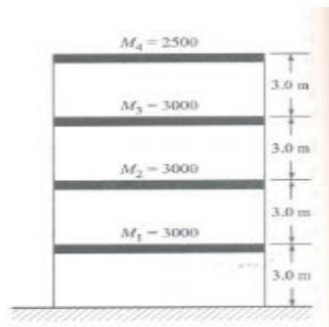


Figure.3

23CE012 Pavement Analysis and Design**3 0 0 3****Course outcomes**

At the end of the course, student will be able to

1. Apply the principles of pavement engineering to analyze the functions and types of pavements.
2. Evaluate the impact of material characteristics, traffic volume, and environmental factors on pavement design.
3. Conduct laboratory tests to assess the properties of pavement materials, including soil, aggregates, and bituminous materials.
4. Analyze the stresses and strains in flexible and rigid pavements using standard theories.
5. Design flexible and rigid pavement structures following IRC guidelines.
6. Assess pavement deterioration and recommend appropriate maintenance and rehabilitation measures.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO12	PSO1
1	3	2	2	1	1	1	2
2	3	3	2	2	1	1	2
3	3	3	2	3	2	1	3
4	3	3	3	2	2	1	3
5	3	3	3	3	2	1	3
6	3	3	3	3	2	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Pavement Engineering**

Functions of Pavements; Types of Pavements: Flexible, Rigid, Composite Pavements; Variables Considered in Pavement Design: Material Characteristics, Traffic Volume, Factors related to Axle and Wheel Loads, Concept of Equivalent Single Wheel Load (ESWL), Factors related to Climatic and Surrounding Environment; Drainage Considerations.

*IRC Traffic Loading Classifications, axle configurations***12 Hours****Unit II****Pavement Materials: Stresses and Strains**

Necessity of Pavement Materials Characterization, Soil: Resilient Modulus, Permeability, Shear Test, CBR Test, Plate Load Test; Stone Aggregate: Crushing Test, Impact Test, Abrasion Test, Shape Test, Water Absorption and Specific Gravity; Bituminous Materials: Viscosity, Ductility, Specific Gravity; Bituminous Mixes: Marshall Test; Stresses and Strains in Flexible Pavement using: Single layer and Double layer theory; Stresses and Strains in Rigid Pavement for: Wheel Load, Temperature and Friction.

*Marginal Pavement Materials, elastic recovery of bituminous materials***12 Hours****Unit III****Design of Components in Flexible and Rigid Pavement**

Overview of IRC design method for Flexible Pavement and Rigid Pavement; Design of Flexible Pavement: Salient features of IRC: 37 (2018), Design of Flexible Pavement using IRC: 37 (2018) guidelines, Design of Rigid Pavement using IRC: 58 (2015) guidelines; Design of Joints in Rigid Pavements: Tie Bars, Dowel Bars, Tie Bars.

*Semi-rigid Pavements, IIT Pune***12 Hours****Unit IV****Introduction to Highway Maintenance and Management**

Importance of Highway Maintenance Works; Deterioration and Damages in Road Infrastructure; Maintenance requirement for different Road Components; Distresses in Flexible Pavement and Maintenance Measures; Distresses in Rigid Pavement and Maintenance Measures; Structural Evaluation of Flexible Pavement by using Benkelman Beam Deflection Approach.

*Pavement Overlay, Falling Weight Deflectometer***12 Hours****Total: 48 Hours**

Textbook(s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019

Reference(s)

1. Yang H. Huang, Pavement Analysis and Design, 2nd Edition, Pearson, 2004
2. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
3. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
4. IRC: 58 Guidelines for the design of rigid pavements (2015)
5. IRC: 37 Guidelines for the design of flexible pavements (2018)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	10
Understand	30	30	30
Apply	30	30	40
Analyze	20	20	20
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)**Remember**

1. List the variables considered in flexible pavement design.
2. What is the effect of temperature differential in the design of slab thickness?
3. What are the methods of flexible pavements construction?
4. List the various maintenance works of bituminous surfaces.
5. List the various layers of flexible pavements.

Understand

1. Outline the importance of rigid pavements over Flexible pavements.
2. Explain ESWL and the concept in the determination of the equivalent wheel load.
3. Explain the factors governing the design of concrete pavements for low volume roads.
4. Classify different types of joints in cc Pavements of a rigid pavement and mention the objects of each.
5. Explain the functions of various component layers of pavements.

Apply

1. A circular load of radius 16cm with uniform contact pressure of 7.5 kg/cm² is applied on the surface of homogeneous elastic mass. Determine the vertical stress under the center of the load at a depth of 48cm from the surface using stress distribution chart for single layer.
2. Determine the EWLF or VDF value of the following two axle loads in terms of the standard axle load of 8.16 t (a) LCV with rear axle load of 1.8t (b) HCV with rear axle load of 16.0t
3. Determine the total thickness of flexible pavement assuming single layer elastic theory and using the following data: Design wheel load = 5100kg, $p=7$ kg/cm², $E=180$ kg/cm², permissible deflection = 0.25 cm.
4. Determine the spacing between contraction joints for 3.5 meters slab width having thickness = 22cm and $f=1.5$, for the following two cases
For plain cement concrete, allowable $S_c = 0.8$ kg/cm². For reinforced cement concrete, 2.0 cm dia. Bars at 0.4m spacing.
5. Design a Bituminous pavement with
 - (a) Granular base and sub-base
 - (b) Cemented base and sub-base with SAMI layer over CT-Base course

Data:

1. 4-lane divided carriageway
2. Initial traffic in each direction in the year completion of construction = 5500 CV/day
3. Design life = 15 years
4. Design CBR of subgrade soil = 5%
5. Traffic growth rate = 5%

6. Vehicle damage factor = 4.5

Analyze

1. Discuss the Westergaard's concept and assumptions for wheel load and temperature stresses.
2. Plate bearing test conducted with 30 cm diameter plate on a subgrade sustained a load of 1500 kg at 0.25cm deflection. The test when carried out on a base course of thickness 18 cm sustained a load of 5500 kg at 0.25 cm deflection. Determine the thickness of pavement section for a wheel load of 5500 kg with tyre pressure of 7.5 kg/cm^2 using Burmister's approach.
3. Calculate the spacing of expansion joint from the following data Maximum joint width = 2cm Temperature of laying concrete = 20°C Maximum slab temperature expected = 55°C Coefficient of thermal expansion = 10×10^{-6} per $^\circ\text{C}$
4. Determine the CC pavement thickness which is to be constructed in Nellore district of Andhra Pradesh for a national highway , spacing of expansion and contraction joints, dowel bars and tie bars for a wheel load of 5100 kg. Assume all suitable data
5. The CBR value of subgrade soil is 8 percent. Determine the most economical flexible pavement design thickness by comparing the design using
 - Design curve developed by California State Highway Department
 - Design chart recommended by IRC
 - Design formula developed by the U.S. Corps of EngineersAssume light traffic or 3175 kg wheel load and tyre pressure of 5 kg/cm^2

23CE013 Prestressed Concrete Structures**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Explain the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing
2. Evaluate the short-term and long-term losses in prestressing and design prestressed structures considering these losses
3. Analyse the stresses in a prestressed concrete member
4. Analyse the flexural behaviour and effect of shear in a prestressed concrete member
5. Design the prestressed concrete members for flexure and shear
6. Calculate the short term and long-term deflection in prestressed members

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	1	2	2	3	2
2	2	3	3	2	2
3	1	3	3	1	2
4	1	3	3	1	2
5	2	3	3	1	2
6	2	3	2	2	2

3 - Strongly linked | 2 - Moderately linked | 1 - Weakly linked

Unit I**Introduction to Prestressed Concrete**

Historic development – General principles of prestressing, pretensioning and post tensioning – Advantages and limitations of prestressed concrete – Materials – High strength concrete and high tensile steel their characteristics. I.S. Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – Analysis of post tensioning - Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.

*Properties of Strands, Properties of Tendon***12 Hours****Unit II****Losses and Analysis of Prestress**

Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel and frictional losses. Load Balancing Concept. Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, and parabolic tendons.

*Cracking moment, Anchorage Slip***12 Hours****Unit III****Design of Sections for Flexure and Shear**

Allowable stress, Design criteria as per IS Code – Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses – design for shear in beams – cable profile, Detailing requirements for shear and flexure. Transmission of Prestress – Transmission length – End zone reinforcement.

*Kern Lines, Flexural strength for T-section***12 Hours****Unit IV****Deflections of Prestressed Concrete Beams**

Importance of control of deflections – factors influencing deflections – short term deflections of uncracked members, stage wise prestressing. Limits of span-to-effective depth ratio Calculation of Crack Width – Method of calculation – Limits of crack width

*Prediction of long-term deflection, short term deflection of cracked members***12 Hours****Total: 48 Hours**

Textbook (s)

1. N. Krishna Raju, Prestressed Concrete, 4th Ed., Tata Mc. Graw Hill Publications, 2006
2. N. Rajasekharan, Prestressed Concrete, 2nd Ed., Narosa Publications, 2014

Reference (s)

1. S. Ramamrutham, Prestressed Concrete, 5th Ed., Dhanpatrai Publications, 2013
2. T.Y. Lin & Ned H. Burns, Design of Prestressed concrete structures, 3rd Ed., John Wiley & Sons, 1981
3. BIS code on prestressed concrete, IS 1343.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	20	-
Understand	20	20	-
Apply	25	30	70
Analyze	25	30	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)
Remember

1. What is known as kern zone and pressure line?
2. Define cracking moment.
3. What is the necessity of shear reinforcement?
4. List out short-term and long-term deflection.
5. What are the remedies for flexure and shear failure?

Understand

1. Write the advantages and limitations for prestressed concrete.
2. Differentiate between Pre tensioning and Post tensioning
3. Write the various types of prestressing systems in pre tensioned and post tensioned.
4. Discuss the importance of control of deflections and factors influencing deflections.
5. How the cable profile will affect the deflection of PSC member? Explain with neat sketch.

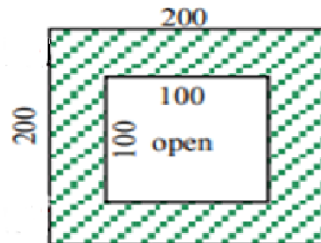
Apply

1. A prestressed concrete beam, 200 mm wide and 300 mm deep, is prestressed with wires area of 320 mm² located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm². The span of the beam is 10 m. Calculate the percentage of loss of stress in wires if (a) the beam is pretensioned and (b) the beam is post tensioned, using the following data: Modulus of elasticity of steel = 210 kN/mm²; Modulus of elasticity of concrete = 35 kN/mm²; Shortening due to creep = 30×10^{-6} mm/mm per N/mm² of stress; Shrinkage of concrete for pretensioning = 300×10^{-6} mm per unit length; and posttensioning 200×10^{-6} mm per unit length; Relaxation of steel stress = 5% of initial stress; Creep coefficient = 1.6; Slip at anchorage = 1 mm; Frictional coefficient for wave effect = 0.0015 per m.
2. A post-tensioned bridge girder with unbonded tendons is of box section of overall dimensions 1200 mm wide by 1800 mm deep, with wall thickness of 150 mm. The high-tensile steel has an area of 4000 mm² and is located at an effective depth of 1600 mm. The effective prestress in steel after all losses is 1000 N/mm² and the effective span of the girder is 24 m. If $f_{ck} = 40$ N/mm² and $f_p = 1600$ N/mm², estimate the ultimate flexural strength of the section using IS code provisions.
3. A concrete beam is prestressed by a cable carrying an initial prestressing force of 300 kN. The cross-sectional area of the wires in the cable is 300 mm². Calculate the percentage of loss of stress in the cable only due to shrinkage of concrete using IS: 1343 recommendations assuming the beam to be, (a) pre-tensioned and (b) post-tensioned. Assume $E_s = 210$ kN/mm² and age of concrete at transfer = 8 days.
4. An unsymmetrical I – section is used for a 30 m span prestressed concrete bridge girder having the top flange width and thickness of 1200 and 250 mm. The web is 1500 mm deep and 200 mm thick. The bottom flange is 500 mm wide and 400 mm deep. The girder is prestressed by cables having an initial tensile force of 6053 kN at an eccentricity of 850 mm at centre of span and 180 mm at the supports. The girder has to support an ultimate shear force of 1909 kN at the supports. The loss ratio is 0.85. Cube strength of concrete as 50 N/mm² and Fe 415 HYSD bars of 8 mm diameter, design suitable spacing for the stirrups conforming to the IS: 1343 – 2012 recommendations.

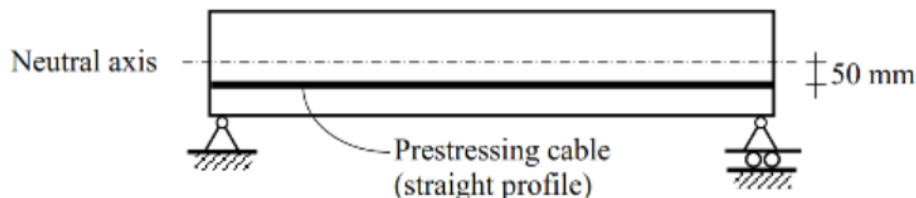
5. A pretensioned T section has a flange width of 1200mm and 150mm thick. The width and depth of the rib are 300mm and 1500mm respectively. The high-tension steel has an area of 4700mm² and is located at an effective depth of 1600mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40Mpa and 1600Mpa respectively; calculate the flexural strength of the section.

Analyze

1. A concrete beam with a symmetrical I section has flange width and depth of 200 mm and 60 mm, respectively. The thickness of the web is 80 mm and over all depth is 400 mm. The beam is prestressed by a cable carrying a force of 1000kN. The span of the beam is 8 m. The centre line of the cable is 150 mm from the soffit of the beam at the centre of span, linearly varying to 250 mm at the supports. Compute the initial deflection at mid span due to prestress and the self-weight of the beam, assuming $E_c = 38\text{kN/mm}^2$. Compare the deflection with the limiting deflection permitted in IS 1343 ($D_c = 24\text{kN/m}^3$).
2. A simply supported beam with a uniform section spanning over 6m is post tensioned by two cables both of which have an eccentricity of 100mm below the centroid of the section at mid span. The first cable is parabolic and is anchored at an eccentricity of 100mm above the centroid at each end, the second cable is straight and parallel to the line joining the supports. The C/S area of each cable is 100mm² and they carry an initial stress of 1200 MPa. The concrete has a c/s of 20000 mm² and a radius of gyration of 120 mm. The beam supports two concentrated loads of 20kN each at the third points of the span. $E_c = 38\text{kN/mm}^2$. Calculate
 - a) The instantaneous deflection at the centre of span
 - b) The deflection at the centre of span after 2 years, assuming 20% loss in prestress and the effective modulus of elasticity to be one-third of the short-term modulus of elasticity
3. A concrete beam having a rectangular section 100mm wide and 300mm deep is prestressed by a parabolic cable carrying an initial force of 240kN. The cable has an eccentricity of 50mm at the centre of span and is concentric at the supports. If the span of the beam is 10m and the live load is 2kN/m, estimate the short-term deflection at the centre of the span. Assuming $E_c = 38\text{kN/mm}^2$ and creep coefficient is 2, loss of prestress is 20% of the initial stress after 6 months. Estimate the long-term deflection at the centre of the span at this stage assume the dead load and live load are simultaneously applied after the release of prestress.
4. A hollow member is reinforced with 4 wires of 62.5 mm² each pretensioned $f_{si} = 1030\text{MPa}$. If $f_c = f_{ci} = 34.4\text{ MPa}$, $n = 7$, determine the stresses when the wires are cut between members. Determine the moment that can be carried at a maximum tension of $0.5\sqrt{f_c}$ and a maximum of $f_c = 0.45f_c$. If 240 MPa of the prestress is lost (in addition to the elastic deformation) determine this limiting moment.



5. A 6 m long simply supported beam is prestressed as shown in the figure.



The beam carries a uniformly distributed load of 6 kN/m over its entire span. If the effective flexural rigidity $EI = 2 \times 10^4\text{ kNm}^2$ and the effective prestressing force is 200 kN, Find the net increase in length of the prestressing cable.

23CES13 IoT for Structural Health Monitoring**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Apply IoT concepts for real-time SHM in critical infrastructure projects.
2. Utilize SHM sensors for dynamic and static structural performance analysis.
3. Design IoT-enabled SHM frameworks with integrated cloud and edge computing systems.
4. Implement predictive maintenance techniques using IoT data for failure detection.
5. Apply IoT solutions for monitoring critical infrastructure such as bridges and high-rise buildings.
6. Develop IoT-based SHM prototypes for long-term performance evaluation and lifecycle management.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO12
1	3	2	3	1	2	3
2	3	3	2	2	3	3
3	3	2	3	3	3	3
4	2	3	3	3	3	3
5	3	2	3	3	3	3
6	3	3	3	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Introduction to Structural Health Monitoring**

Importance of SHM in Civil Infrastructure: Need for SHM in critical structures, Benefits of SHM in safety and maintenance, Economic and operational advantages of SHM. Role of IoT in SHM: IoT architecture for SHM applications, IoT-enabled sensors and data collection methods, Real-time monitoring and control using IoT. SHM Process and Techniques: Overview of SHM processes, Techniques: Visual inspection, vibration analysis, and non-destructive testing (NDT), SHM lifecycle management and decision-making. Types of Sensors Used for SHM: Strain gauges: Types, working principles, and applications, Accelerometers: Use in dynamic structural analysis, Displacement sensors: Techniques and real-world usage examples.

SHM lifecycle management, decision-making in SHM.

12 Hours**Unit II****IoT Architecture for SHM**

IoT-Enabled SHM Framework: Layered architecture of IoT-based SHM systems, Sensor integration and network design, Edge computing vs. cloud computing in SHM. Real-Time Data Collection and Transmission Methods: Data acquisition systems (DAS), Wireless communication protocols (Zigbee, LoRa, NB-IoT), Latency and bandwidth considerations for SHM applications. IoT Platforms for SHM: Overview of popular platforms: ThingSpeak, AWS IoT, Azure IoT, Data ingestion, visualization, and analysis on IoT platforms, Platform selection criteria for SHM projects. Data Storage and Cloud Integration: Cloud storage architecture and solutions, Data security and privacy measures, Cost considerations for cloud-based SHM systems.

Data security and privacy measures, Cost considerations for cloud-based SHM systems.

12 Hours**Unit III****Applications of IoT in SHM**

Monitoring of Critical Infrastructure: IoT-based SHM for bridges: Load, vibration, and temperature monitoring, SHM applications in dams and tunnels: Case studies and best practices, High-rise buildings: Wind load monitoring and earthquake resilience. Case Studies on SHM of Critical Infrastructure: Success stories of IoT-enabled SHM projects, Analysis of failures prevented through IoT-based SHM, Lessons learned from global SHM implementations. Predictive Maintenance and Failure Detection Using IoT: Machine learning for predictive maintenance in SHM, Real-time anomaly detection techniques, Cost

benefits of predictive maintenance. Legal and Ethical Aspects of SHM Data Usage: Data ownership and sharing policies, Privacy concerns in real-time SHM, Ethical frameworks for SHM data utilization.

Privacy concerns in real-time SHM, Ethical frameworks for SHM data utilization.

12 Hours

Unit IV

Practical SHM Solutions and Projects

Hands-On: Designing an IoT-Based SHM Prototype: Planning and requirements gathering, Hardware and software selection, Prototype development and testing. Vibration and Displacement Monitoring Using IoT Systems: Sensor placement and calibration techniques, Real-time vibration monitoring for structural analysis, Displacement data interpretation and alert generation. Long-Term Performance Evaluation Using IoT Data: Techniques for long-term monitoring of structural performance, Data analytics for lifecycle management, Maintenance scheduling based on IoT data insights. Future Trends in IoT for SHM: Emerging IoT technologies for SHM, Role of AI and machine learning in future SHM systems, Challenges and opportunities in large-scale SHM deployments.

Role of AI and mL in future SHM systems, Challenges and opportunities in large-scale SHM deployments.

12 Hours

Total: 48 Hours

Textbook(s)

1. Charles R. Farrar and Keith Worden, "Structural Health Monitoring: A Machine Learning Perspective," 1st Ed., Wiley, 2012.
2. D. Inaudi and B. Glisic, "Structural Health Monitoring of Civil Infrastructure Systems," Woodhead Publishing, 2009.

Reference(s)

1. Jerome Lynch and Kenneth Loh, "A Summary Review of Wireless Sensors and Sensor Networks for Structural Health Monitoring," The Shock and Vibration Digest, 2006 -
2. Maria Q. Feng, "Internet of Things and Data Analytics Handbook," Wiley, 2017 -
3. Hoon Sohn et al., "Wireless Sensor Networks for Structural Health Monitoring," Springer, 2016
4. Ting-Hua Yi, "Applications of Structural Health Monitoring Technology in Asia," Research Publishing, 2014.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. List four types of sensors commonly used in IoT-based SHM.
2. Name three IoT platforms suitable for SHM applications.
3. Define predictive maintenance in the context of IoT and SHM.
4. Identify two real-time data transmission methods used in SHM.

Understand

1. Explain the role of edge computing in IoT-based SHM systems.
2. Describe how IoT can enhance the lifecycle management of a bridge.
3. Illustrate the process of data collection and analysis in IoT-enabled SHM frameworks.
4. Summarize the benefits of using non-destructive testing techniques in SHM.

Apply

1. Design an IoT system for monitoring the structural health of a high-rise building using accelerometers and strain gauges.
2. Develop a cloud-based dashboard for real-time visualization of SHM data from multiple sensors.
3. Create a maintenance schedule based on predictive analytics derived from IoT sensor data.
4. Implement a wireless sensor network for a tunnel SHM project using LoRa technology.

Analyze

1. Compare and contrast the effectiveness of Zigbee and NB-IoT for data transmission in SHM systems.
2. Analyze the potential cost savings from implementing IoT-based predictive maintenance in critical infrastructures.
3. Discuss the challenges of integrating new IoT technologies into existing SHM systems.
4. Differentiate between static and dynamic monitoring techniques in the context of SHM.

Evaluate

1. Evaluate the impact of IoT-based SHM on the operational efficiency of infrastructure projects.
2. Assess the reliability of machine learning algorithms for failure detection in structural components.
3. Critically appraise the ethical considerations in the data sharing of SHM systems.
4. Determine the effectiveness of IoT solutions in improving the earthquake resilience of buildings.

23CES23 Data Mining and Exploratory Data Analysis (EDA)**Course Outcomes**

At the end of the course, student will be able to

1. Apply data mining techniques such as clustering, classification, and association rule mining to analyze engineering datasets using appropriate tools.
2. Implement data preprocessing techniques, including handling missing values, normalization, and feature engineering, to improve data quality.
3. Apply outlier detection and dimensionality reduction techniques like PCA and t-SNE to enhance data representation and analysis.
4. Perform univariate, bivariate, and multivariate exploratory data analysis (EDA) using visualization techniques to identify patterns and trends in engineering data.
5. Apply the Apriori algorithm for association rule mining to extract meaningful relationships from large datasets.
6. Implement clustering techniques such as K-Means, Hierarchical, and DBSCAN to group data and evaluate clustering performance using appropriate metrics.

COs-POs Mapping

COs	PO1	PO2	PO3	PO5	PO12
1	3	2	2	3	2
2	3	3	2	3	2
3	3	3	3	3	2
4	3	2	3	3	2
5	3	2	3	3	3
6	3	2	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I**Introduction to Data Mining**

Definition and Importance of Data Mining. Data Mining vs Data Analytics vs Machine Learning. Types of Data Mining: Predictive, Descriptive, and Prescriptive Analytics. Data Mining Techniques: Clustering, Classification, Association Rule Mining. Introduction to Tools: Weka, RapidMiner, Python (pandas, numpy) *Comparison of Data Mining, Data Analytics, and Machine Learning, Real-world applications of predictive vs. descriptive analytics*

12 Hours**Unit II****Data Cleaning and Transformation**

Handling Missing Data: Imputation Techniques. Data Transformation: Normalization, Standardization. Feature Engineering: Feature Selection, Feature Extraction. Outlier Detection Methods: Z-score, IQR, Isolation Forest. Data Reduction Techniques: PCA, t-SNE. *Importance of feature engineering in model performance, Role of dimensionality reduction in high-dimensional datasets.*

12 Hours**Unit III****Exploratory Data Analysis (EDA)**

Importance of EDA in Data Science. Univariate, Bivariate, and Multivariate Analysis. Data Visualization Techniques: Box Plots, Heatmaps, Pair Plots. Identifying Patterns and Trends in Data. Case Studies on EDA Applications in Engineering. *Impact of EDA on machine learning model performance, Advanced visualization techniques for high-dimensional data.*

12 Hours

Unit IV

Association Rule Mining and Clustering

Apriori Algorithm: Support, Confidence, Lift. Market Basket Analysis and Rule Generation. Clustering Methods: K-Means, Hierarchical, DBSCAN. Evaluating Clustering Performance: Silhouette Score, Elbow Method. Case Studies on Data Mining in Civil, Mechanical, and Electrical Engineering.

Practical applications of Market Basket Analysis, Strengths and limitations of different clustering techniques.

12 Hours

Total : 48 Hours

Textbooks

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques," 3rd Edition, Morgan Kaufmann, 2011.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, "Introduction to Data Mining," 2nd Edition, Pearson, 2019.

Reference Books

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning," Springer, 2nd Edition, 2009.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning," Springer, 2013.
3. T. Hastie, R. Tibshirani, J. Friedman, "Statistical Learning with Applications in R," Springer, 2014.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	10	-
Understand	40	40	-
Apply	50	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. Define Data Mining and explain its importance in real-world applications.
2. What is the difference between data mining and machine learning?
3. List and briefly describe different types of data mining techniques.
4. What is the role of feature engineering in data mining?
5. Define association rule mining and explain its basic concepts.

Understand

1. Explain the differences between predictive, descriptive, and prescriptive analytics with examples.
2. How does PCA help in dimensionality reduction? Explain with an example.
3. Discuss the importance of exploratory data analysis (EDA) in data science.
4. How do outlier detection techniques improve data quality?
5. Explain the working principle of the Apriori algorithm in association rule mining.

Apply

1. Implement K-Means clustering on a dataset and evaluate its performance.
2. Apply Z-score and IQR methods to detect and remove outliers from a given dataset.
3. Use Python (pandas, seaborn) to perform exploratory data analysis on an engineering dataset.
4. Implement the Apriori algorithm to find frequent itemsets in a transactional dataset.
5. Apply PCA on a high-dimensional dataset and visualize the transformed data using scatter plots.

23CES33 Product Design and Innovation**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Building participants confidence and competence in integrating multiple functions for product design and development
2. Enhance team working skills in coordinating multiple interdisciplinary tasks for achieving common objective.
3. Develop Ability to understand the process of product design and improve their technical and communication skills with regard to that.
4. Provide innovative solutions to problems in all the fields of the business.
5. Design marketing tactics appropriate to the limited resources of a new venture.
6. Build an innovative marketing strategy for a new venture.

COs-POs Mapping

COs	PO2	PO3	PO4	PO5	PO10	PO12
1	3	3	3	3	2	3
2	3	3	3	1	3	3
3	3	3	3	2	3	3
4	2	2	3	2	3	3
5	3	3	3	3	3	3
6	2	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Foundations of Design Thinking**

Curiosity and risk, Reflective judgment, User centred thinking, Understanding of problem formulation; idea generation; and solution iteration, R & D, Importance of Quality Control, Understanding of working and communicating with other stakeholders.

Cognitive Biases and Their Impact on Design Thinking- Systems Thinking in Design

12 Hours**Unit II****Creative Exploration and Idea Development in Design**

Design development -problem exploration and formulation, ethnographic methods, iteration of ideas, methods for creative thinking, and conversion of ideas into realizable designs.

Scenario Planning and Future Thinking in Design- Collaborative Design

12 Hours**Unit III****The Product Design Process**

Product Design Process- Defining the Product, Conducting the User Research, Sketching, Prototyping, Compiling Specifications, Samples, Sample Testing, Starting the Production/Development, Providing Quality Assurance.

Eco-friendly Products- Human-Centered Design

12 Hours**Unit IV****Prototyping and Product Evaluation**

Types of Prototyping, functional prototype, using digital & physical model in prototyping, Evaluating product design, Design Iteration, Rapid prototyping, Product Testing, Testing methods.

User Experience (UX) Metrics- Digital Twin Technology in Prototyping

12 Hours**Total:48 Hours**

Reference Books

1. Maddock M. and Uriarte L. (2011). Brand New: Solving the Innovation Paradox – How Great Brands Invent and Launch New Products, Services and Business Models. John Wiley & Sons, Inc., Hoboken, New Jersey.
2. Burkus D. (2014). The Myths of Creativity: The Truth About How Innovative Companies and People Generate Great Ideas. Jossey-Bass- A Wilery Brand, San Francisco, California.
3. Ulrich, Karl, & Steven Eppinger. (2003). Product Design and Development. NY: McGraw-Hill.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the meaning of user-centered thinking in design?
2. List the key steps involved in the problem formulation process.
3. Define quality control and explain its importance in product design.
4. What are ethnographic methods, and how are they used in design exploration?
5. Name three different types of prototyping used in product design.

Understand

1. Explain the role of curiosity and risk-taking in the design thinking process.
2. How does reflective judgment help in identifying the right solutions in design?
3. Compare and contrast iteration of ideas and solution iteration in the design process.
4. Why is prototyping important in product evaluation and testing?
5. How does conducting user research influence the product design process?

Apply

1. Given a new mobile app idea, apply the problem formulation process to define the key challenges and potential solutions.
2. Design a prototype for a smart home device and outline the steps for functional and rapid prototyping.
3. Conduct a user research plan for a new wearable fitness tracker by defining the target audience and data collection methods.
4. Given a scenario where product samples fail quality testing, suggest ways to improve quality control measures before mass production.
5. Develop a creative thinking exercise that can help a design team brainstorm innovative product ideas.

23CES43 Safety in Engineering Industries**3 0 0 3****Course Outcomes**

At the end of the course, student will be able to

1. Illustrate the safety rules, standards and codes in various mechanical engineering processes.
2. Explain various machine guarding systems for lathe, drilling, boring and milling machines.
3. Develop safe procedures for welding, cold forming and hot working of metals.
4. Explain the sources of fire, their prevention techniques and fire suppression systems.
5. Describe the concepts of reliability and risk assessment.
6. Estimate reliability of various systems.

COs-POs Mapping

COs	PO1	PO2	PO6	PO8	PO12
1	2	2	1	2	1
2	3	3	1	1	1
3	2	3	2	1	1
4	3	3	2	2	1
5	2	3	2	1	1
6	2	1	2	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Safety in Metal Working Machinery and Principles of Machine Guarding**

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, safety principles, electrical guards, work area, material handling, inspection. Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening.

Safety Considerations in CNC Machines- Automation and Safety in Material Handling Systems

12 Hours**Unit II****Safety in Welding, Cold Forming and Hot Working of Metals**

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing and soldering– explosive welding, selection, care and maintenance of the associated equipment and instruments. Cold working, power presses, point of operation safe guarding, power press electric controls, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes. Personal protective equipment (PPE).

Occupational Health Hazards in Foundries-Safety Regulations for Metal Forming and Press Operations

12 Hours**Unit III****Fire Prevention and Protection Systems**

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E-Fire extinguishing agents- Water, Foam, Dry chemical powder, Carbon-dioxide, Halon alternatives, Halocarbon compounds-Inert gases , dry powders – types of fire extinguishers. Sprinkler-hydrants-stand pipes – special fire suppression systems-Other suppression systems – CO₂ system, foam system, dry chemical powder (DCP) system, halon system.

Fire Safety Standards and Regulations-Role of Internet of Things (IoT) in Fire Safety Monitoring

12 Hours

Unit IV

Reliability Concept

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – mortality curve – useful life – availability – maintainability – system effectiveness. Reliability Prediction Models- Series and parallel systems, Markov analysis – Fault Tree Analysis. Risk assessment: Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

Human Error and Its Impact on System Reliability- Bayesian Networks in Risk Assessment

12 Hours

Total: 48 Hours

Textbook(s)

1. Philip Hagan “Accident Prevention Manual for Business and Industry”, N.S.C. Chicago, 13th edition, 2009.
2. John V. Grimaldi and Rollin H.Simonds, “Safety Management”, Richard D Irwin, 1994.

References

1. “Occupational safety Manual” BHEL, Trichy, 1988.
2. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
3. “The Indian boilers act 1923 with amendments”, Law Publishers (India) Pvt. Ltd., Allahabad.
4. “Health and Safety in Welding and Allied processes”, Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.
5. “Safe use of wood working machinery”, HSE, UK, 2005. “ISO 14020:2000 Environmental Labels and Declarations-General Principles”, ISO, 2000.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the general safety rules for metalworking machinery?
2. Define Zero Mechanical State (ZMS) and its policy.
3. List the different types of machine guards used in industrial safety.
4. What are the different classes of fire (A, B, C, D, E)?
5. Define Mean Time Between Failures (MTBF) and Mean Time to Failure (MTTF).

Understand

1. Explain the principles of machine guarding and why it is essential in the workplace.
2. Describe the common hazards associated with welding and the precautions to be taken.
3. How does a fire suppression system work in industrial safety?
4. Explain the concept of Fault Tree Analysis (FTA) in risk assessment.
5. Compare series and parallel systems in terms of reliability.

23CES53 Remote Sensing and GIS for Smart Cities**3 0 0 3****Course Outcome**

At the end of the course, student will be able to

1. Describe the role of Remote Sensing and smart city components in urban development.
2. Analyze aerial photographs for spatial surveys.
3. Apply spatial techniques using GIS for smart city applications.
4. Interpret satellite images to derive meaningful information for city management and planning.
5. Apply remote sensing and GIS in real-world smart city scenarios.
6. Integrate IoT, Big Data, and cloud-based geospatial platforms for smart city decision-making.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO7	PO12
1	3	2	1	2	2	3	3
2	3	3	1	3	2	2	3
3	3	3	3	2	3	2	3
4	3	2	1	3	3	2	2
5	3	2	3	2	3	3	3
6	2	2	3	2	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Introduction to Remote Sensing and Smart Cities**

Smart Cities- Definition and Smart City Components - transportation, utilities, governance and disaster management. Remote Sensing Basics- Electromagnetic Spectrum, Important Wavelength Regions for Remote Sensing, Reflectance, Thermal Emissions, Scattering, and Elements involved in Remote Sensing. Platforms and Sensors- Types of platforms, orbit types, Passive and Active sensors, resolution concept, Advantages and Disadvantages of Remote Sensing. Photogrammetry- Definition, Types of Aerial photographs, Vertical Photographs – Geometry, Scale, problems on Flying height and scale.
Role of Remote Sensing and Photogrammetry in Smart City Development.

12 Hours**Unit II****GIS and Spatial Data Management**

GIS Basics- Definition, Objectives, Components, Data Models, Data Structures, Introduction to DBMS, Data Integration and Management in Smart Cities. Map- Types of Maps and an Introduction to Map projections. Urban Spatial Data Analysis- Buffer, Overlay and Network Analysis.
GIS Project Planning for Smart Cities.

12 Hours**Unit III****Satellite Data Analysis**

Satellite Data- Satellite Missions and Data Products Useful for Smart Buildings and Cities. Image Interpretation- Basic Elements of Visual image Interpretation. Image Classification -Techniques for Supervised and Unsupervised classification. Indices- Vegetation indices, water related indices for environmental monitoring.
Urban Heat Island (UHI) Monitoring Indices- Soil Moisture and Drought Indices

12 Hours**Unit IV****Applications and Emerging Trends in Remote Sensing and GIS for Smart Cities**

Urban Land Use and Planning- Change detection, land use classification, and zoning. Utility Management- Monitoring water, electricity, and waste management networks. Environmental Monitoring- Air quality assessment, heat islands, green space analysis. Disaster Management- Risk assessment, evacuation planning, post-disaster damage assessment. Transportation Planning- GIS based route optimization and smart mobility planning. Emerging Trends- Big Data and IOT integration with GIS, Web and Mobile GIS

Applications, Cloud based geospatial platform (Google Earth Engine) for smart city development. Smart building and energy efficiency through GIS.

Smart city initiatives using Geospatial Technologies, Geofencing.

12 Hours

Total: 48 Hours

Textbook (s)

1. Remote Sensing and Geographical Information systems, (4th edition) by M.Anji Reddy B.S. Publications, JNTU Kakinada, 2018.
2. Remote Sensing and GIS, (2nd edition) By Basudeb Bhatta Oxford Higher Education.

Reference (s)

1. Remote Sensing and Image Interpretation, Lillesand T.M & Kiefer R.W., John Wiley and Sons, 2015
2. Elements of Photogrammetry with Application in GIS, Wolf P. R., McGraw Hill International Book Company, Fourth Edition, 2014.
3. Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang,, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2018.
4. Remote Sensing and GIS for Sustainable Urban Development by Ioannis Manakos, Matthias Braun
5. Geospatial Technologies and Smart Cities by Poonam Sharma and Swati Mehtre

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	--
Understand	30	30	--
Apply	50	50	100
Analyze	--	--	--
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the wavelength regions important to remote sensing?
2. What are the components of smart city?
3. What are the types of aerial photographs?
4. Define overlay operations in GIS
5. Define GIS.

Understand

1. Explain the geometry of vertical photographs.
2. Explain the resolution concept in remote sensing
3. Compare between data models and data structures in GIS
4. Explain the difference between supervised and unsupervised image classification techniques.
5. Summarise the scientific approach of remote sensing data analysis

Apply

1. Utilize the given data to determine the photo scale of a vertical aerial photograph taken over flat terrain with a 152.4 mm focal-length camera from an altitude of 1830 m above ground.
2. Solve for the maximum scale, minimum scale, and average scale given that the highest terrain (h1), average terrain (havg), and lowest terrain (h2) are 610, 460, and 310 m above mean sea level, respectively. The flying height above mean sea level is 1800 m and the camera focal length is 152.4 mm.
3. Utilize RS and GIS techniques for the preparation of LULC.
4. Explain how air quality assessment, urban heat island mapping, and green space analysis can be performed using geospatial technologies. Provide examples of cities that have successfully implemented these techniques.

23FIX01 Full Semester Internship (FSI)

0 0 0 8

Course Outcomes

At the end of the course, student will be able to

1. Use the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. Select appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
4. Use ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
5. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
6. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Cos - POs Mapping

COs	PO1	PO2	PO5	PO8	PO9	PO10	PSO1	PSO2
1	3							3
2		3						3
3			3					
4				3				
5					3		1	1
6						3	3	

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

23CE014 Repair and Rehabilitation of Structures

0 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Evaluate the underlying causes and mechanisms of structural distress and deterioration in various structures and develop comprehensive strategies to mitigate these effects.
2. Analyze the deterioration of structures due to corrosion of steel reinforcement, including its causes, effects, mechanisms, and prevention strategies.
3. Acquire knowledge of damage assessment methodologies, including non-destructive and semi-destructive tests, to evaluate the structural integrity of buildings.
4. Identify appropriate methods and materials for the repair and strengthening of damaged structural members.
5. Analyze the components and principles of structural health monitoring systems to assess their essential roles in maintaining structural integrity
6. Predict the impact of smart materials on enhancing the effectiveness of structural health monitoring systems.

Cos - POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	2	3	3	2	3
2	2	3	3	2	3
3	2	3	2	2	3
4	2	3	3	2	3
5	1	2	2	2	2
6	2	2	2	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Structural Distress and Structural Damage

Introduction to Structural Distress – Deterioration of Structures – Causes and prevention of Deterioration.
 Introduction to Structural Damage– Types of causes of Damage-Mechanism of Damage.
Importance of Maintenance – Facets of Maintenance – Need for Rehabilitation

12 Hours

Unit II

Corrosion and Damage Assessment

Introduction to Corrosion of Steel Reinforcement – Causes and Effects – Mechanism and Prevention of Corrosion. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation
 Introduction to Damage assessment, Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT – Mechanical and Chemical Properties – Semi destructive Tests
Ground Penetrating Radar (GPR) – NDT Methods for Corrosion Monitoring

12 Hours

Unit III

Damage Repairs and Retrofitting

Introduction to Repair of Structure – Common Types of Repairs – Material selection for Repair – Repair in Concrete Structures – Repairs in Under Water Structures – Repair Techniques – Guniting – Shotcrete – Underpinning. Introduction to Retrofitting – Strengthening of Structures – Strengthening Methods – Retrofitting techniques – Jacketing
Rust Eliminators – Seismic Retrofitting of Beams and Columns

12 Hours

Unit IV

Structural Health Monitoring

Introduction – Need for continuous monitoring – Levels of system Identification – Components of SHM system –Techniques of SHM – Sensors, actuators and its role in SHM – Principle and organization of a SHM system – Smart materials in SHM
Non-Invasive techniques for SHM – Case study using SHM and Building Instrumentation in SHM

12 Hours

Total:48 Hours

Text Book(s)

1. Poonam I. Modi, Chirag N. Patel, Repair and Rehabilitation of Concrete Structures, PHI Learning Pvt. Ltd.,
2. E F & N Spon, Defects and Deterioration in Buildings, 2nd Ed., Spon press London

Reference(s)

1. W. H. Ranso, Concrete Repair and Maintenance Illustrated, RS Means Company Inc, 1993
2. B. A. Richardson, Building Failures: Diagnosis and Avoidance, EF & N Spon, London, 1991
3. Bungey, Non-Destructive Evaluation of Concrete Structures, Surrey University Press, 1982
4. B.L. Gupta and Amit Gupta, Maintenance and Repair of Civil Structures, 1st Ed., Standard Publications, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1(%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	15	15	-
Understand	85	85	100
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What are the main distress symptoms in a structure?
2. What are the causes for deterioration and distress in structures?
3. What are the various crack repair techniques?
4. Define the terms Repair, Rehabilitation and Retrofitting of structures with examples.

Understand

1. How can the defects and cracks be prevented to appear in concrete? How can these be repaired?
2. Enunciate different causes of cracks in concrete elements.
3. How is corrosion caused in reinforcing steel in R.C. work? Explain some, of the corrosion control methods commonly adopted.
4. List the various non-destructive testing methods for determining physical conditions of concrete and monitoring of defects. Give short details of the tests.
5. Discuss the evaluation procedure for repair and strengthening of concrete structures deteriorated due to corrosion.

23CE015 Remote Sensing and GIS

0 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Describe the remote sensing fundamentals, platforms, and sensors.
2. Analyse aerial photographs during spatial survey.
3. Apply the spatial data analysis in various GIS projects.
4. Analyse the satellite data using image processing techniques.
5. Apply remote sensing and GIS technologies in real-world scenarios.
6. Analyse the capabilities of advanced technologies over conventional in remote sensing and GIS.

COs-POs Mapping

COs	PO1	PO2	PO5	PO12	PSO1	PSO2
1	3	2	2	1	3	2
2	3	2	2	1	3	2
3	3	3	2	2	3	3
4	3	2	2	1	3	2
5	3	2	2	2	3	3
6	3	2	3	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basics of Remote Sensing

Electromagnetic Spectrum: wavelength regions important to remote sensing, Reflectance, Transmission, Absorption, Thermal Emissions, Scattering, Elements involved in Remote Sensing, Advantages and Disadvantages of Remote Sensing.

Platforms and Sensors: Types of platforms, orbit types, Sun-synchronous and Geosynchronous, Passive and Active sensors, resolution concept, Indian Remote Sensing Satellites and their Features-Indian Space Program.

Photogrammetry: Definition, Types of Aerial photographs, Vertical Photographs – Geometry, Scale, problems on Flying height and scale.

12 Hours

Unit II

Basics of Geographical Information systems

GIS: Definition, Objectives, Components, Data Models and Data Structures, Introduction to DBMS.

Map: Types of Maps, Co-ordinate system, Introduction to Map projections.

Spatial Data Analysis: Buffer and Overlay operations, GIS Project Planning.

12 Hours

Unit III

Satellite Data Analysis

Exploration of web sources of satellite data products-Bhuvan, Basic Elements of Visual image Interpretation, Image classification techniques – Supervised and unsupervised, Vegetation indices, water related indices.

12 Hours

Unit IV

GIS Applications and Advancements

Remote Sensing and GIS Applications: Transportation, Water Resources, Environment, Geology, Emergency Management, Agriculture, Urban planning,

Advances in Remote Sensing and GIS: Introduction to Thermal, Microwave and Hyperspectral Remote Sensing. Introduction to Web and Mobile GIS, Google Earth Engine platform for satellite data processing.

12 Hours

Total: 48 Hours**Textbook (s)**

1. Remote Sensing and Geographical Information systems, (4th edition) by M.Anji Reddy B.S. Publications, JNTU Kakinada, 2018.
2. Remote Sensing and GIS, (2nd edition) By Basudeb Bhatta Oxford Higher Education.

Reference (s)

1. Remote Sensing and Image Interpretation, Lillesand T.M & Kiefer R.W., John Wiley and Sons, 2015
2. Elements of Photogrammetry with Application in GIS, Wolf P. R., McGraw Hill International Book Company, Fourth Edition, 2014.
3. Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang., Tata McGraw Hill Publishing Company Ltd, New Delhi, 2018.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	--
Understand	30	30	--
Apply	50	50	100
Analyze	--	--	--
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)**Remember**

1. What are the wavelength regions important to remote sensing?
2. What are the types of aerial photographs?
3. Define overlay operations in GIS
4. Define GIS.
5. List the basic elements of visual image interpretation.

Understand

1. Explain the geometry of vertical photographs.
2. Explain the resolution concept in remote sensing
3. Compare between data models and data structures in GIS
4. Explain the difference between supervised and unsupervised image classification techniques.
5. Summarise the scientific approach of remote sensing data analysis

Apply

1. Utilize the given data to determine the photo scale of a vertical aerial photograph taken over flat terrain with a 152.4 mm focal-length camera from an altitude of 1830 m above ground.
2. Solve for the maximum scale, minimum scale, and average scale given that the highest terrain (h₁), average terrain (h_{avg}), and lowest terrain (h₂) are 610, 460, and 310 m above mean sea level, respectively. The flying height above mean sea level is 1800 m and the camera focal length is 152.4 mm.
3. Utilize RS and GIS techniques for the preparation of LULC.
4. Construct the flow chart for highway alignment using RS and GIS techniques
5. Apply RS and GIS techniques to evaluate the potential sites for artificial recharge of ground water.

23CE016 Pavement Management System

0 0 0 3

Course Outcomes

At the end of the course, student will be able to

1. Explain the components, functions, and influence levels of pavement management systems (PMS) to assess their role in effective pavement maintenance and planning.
2. Analyze different pavement deterioration models, including mechanistic-empirical approaches, to evaluate pavement performance and predict serviceability.
3. Apply various pavement evaluation techniques such as Non-Destructive Testing (NDT) and condition surveys to assess pavement structural capacity and user-related performance.
4. Apply pavement design principles, structural response models, and life cycle cost analysis to evaluate alternative pavement strategies and optimize design solutions.
5. Analyze the effects of traffic loads and temperature-induced stresses on pavement performance to assess structural durability and distress behavior.
6. Evaluate expert systems, decision support tools, and economic evaluation methods for effective pavement management, rehabilitation, and maintenance planning.

Cos - POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	2	1	1	2
2	3	3	2	1	3
3	3	3	2	2	3
4	3	3	2	2	3
5	3	3	2	2	3
6	3	2	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Pavement Management Components Levels and functions

Definition - Components of pavement management systems, essential features. ideal PMS - network and project levels of PMS - influence levels - PMS functions – function of pavement evaluation

Major Phases and Components of the Pavement System Methods - Various Tools and Usage in Pavement Management Systems

12 Hours

Unit II

Pavement Performance and Evaluation of Pavement Structural capacity

Serviceability concepts – roughness - roughness components – equipment – IRI - modelling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models, basics - Non-Destructive Testing (NDT) and Analysis — Condition Surveys – Distress - Destructive Structural Analysis - Application in Network and Project Levels *User Related Evaluation Vs. Engineering Evaluation of Pavements - Pavement Evaluation with respect to User Cost and Benefits*

12 Hours

Unit III

Pavement Design Selection and Alternatives

Design objectives and constraints, basic structural response models, physical design inputs, Alternate pavement design strategies and economic evaluation, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Equipment.

General Response of Pavement Subjected to Traffic Loads and Temperature Induced Stresses

12 Hours

Unit IV

Expert Systems and Pavement Management, Project Appraisal decision support system

Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge - based expert systems, case studies. Project appraisal: private sector participation - Environmental impact assessment – Total Quality Management (TQM) in highway projects

Rehabilitation and Maintenance Policies - Methods for Economic Evaluation of Pavement

12 Hours

Total: 48 Hours

Textbook(s)

1. Ralph Haas, W. Ronald Hudson, Pavement Management Systems, McGraw Publishers, 2015
2. S. K. Khanna & C. E. G Justo, Highway Engineering, 10th Ed., Nem Chand & Bros., Publisher, 2018

Reference(s)

1. AASHTO Guidelines on Pavement Management, American Association of State Highway and Transportation Officials, Washington D.C., 9p. 1985.
2. National Cooperative Highway Research Program Synthesis of Highway Practice 135: Pavement Management Practices. NCHRP, TRB, National Research Council. Washington, D.C. 1987
3. National Cooperative Highway Research Program Synthesis 222: Pavement Management Methodologies to Select Projects and Recommend Preservation Treatments. Transportation Research Board, National Research Council. Washington, D.C. 1995.
4. International Roughness Index. Web page from the Road Roughness Home Page: <http://www.umtri.umich.edu/erd/roughness/iri.html>.
5. Pavement Performance, Lijun Sun, in Structural Behaviour of Asphalt Pavements, ScienceDirect, 2016.
6. IRC 115. (2014). Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique. New Delhi.

Internal Assessment Pattern

Cognitive Level	In Test 1(%)	In Test 2(%)	Open Book/Assignment Exam(%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question(s)

Remember

1. Illustrate the components of PMS
2. List out the equipment involved in non-distractive testing of highway performance.
3. Explain the concept of life cycle cost with respect to a highway.
4. List out the model available to assess the present condition of highway and explain the significance of each model in PMS.
5. Explain the concept of project appraisal in context of highway project and illustrate major involved in it.

Understand

1. Explain the difference between the PMS at network level and project level.
2. Explain the concept of pavement serviceability and methods to evaluate it.
3. Relate the concepts of PMS to new highway project and illustrate the data required in various steps of PMS.
4. Explain the role of alternative design strategies for highway project implementation and clearly discuss various steps involved in pavement rehabilitation.
5. Explain the relevance of environment impact assessment with respect to highway projects.

23CES14 AI and ML for IoT Data Analytics in Civil Engineering**2 0 0 2****Course Outcomes**

At the end of the course, student will be able to

1. Apply AI and ML concepts to solve civil engineering IoT data challenges.
2. Implement data preprocessing techniques for preparing IoT sensor data in civil applications.
3. Utilize data analytics tools for anomaly detection in civil engineering IoT applications.
4. Develop predictive maintenance models using ML for structural health and building systems.
5. Apply deep learning techniques for real-time IoT data analysis in civil engineering.
6. Design AI-powered IoT systems using edge AI and fog computing for real-world applications.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO12
1	3	3	2	2	3	3
2	3	2	2	3	3	3
3	2	3	3	3	3	3
4	3	3	3	3	3	3
5	3	3	3	2	3	3
6	3	3	2	2	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I**Fundamentals of AI and ML for IoT**

Introduction to AI and ML concepts, Importance of data analytics in IoT for civil engineering, Data preprocessing and cleaning techniques, Overview of machine learning algorithms (supervised, unsupervised, reinforcement learning).

Sensor types, network connectivity, and common communication protocols

12 Hours**Unit II****Data Analytics for Civil Engineering IoT Applications**

Descriptive, predictive, and prescriptive analytics, Time-series analysis for IoT sensor data, Anomaly detection in civil engineering structures, Tools for IoT data analytics (Python, Pandas, Scikit-learn, Tensor Flow).

Data cleaning, Explanatory analysis.

12 Hours**Unit III****Machine Learning for Predictive Maintenance**

Predictive models for structural health and building systems, Case studies on AI-driven IoT applications in civil engineering, Deployment of ML models for real-time IoT data streams, Hands-on: Building ML models for sensor data analysis.

Time series analysis, Anomaly detection

12 Hours**Unit IV: Advanced AI Techniques and Future Trends**

Deep learning applications in IoT for civil engineering, Edge AI and fog computing for real-time decision-making, Ethical considerations in AI-powered IoT solutions, Capstone Project: AI-powered IoT system for real-world civil engineering application.

AI-powered IoT systems contribute to smart city, AI-powered IoT systems contribute to smart city

12 Hours**Total: 48 Hours****Textbook(s)**

1. "Machine Learning and IoT: A Biological Perspective" by Ashish Ghosh and Bishnu S. Gupta, Springer, 2021
2. "Big Data and IoT for Structural Health Monitoring" by Abdul Wahid, Wiley, 2020.

Reference(s)

1. "Data Science for Civil Engineers: An Introduction" by Charles Huyck and Jonathan Shoaf, CRC Press, 2021.
2. "Python for Data Analysis" by Wes McKinney, O'Reilly Media, 2017
3. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron, O'Reilly Media, 2019.
4. "Edge AI: Convergence of Edge Computing and Artificial Intelligence" by Zhou Sa, Packt Publishing, 2021.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. List three machine learning algorithms applicable to IoT data analytics in civil engineering.
2. Define anomaly detection in the context of civil engineering IoT systems.
3. Name two data preprocessing techniques crucial for IoT sensor data analysis.
4. Identify two popular Python libraries used for IoT data analytics in civil engineering.

Understand

1. Explain the role of time-series analysis in predicting structural health.
2. Describe how reinforcement learning can be applied to optimize civil infrastructure systems.
3. Illustrate the process of data cleaning for IoT sensor data.
4. Summarize how deep learning differs from traditional machine learning in analyzing IoT data.

Apply

1. Develop a predictive model using scikit-learn to forecast potential failures in building systems based on IoT sensor data.
2. Create a Python script using Pandas to preprocess and clean time-series data from civil engineering sensors.
3. Implement a simple deep learning model using TensorFlow to analyze real-time data from civil structures.
4. Set up a basic edge computing solution for processing IoT data streams in real-time.

Analyze

1. Compare and contrast the use of supervised vs. unsupervised learning models in IoT data analytics for civil engineering.
2. Analyze the implications of using real-time vs. batch processing in structural health monitoring.
3. Discuss the benefits and challenges of using fog computing in civil engineering IoT applications.
4. Differentiate between descriptive and prescriptive analytics in the context of civil engineering data analysis.

Evaluate

1. Evaluate the effectiveness of machine learning models in detecting anomalies in civil structures.
2. Assess the potential of edge AI to enhance real-time decision-making in critical infrastructure monitoring.
3. Critically appraise the ethical considerations in deploying AI-powered IoT systems in public infrastructure projects.
4. Determine the impact of AI and ML on improving the lifecycle management of civil engineering projects.

23CES24 Predictive Analytics and Machine Learning**2 0 0 2****Course Outcomes**

At the end of the course, student will be able to

1. Apply machine learning concepts and model evaluation metrics to assess the performance of predictive models in engineering applications.
2. Implement regression-based models (Linear, Polynomial, Logistic) and decision tree-based methods for predictive modeling.
3. Apply advanced supervised learning techniques such as SVM and boosting algorithms to enhance model accuracy and interpretability.
4. Utilize clustering, dimensionality reduction, and anomaly detection techniques to analyze complex engineering datasets.
5. Implement deep learning architectures (CNNs) and time series forecasting models for predictive analytics in engineering applications.
6. Deploy machine learning models using Flask and FastAPI and apply MLOps principles for efficient model lifecycle management.

COs-POs Mapping

COs	PO1	PO2	PO3	PO5	PO12
1	3	2	2	3	2
2	3	3	2	3	2
3	3	3	3	3	2
4	3	3	3	3	2
5	3	2	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Predictive Analytics**

Basics of Predictive Analytics and its Role in Engineering. Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning. Overview of Machine Learning Models: Regression, Classification, Clustering. Model Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, AUC-ROC. Introduction to Python for Machine Learning (Scikit-Learn, TensorFlow).

Model evaluation metrics, Scikit-Learn vs. TensorFlow.

12 Hours**Unit II****Supervised Learning Algorithms**

Linear Regression, Polynomial Regression. Logistic Regression and its Applications. Decision Trees and Random Forest. Boosting Algorithms. Support Vector Machines (SVM). Model Interpretation and Tuning.

Boosting algorithms, Hyperparameter tuning

12 Hours**Unit III****Unsupervised Learning Algorithms**

K-Means and Hierarchical Clustering. Principal Component Analysis (PCA) for Dimensionality Reduction. Association Rule Learning: Apriori, FP-Growth. Anomaly Detection in Engineering Data. Case Study: Predictive Analytics in Smart Cities.

Anomaly detection, Dimensionality reduction in clustering.

12 Hours

Unit IV

Advanced Machine Learning and Model Deployment

Introduction to Deep Learning: Neural Networks and CNNs. Time Series Forecasting: ARIMA, LSTMs. Model Deployment using Flask and FastAPI. Introduction to MLOps: CI/CD for ML Models. Case Study: Predictive Maintenance in Civil, Mechanical, and Electrical Engineering
ML model deployment, MLOps automation.

12 Hours
Total : 48 Hours

Textbooks

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning," Springer, 2nd Edition, 2009.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.

Reference Books

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning," MIT Press, 2016.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning," Springer, 2013.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	10	10	-
Understand	40	40	-
Apply	50	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Questions

Remember

1. Define logistic regression and its applications.
2. List different types of bias and their impact on model performance.
3. What is the role of cross-validation in model selection?
4. Describe the concept of principal component analysis (PCA).
5. What are association rules in unsupervised learning?

Understand

1. Explain the bias-variance trade-off with an example.
2. How does Lasso regression differ from Ridge regression?
3. Describe the process of backpropagation in neural networks.
4. Explain how the k-nearest neighbor algorithm classifies data points.
5. Discuss the importance of ensemble learning in predictive analytics.

Apply

1. Implement Ridge regression on a given dataset and analyze the results.
2. Use the bootstrap method to estimate the confidence interval of a sample dataset.
3. Develop a decision tree classifier for a real-world classification problem.
4. Apply PCA to reduce the dimensionality of a dataset and interpret the results.
5. Train a support vector machine on an image dataset and evaluate its performance.

23CES34 Business Analytics for Entrepreneurship**2 0 0 2****Course Outcomes**

At the end of the course, student will be able to

1. Apply the concepts and methods of business analytics in a business.
2. Identify, model and solve decision problems in different settings
3. Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
4. Create viable solutions to decision making problems
5. Evaluate how contemporary marketing techniques can be used for maximizing entrepreneurial success.
6. Demonstrate competence in development and problem solving in the business.

COs-POs Mapping

COs	PO2	PO3	PO4	PO5	PO10	PO11	PO12
1	3	3	3	3	2	3	3
2	3	3	3	1	3	3	3
3	3	3	3	2	3	3	3
4	2	2	3	2	3	3	3
5	3	3	3	3	3	2	3
6	2	3	3	3	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Business and Entrepreneurship Analytics**

Business Analytics- Introduction and role of analytics in industry, Types of analysis – Descriptive – Diagnostic – Predictive and Prescriptive, Business analytics in practice. Introduction to Entrepreneurship Analytics, Global Entrepreneurship Analytics, Innovation and new product development analytics.

Real-time Analytics and Decision Making in Business- Role of Artificial Intelligence (AI) in Business Analytics

12 Hours**Unit II****Innovation and Big Data Analytics in Entrepreneurship**

Entrepreneurship Analytics- Innovation analytics as a critical success factor for innovation, and new product development; Three levels of analytics capability emerge at a managerial level: operational, experienced, and transformed, Big Data in Innovation and Entrepreneurship and its applications.

Predictive Analytics for Startup- Risk Assessment strategies using Big Data

12 Hours**Unit III****Business Analytics Tools and Techniques**

Business Analytics: Tools and Techniques - Introduction to R Programming, PYTHON, SPSS, AMOS and MS-Excel – Key data analysis techniques used – Descriptive – Diagnostic – Predictive and Prescriptive (Practical), Big Data Analytics- Big Data- Characteristics and Relevance , Data search algorithms in search engines.

Natural Language Processing (NLP) in Business Analytics- Data Visualization for Business Insights

12 Hours**Unit IV****Data-Driven Marketing and Customer Analytics**

Data Analytics in Marketing and Customer Analytics- Introduction to Marketing analytics, relevance and scope; Understanding consumer attitudes and

perceptions, Customer Analytics – Compliance analytics – Fraud analytics – Operational analytics, Cluster Analysis, Discriminant Analysis, Principal Components Analysis, Market Basket Analysis, Digital advertisements – Recommender systems.

*Sentiment Analysis in Digital Marketing- AI-Powered Chatbots in Marketing Strategies***12 Hours****Total: 48 Hours****Text Books**

1. Kehal, M., & Alf, S.E. (Eds.). (2021). Data Analytics in Marketing, Entrepreneurship, and Innovation (1st ed.). CRC Press.
2. Maheswari A. (2017) Data Analytics, McGraw Hill Education

References

1. S, A.Vivek & Kumar, Rakesh S. (2019). Business Analytics: An Introduction. Kollam: SS Book Series
2. Siegel E. (2013). Predictive Analytics, The Power To Predict Who Will Click, Buy, Lie Or Die R, Wiley
3. Simon P. (2015). Too Big to Ignore, The Business Case for Big Data. Wiley, 58

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)**Remember**

1. Define Business Analytics and explain its role in industry.
2. What are the four types of business analytics? Briefly describe each.
3. What is the significance of entrepreneurship analytics in modern businesses?
4. List the three levels of analytics capability in entrepreneurship.
5. What are the key characteristics of big data, and why is it important for innovation?

Understand

1. Explain the difference between descriptive, diagnostic, predictive, and prescriptive analytics with examples.
2. How does innovation analytics contribute to new product development?
3. Compare and contrast Big Data Analytics in entrepreneurship and traditional business analytics.
4. Why is data search algorithm optimization important for search engines and business analytics?
5. How do customer attitudes and perceptions influence marketing analytics and decision-making?

Apply

1. Given a startup company, apply predictive analytics to forecast sales trends for the next year.
2. Use Big Data Analytics to suggest an innovative strategy for improving customer engagement in an online business.
3. Develop a marketing analytics strategy using customer segmentation and cluster analysis for a new e-commerce platform.
4. Implement a basic R/Python script to perform descriptive analytics on business sales data.
5. Design a fraud detection system using fraud analytics techniques for an online banking platform.

23CES44 Reliability Engineering and Integrated Management Systems**2 0 0 2****Course Outcomes**

At the end of the course, student will be able to

1. Describe the significance of reliability metrics and apply failure data analysis using exponential, normal, gamma and Weibull distribution
2. Solve problems and work on m/n configuration systems, series parallel systems.
3. Conduct risk assessment to identify the industrial problem and provide suitable solution
4. Explain the basic concepts and knowledge about occupational health and safety management systems
5. Discuss the structure and features of OHSAS 18001.
6. Illustrate the significance of ISO 45001 OSHMS.

COs-POs Mapping

COs	PO1	PO2	PO6	PO8	PO12
1	3	2	3	2	1
2	3	3	3	2	3
3	3	3	3	2	3
4	3	2	2	2	1
5	3	1	2	3	1
6	3	1	1	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Reliability and Failure Data Analysis**

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) -- mortality curve – useful life – availability – maintainability – system effectiveness. Time to failure distributions – Exponential, normal, Gamma, Weibull - ranking of data – probability plotting techniques – Hazard plotting.

Bathtub Curve in Reliability Engineering-Practical Applications of Weibull Analysis

12 Hours**Unit II****Reliability Prediction Models and Risk Assessment**

Series and parallel systems – RBD approach – Standby systems – m/n configuration – Application of Bayes' theorem – cut and tie set method – Markov analysis – Fault Tree Analysis – limitations. Risk Assessment-Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

Monte Carlo Simulation for Reliability Analysis-Bow-Tie Analysis in Risk Management

12 Hours**Unit III****OHSAS Standard**

OHSAS Standard Introduction – Development of OHSAS standard – Structure and features of OHSAS 18001 –FOHSR -Planning – Guidelines, methodology steps developing action plan-OHSAP -OH&S policy-certification procedure – OH & S management system element, specification and scope- Benefits of certification of OHSAS 18001- correspondence between OHSAS 18001, ISO22000, ISO18001, ISO 15001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.

Legal and Regulatory Requirements for OHSAS 18001 Certification

12 Hours**UNIT IV****ISO 45001 Standard**

ISO 45001 ISO 45001- need for ISO 45001 – Terms and definitions -structure and features of ISO 45001- contents of ISO 45001- developing OH&S Policy –guidelines- Benefits -Certification Procedure-correspondence between OHSAS 18001 and ISO 45001. Gap Analysis -migration from OHSAS 18001 to ISO 45001. ISO 45001 Implementation and Operation, OHSMS audit –Continual improvement – Beyond ISO 45001.

Role of Leadership and Worker Participation in ISO 45001

12 Hours
Total: 48 Hours

Textbook(s)

1. Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", McGraw Hill Education, 12th edition 2017.
2. Arora K C Dr, "ISO 9000 to OHSAS 18001", S.K. Kataria & Sons, Delhi, 2010.
3. ISO 45001:2018 – Occupational Health and Safety Management System

References(S)

1. Srinath L.S, "Reliability Engineering", East West Press, 2005.
2. Modarres, "Reliability Engineering and Risk analysis", CRC Press, 2009.
3. John Davidson, "The Reliability of Mechanical Systems" Mechanical Engineering Publications Limited, 1994.
4. Wayne Parady, Terri Andrews, "Integrated Management System", Bernan Press, 2nd Edition, 2019.
5. Ramesh C Grover, Sachin Grover, "Providing Safe & Health workplace with ISO 45001:2018", Notion Press,

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	40	40	50
Apply	30	30	50
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Mean Time Between Failures (MTBF) and Mean Time to Failure (MTTF).
2. What is the purpose of Fault Tree Analysis (FTA) in risk assessment?
3. List the key differences between OHSAS 18001 and ISO 45001 standards.
4. What are the major time-to-failure distributions used in reliability engineering?
5. Define the Hazard Plotting Technique and its significance in reliability analysis.

Understand

1. Explain how the mortality curve is used in failure data analysis.
2. Describe the importance of reliability metrics in engineering systems.
3. How does the RBD (Reliability Block Diagram) approach help in predicting system reliability?
4. Explain the certification process for ISO 45001 and its benefits for industries.
5. Discuss the significance of Gap Analysis when migrating from OHSAS 18001 to ISO 45001.

Apply

1. Given failure data, calculate the MTBF and reliability function for a system using an exponential distribution.
2. Develop a risk assessment plan for a manufacturing plant using Bayes' theorem.
3. Using a case study, apply Fault Tree Analysis (FTA) to identify potential risks in an industrial process.
4. Design a migration roadmap for an organization transitioning from OHSAS 18001 to ISO 45001.
5. Create an ISO 45001 implementation checklist for an organization aiming for certification.

23CES54 Intelligent Transportation Systems

2 0 0 2

Course Outcomes

At the end of the course, student will be able to

1. Apply ITS concepts to improve transportation system performance and sustainability.
2. Utilize sensor technologies and advanced data collection techniques for real-time traffic management.
3. Evaluate user needs to select and implement suitable ITS solutions for diverse transportation challenges.
4. Analyze ITS architecture and applications in traffic management, incident response, and sustainable mobility.
5. Develop ITS-based solutions for electronic toll collection, road pricing, and transportation network operations.
6. Design and implement ITS for traffic management, incident management, and transportation planning.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO9	PO10
1	3	2	1	2	2	1	2	2
2	3	3	2	1	2	1	2	2
3	2	3	3	2	2	2	2	2
4	3	2	3	2	3	2	3	3
5	2	2	3	3	3	2	3	3
6	3	2	3	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Intelligent Transportation Systems (ITS)

Fundamentals of ITS: Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS. Introduction to the role of ITS in traffic and incident management systems. ITS Programs in the World - Overview of ITS implementations in developed countries, ITS in developing countries.

Evolution of ITS Technologies, ITS in Sustainable Transportation

12 Hours

Unit II

Sensor Technologies and Data Requirements of ITS

Importance of telecommunications in the ITS. Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques - Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection.

Advanced Sensor Technologies in ITS, Data Fusion Techniques in Traffic Management

12 Hours

Unit III

ITS User Needs, Services, and Functional Areas

Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS).

AI in Advanced Traffic Management Systems, ITS for Public Transportation Efficiency

12 Hours

Unit IV

ITS Architecture, Applications, and Global Implementation

Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning. ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems- Vehicles in Platoons – Integration of Automated Highway Systems.

Regional ITS Architectures, ITS for Road Pricing and Electronic Toll Collection

12 Hours

Total: 48 Hours

Textbook (s)

1. Mashrur A. Chowdhury, Adel Wadid Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, 2003.
2. Lawrence A. Klein, Sensor Technologies and Data Requirements of ITS, Artech House, 2004.
3. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.

Reference (s)

1. Kan Paul Chen, John Miles, ITS Handbook 2000: Recommendations for World Road Association (PIARC), PIARC, 2000 .
2. US Department of Transportation, National ITS Architecture Documentation, 2007.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	50	50	-
Apply	30	30	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Intelligent Transportation Systems (ITS).
2. List the types of sensor technologies used in ITS.
3. Recall the main components of Advanced Traffic Management Systems (ATMS).
4. Define Automatic Vehicle Location (AVL) and its role in ITS.
5. Name the benefits of implementing ITS in urban areas.

Understand

1. Explain the role of traffic sensors in ITS.
2. Describe the concept of Data Fusion in Traffic Management Centers.
3. How does an Advanced Traveler Information System (ATIS) assist commuters?
4. Explain how Automatic Vehicle Identification (AVI) works and its role in toll collection.
5. Describe the relationship between ITS architecture and transportation planning.

Apply

1. Propose an ITS solution to alleviate traffic congestion in a metropolitan city. What technologies would you implement?
2. Suggest a combination of ITS technologies to improve the efficiency of a public transportation system in a city
3. Design an ITS framework for incident management on a busy highway using real-time data collection and sensors.
4. Apply the concept of Advanced Vehicle Control Systems (AVCS) to propose a solution for improving road safety in urban areas.
5. How would you use Automatic Vehicle Location (AVL) and Geographic Information Systems (GIS) to track and manage a fleet of commercial vehicles?

23CEH11 Advanced Concrete Technology

4 0 0 4

Course Outcomes

1. Demonstrate various concreting methods, including underwater concreting, shotcrete application, high-volume fly ash concrete, and the use of concrete incorporating construction and demolition waste.
2. Implement the concepts, constituent materials, and properties of self-compacting concrete (SCC) in practical applications.
3. Apply knowledge of the behavior of Fiber-Reinforced Concrete (FRC) and ferrocement under compression, tension, flexure, and shear to assess their structural performance.
4. Calculate the fundamental material properties of various concrete types, including lightweight, high-density, and high-performance concrete.
5. Evaluate the impact of different end conditions of concrete specimens, capping techniques, and the height-to-diameter (H/D) ratio on the accuracy and reliability of tests.
6. Assess the reliability and applicability of Non-Destructive Testing (NDT) methods in evaluating concrete properties and integrity.

COs-POs Mapping

COs	PO1	PO2	PO12	PSO1	PSO2
1	2	1	1	3	3
2	3	2	2	3	3
3	2	2	2	3	3
4	2	1	3	3	3
5	3	2	3	3	3
6	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

RMC concrete and Self-compacting concrete

Manufacture, transporting, placing, precautions, Methods of concreting, under water concreting, shotcrete, High volume fly ash concrete, concrete with construction & demolition waste - concept, properties, typical mix Self-compacting concrete concept-materials, tests, properties and typical mix.

Pumping, Applications of Self-compacting concrete

16 Hours

Unit II

Fiber reinforced concrete and Ferro cement

Fibers types and properties, Behaviour of FRC in compression, tension including pre-cracking stage and post-cracking stages, behaviour in flexure and shear Ferro cement - materials, techniques of manufacture, properties and application.

Nylon fiber, Bamboo fiber

16 Hours

Unit III

Light weight concrete and high performance concrete

Materials properties, Typical light weight concrete mix High density concrete High performance concrete-sustainable materials, properties, typical mix.

Applications, Types

16 Hours

Unit IV

Test on Hardened concrete and NDT tests

Effect of end condition of specimen, capping, H/D ratio, Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods.

Rate of loading, Moisture condition

Total: 64 Hours

Textbook (s)

1. Neville A.M., "Properties of Concrete", 5th Edition, Trans-Atlantic Publications, Inc.; 2012
2. Concrete Technology, Gambhir M.L, Tata McGraw Hill Fifth edition, 2013.
3. Shetty M. S., Concrete Technology", S. Chand & Co.,8th Edition, 2019.
4. Job Thomas., "Concrete Technology", Cenage learning, 2015.
5. R. Santhakumar „ Concrete Technology", Oxford Universities Press, 2018.

Reference (s)

1. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2010
2. Lea, Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017
3. Bungey, Millard, Grantham – Testing of Concrete in Structures- Taylor and Francis, 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	---
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Classify the fibers.
2. List out various test conducted on RMC.
3. What is meant by placing?
4. What is meant by self-compacting concrete?
5. Define Ferro cement.

Understand

1. Explain about the behaviour of FRC in compression.
2. Explain about various properties of Ferro cement.
3. What do you understand by lightweight of concrete and explain briefly the test to be conducted for light weight concrete?
4. Explain about the composition of hardened concrete.
5. Explain the Cracking behaviour for beam with the help of different types natural fiber as per the aspect ratio (OBE).

23CEH12 Advanced Structural Analysis**4 0 0 4****Course Outcomes**

1. Analyze the determinate beams for practical moving load combinations using Influence Line diagram.
2. Determine the shape factor for various types of beam cross sections.
3. Evaluate the plastic moment capacity for beams.
4. Analyze the indeterminate beam subjected with different loading condition using flexibility matrix method with and without settlement of supports.
5. Analyze the indeterminate beam subjected with different loading condition using stiffness matrix method without settlement of supports.
6. Analyze the indeterminate beam subjected with different loading condition using flexibility matrix method with settlement of supports.

COs-POs Mappings

COs	PO1	PO2	PO3	PO12	PSO2
1	2	3	1	3	3
2	2	3	1	3	3
3	2	3	2	3	3
4	2	3	1	3	3
5	2	3	1	3	3
6	2	3	2	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Influence Lines and Moving Loads**

RLD and ILD for statically determinate beams subjected to single & several point loads, UDL longer than the span and shorter than the span – Maximum positive, negative shear force, Maximum bending moment and absolute maximum bending moment.

ILD for pratt truss, ILD for Warren truss

16 Hours**Unit II****Plastic Analysis**

Determination of shape factor for rectangular, triangular, circular, T and I sections – Lower bound and upper bound theorems – Plastic Moment analysis for statically determinate and indeterminate beams.

Shape factor for rhombus, Shape factor for trapezium

16 Hours**Unit III****Flexibility Matrix Method**

Equilibrium and compatibility – Continuous beam with simply supported end, fixed support end & end span overhanging with and without support settlements.

Flexibility method for determinate beam, rigid jointed plane frames

16 Hours**Unit IV****Stiffness Matrix Method**

Equilibrium and compatibility – Continuous beam with simply supported end, fixed support end & end span overhanging with and without support settlements.

Stiffness method for determinate beam, rigid jointed plane frames

16 Hours**Total: 64 Hours****Textbook (s)**

1. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‘Analysis of Structures-Vol I’, 17th Ed., Khanna Publishers, New Delhi, 2015
2. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‘Analysis of Structures-Vol II’, 16th Ed., Khanna Publishers, New Delhi, 2015

3. S.S. Bhavikatti, Structural Analysis II, 5th Ed.,Vikas Publishing House Pvt Ltd, 2013

Reference (s)

1. S.B.Junnarkar, Mechanics of Structures Vol.I, 31st Ed., Charotar Publishing House, 2015.
2. S.B.Junnarkar, Mechanics of Structures Vol.II, 24th Ed., Charotar Publishing House, 2015
3. T.S. Thandavamoorthy, Analysis of Structures, 1st Ed., Oxford University Press, New Delhi, 2011.
4. B.C. Punmia, Strength of Materials and Mechanics of Solids,5th Ed., Vol-2Laxmi Publications, New Delhi, 2010
5. C.S. Reddy, Structural Analysis, 11th Ed.,Tata McGhill Publications, New Delhi, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	10	10	--
Understand	10	10	--
Apply	80	80	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

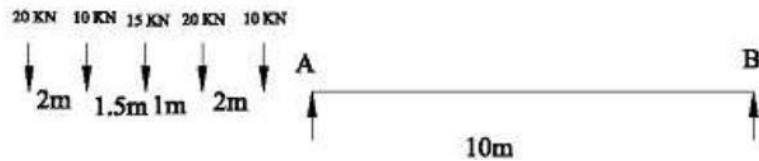
1. Define influence line.
2. What are the basic unknowns in stiffness matrix method?
3. What is the equilibrium condition used in the stiffness method?

Understand

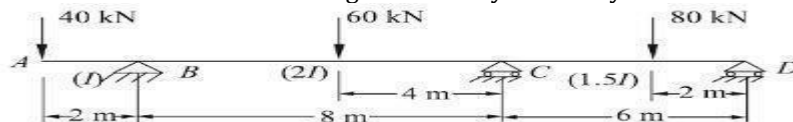
1. Differentiate upper bound theorem and lower bound theorem.
2. Contrast between Statically determinate structures and Indeterminate structures?
3. What are degrees of freedom?

Apply

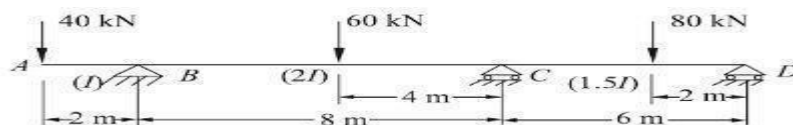
1. A system of concentrated loads role a simply supported beam of span 10 m from left to right with 10 KN load leading. Calculate the absolute maximum positive and negative shear in the beam. Also Calculate the absolute max BM?



2. A live load of 15 kN/m, 5 m long moves on a girder simply supported on a span of 13 m. Find the maximum shear force that can occur at a section 6 m from the left end. Also find the maximum bending moment that can occur at a section 6 m from the left end.
3. Analyze the Portal Frame ABCD shown in the figure below by Flexibility Method. EI is constant.



4. Analyze the Continuous Beam ABCD shown in the figure below by Stiffness Method. EI is constant.



23CEH13 Design of Industrial Structures**4 0 0 4****Course Outcomes**

1. Develop planning strategies to meet the functional requirements of industrial structures.
2. Apply design concepts and construction techniques for industrial structures.
3. Build various loads and configurations to determine their impact on industrial structures.
4. Develop the design and detailing of industrial reinforced concrete structures under different loading conditions.
5. Develop the design and detailing of industrial chimneys considering various loading conditions.
6. Apply design principles and methodologies in the planning and construction of cooling towers.

COs-POs Mappings

COs	PO1	PO2	PO3	PSO1	PSO2
1	3	2	1	2	3
2	3	3	2	2	3
3	3	3	2	2	3
4	3	3	1	2	3
5	3	3	2	2	3
6	2	3	2	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Planning and Functional Requirements**

Classification of Industries and Industrial Structures – General requirements for Industries like cement, chemical and steel plants – Planning and layout of buildings and components
Lighting – ventilation - Acoustics – Fire safety – Guidelines from factories act.

*Electrical installations – substations***16 Hours****Unit II****Loads on Industrial Buildings and Various Configurations**

Loads on Industrial structures – Gravity load, Live load, wind load and Earthquake load - Configuration of various Industrial buildings, Need for large column free areas - Various types of floors.

*Roofs, Roof coverings***16 Hours****Unit III****Industrial RC Structures**

Structural design and detailing of corbels, bunkers, silos

*Function of Bunker, Function of Silos***16 Hours****Unit IV****Industrial Steel Structures**

Structural design and detailing of Chimneys and Cooling towers

*Requirement of Chimney, Requirement of Cooling towers***16 Hours****Total: 64 Hours****Textbook (s)**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2016
2. A. R. Santhakumar and S. S. Murthy, Transmission Line Structures, Tata McGraw Hill, 1992

Reference (s)

1. P. Dayaratnam, Design of Steel Structures, A.H. Wheeler & Co., Ltd., Allahabad, 2008
2. S. N. Manokar, Tall Chimneys – Design and Construction, Tata McGraw Hill, 1986

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	20	20	--
Apply	60	60	--
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	100
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down the important guidelines from Factories act with reference to planning of industrial buildings
2. Enumerates the points to be considered for providing natural lighting and ventilation.
3. Enlist the types of fire extinguishers.

Understand

1. Analyse the functions of Transmission line Towers.
2. Explain about Specific requirements for Industries
3. Generalize the causes for fire in Industrial Buildings.

Apply

1. An industrial building is to be provided with a hand operated 50 kN crane facility. The details of the building and the gantry girders are: Longitudinal spacing of columns = 6m, Centre to centre distance of gantry girders = 12m, Wheel spacing = 3m, Edge distance = 1m, Weight of crane girder = 40 kN, Weight of trolley car = 10 kN. Design the gantry girder for bending and shear.
2. Explain the difference between bunkers and silos in various aspects.
3. Design a Bunker. Assume suitable data. **(For Open Book Examination and not for semester end examination)**

23CEH14 Bridge Engineering**4 0 0 4****Course Outcomes**

1. Utilize principles, procedures, and current Indian code requirements to analyze and design bridge elements.
2. Examine the general considerations and specifications for the design of road bridges.
3. Build knowledge on the various types of loads induced on road bridges
4. Implement key design parameters in the design of culverts.
5. Design and check the stability of piers
6. Design and check the stability of abutments

COs-POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	1	2	2	2	2
2	2	2	2	2	2
3	1	2	2	2	2
4	2	2	3	2	3
5	1	3	3	2	3
6	2	3	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction to Bridges**

Introduction – Classification of bridges - Site selection – Soil exploration for site – Selection of bridge type – Economical span – Number of spans – Determination of HFL – General arrangement drawing.

*Linear water way, Afflux***16 Hours****Unit II****Standard Specifications for Road Bridges**

Width of carriageway- Clearances - Loads to be considered - Dead load – I.R.C standard live loads - Impact effect - Review of I.R.C loadings - Application of live loads on deck slabs – Wind load – Longitudinal forces - Centrifugal forces - Horizontal forces due to water currents.

*Buoyancy effect, Earth Pressure***16 Hours****Unit III****Design of Culverts**

Introduction, analysis and design of – pipe culverts -- slab culverts - box culverts - Reinforcement detailing.

*Skew slab culvert, Skew angle***16 Hours****Unit IV****Design of Substructures**

Introduction to pier and abutments – Types of pier and abutments - Forces acting on Piers and Abutments -Analysis and Design of Abutments and pier

*Types of Foundations, Bearings***16 Hours****Total: 64 Hours****Textbook (s)**

1. Johnson Victor D , Essentials of Bridge Engineering, 6th Ed., Oxford & IBH Publishing Company, 2015
2. B. C. Punmai, Jain & Jain , Design of RC Structures, 10th Ed., Lakshmi publications, 2016

Reference (s)

1. R.P.Pama & A.R.Cusens, Bridge Deck Analysis, 1st Ed., John Wiley & Sons, 1975
2. T.R. Jagadish & M.A. Jairam, Design of Bridge Structures, 2nd Ed., Prentice Hall of India, N. Delhi, 2004
3. Aswani, Vazirani & Ratvani, 4th Ed., Bridge Engineering, 2014

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Exam (%)
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	--	--	100

Sample Question (S)

Remember

1. List the different components of a bridge.
2. List any four types of loads to be considered in the design of road bridges.
3. Write an expression to calculate the centrifugal force when a road bridge is situated on a curve.
4. What is economical span of a bridge?

Understand

1. What are the characteristics of an ideal site for a major bridge across a river?
2. What is the significance of impact factor and how it is estimated?
3. Differentiate culvert and a bridge.
4. Sketch a typical well foundation indicating clearly its component parts and also discuss their functions.

Apply

1. Design a R.C. Slab culvert for a national highway to suit following data:
 Clear span = 5.5m
 Carriage way width = Two Lane
 Wearing coat = 100mm
 Width of bearings = 400mm
 Foot Path = 1m on either side
 Loading = IRC Class A-A tracked vehicle
 Materials M35 grade concrete and Fe415 steel
 Sketch the details of reinforcement in the cross section of slab.
2. Check the adequacy of the dimensions of the pier with the given data:
 Top Width of Pier = 1.5m with semicircular ends
 Bottom Width of Pier = 2.4m with semicircular ends
 Length of pier = 7m excluding the semicircular part
 Height above footing = 10m
 HFL above the top of footing = 8m
 Total DL reaction = 2000kN
 Total LL reaction = 1100kN
 Braking Force = 130kN
 C/C distance of bearing on either side of centre line of pier = 0.45m
 Material for pier M20 & Fe 415
 Live Load: IRC Class A-A tracked vehicle
 Velocity of water current = 4m/s
3. Design a pipe culvert through a road embankment of height 5m. The width of the road is 7.5m and the formation width is 12m. The side slope of the embankment is 2:1. The maximum discharge is $5\text{m}^3/\text{s}$. The safe velocity is 3m/s. Class A wheeled vehicle is to be considered as live load. Assume sharp edged entry. Given $C_e = 1.5$, $C_s = 0.010$ and the unit weight of the soil is $20\text{kN}/\text{m}^3$.
4. Design a Reinforced concrete slab culvert for a two lane national highway with M35 grade concrete and Fe 415 steel. Assume the necessary data and follow all the standard specifications as per IRC. **(For Open Book Examination and not for semester end examination)**

23CEH21 Rural Road Technology**4 0 0 4****Course Outcomes:**

1. Comprehend the necessity and significance of rural road networks.
2. Develop knowledge in the geometric design of rural roads.
3. Select appropriate materials for the construction of rural road pavements.
4. Acquire skills in pavement design and construction for rural roads.
5. Illustrate the importance of green roads and their impact on the ongoing infrastructure growth in India.
6. Explore the utilization of various waste materials for constructing rural roads and transforming them into green roads.

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PSO1	PSO2
1	3	2	1	1	1	3
2	3	3	3	2	1	3
3	3	2	1	3	3	2
4	3	3	3	3	3	3
5	3	2	3	2	2	3
6	3	2	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Introduction**

Importance of Rural roads, Classification of rural roads, Terrain classification, Socio-economic impact of rural roads. Planning and Alignment: Data base for master plan, Concept of network planning, Rural Roads plan, Road alignment, Governing factors for route selection, Factors controlling alignment, Surveys.

*Detailed project report, Environmental issues***16 Hours****Unit II****Geometric Design**

Introduction, Design speed, Basic principles of geometric design, Elements, Horizontal and vertical alignment, Alignment compatibility,. Materials for bituminous pavement construction, semi-rigid pavement, rigid pavement and special pavements.

*Lateral and vertical clearances***16 Hours****Unit III****Pavement Design**

Introduction, Design parameters, Pavement components, Design of flexible pavement for low volume roads, Design of rigid pavement for low volume roads, Method of construction bituminous pavements, Semi-rigid pavements, Concrete pavements, special pavements.

*Equipment required for earthwork***16 Hours****Unit IV****Green Road Concept and Use of Waste Materials**

Introduction, Significance of green roads, Fly ash for road construction, Iron & steel and copper slags, Lime, rice husk ash concrete, Recycled concrete aggregate, other waste materials.

*RAP, cold mix technology***16 Hours****Total: 64 Hours****Textbook (s)**

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. IRC: SP 19-2002 "Rural Roads Manual" Indian road congress, New Delhi, 2002

Reference (s)

1. IRC: SP 62-2015 'Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads'
2. IRC: SP 72-2015 'Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads'
3. IRC 'Specifications for Rural Roads', MoRD, 2004
4. Handbook of Transportation Engineering by Myer Kutz, Editor, McGraw-Hill Publishers, 2000.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	50
Understand	40	40	50
Apply	30	30	--
Analyze			--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Explain the socio economic impact of rural roads.
2. Discuss the salient features of flexible pavement design for rural roads in India as per the guideline of IRC: SP:72.

Understand

1. Discuss the factors controlling the alignment of rural roads.
2. What are the various elements considered in pavement curve design for different terrains? Say the importance of each element and mention the draw back in absence of those for flexible and rigid pavement.
3. Why mostly Indian road network is laid with Asphalt, what are all the limitations with Asphalt Pavement in line to environmental issues? Detail the alternatives developed to overcome those. **(For Open Book Examination and not for semester end examination)**

23CEH22 Evaluation and Strengthening of Pavements

4 0 0 4

Course Outcomes

1. Grasp the impact of various factors on pavement design.
2. Analyze structural and functional stresses affecting pavements.
3. Recognize different types of distress in pavements.
4. Apply modern tools to assess the surface condition of pavements.
5. Understand the BBD and FWD tests used in the evaluation of pavements.
6. Evaluate the structural condition of pavements. measures

COs-POs Mappings

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	3	2	1	1	1	1	3
2	3	3	3	2	1	2	3
3	3	3	2	3	2	3	3
4	3	2	3	3	3	3	3
5	3	2	3	3	3	3	3
6	3	2	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Stresses and Deflections in Flexible & Rigid Pavements

Highway pavement: Types and components, Factors affecting design and performance of pavements. Stresses and deflections, factors influencing the stresses.

KENPAVE, IIT PAVE

16 Hours

Unit II

Distresses In pavements

Pavement distress; different types of failures in flexible and rigid pavements and its causes, structural and functional safety, repair and retrofitting of road structures.

Types of Pavement maintenance, recycling of pavements

16 Hours

Unit III

Evaluation of Surface Condition

Methods of measurement of skid resistance, unevenness, ruts and cracks. Pavement surface condition evaluation by physical measurements, their applications.

Stone polishing value, Road Profiling Van

16 hours

Unit IV

Evaluation of Pavement Structural Condition

Evaluation by non-destructive tests such as FWD, Benkelman Beam rebound deflection using BBD for flexible overlay design, Plate load test.

LIDAR survey, Area under pavement profile

16 hours

Total: 64 Hours

Textbook (s)

1. Principles of Pavement Design' by Yoder, E.J., and Witczak, 2nd ed. John Wiley and Sons, 2011.
2. The design and performance of road pavements by Croney, D. and P. Croney, McGraw-Hill Book Company, London, UK, 1997.

Reference (s)

1. Pavement Management System' by Haas and Hudson McGraw Hill Book Co., New York, 1994.
2. Pavement Design and Materials by Papagiannakis, A.T. and E.A. Masad, John Wiley and Sons, New Jersey, USA, 2008.

- Pavement Engineering Principles and Practice by Mallick, R.B. and T. El-Korchi CRC Press, Taylor and Francis Group, Florida, USA, 2009.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	19	19	--
Understand	30	30	50
Apply	50	50	50
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

- What are the factors that affect pavement design?
- List the types of distresses.

Understand

- Explain Benkelman beam rebound deflection test at evaluation and strengthening of pavement.
- Explain FWD test at evaluation and strengthening of pavement.

Apply

- Due to increased traffic a thickness of 20cm of concrete pavement is required overlay. Calculate the thickness of the rigid overlay when, (i) existing pavement is 10cm thick and is in good condition and (ii) existing pavement is 10cm thick but is badly cracked.
- Plate bearing tests were conducted using 30cm diameter plate on soil subgrade and over a base course of thickness 45 cm. The pressure yielded at 0.5cm deflection on the subgrade and base course were 1.25kg/cm² and 8 kg/cm² respectively. Design the thickness requirement of flexible pavement for a wheel load of 5300kg. With tyre pressure of 7 k/cm² for an allowable deflection of 0.5cm using Burmister's two layer deflection factor chart.

23CEH23 Traffic Engineering and Management

4 0 0 4

Course outcomes

1. Explain the fundamental traffic parameters, including volume, speed, and density, and apply statistical methods for analyzing speed and parking survey data.
2. Analyze the relationship between traffic flow characteristics, delay studies, and parking parameters to evaluate road network efficiency and performance.
3. Evaluate highway capacity and Level of Service (LOS) by considering factors such as lane width, lateral clearance, heavy vehicle adjustments, and peak-hour demand.
4. Apply signal design principles, including cycle length determination, saturation flow rate, and vehicle-actuated signals, to optimize traffic signal operations.
5. Analyze road accident data using statistical techniques and conduct road safety audits to develop effective accident prevention strategies.
6. Evaluate transportation system management measures such as one-way streets, transit stop relocation, and congestion pricing to improve traffic flow and reduce peak-period congestion.

COs-POs Mappings

COs	PO1	PO3	PO7	PO12	PSO2
1	3	2	1	2	2
2	3	3	2	2	3
3	3	3	2	2	3
4	3	3	2	2	3
5	3	3	3	2	3
6	3	2	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Traffic Studies

Basic tenets of traffic: Volume, Speed and Density; Definitions and their interrelationships; Moving observer method, statistical methods for speed data Analysis, Presentation of speed data. Parking Studies: parameters of parking, definitions; Analysis of Parking Survey data. Delay Studies: Head ways and Gap Studies.

PCE, Desire lines

16 hours

Unit II

Capacity, LOS Analysis

Introduction to Traffic capacity, Analysis concepts, Level of Service, Basic definitions, Factors affecting Capacity and LOS, Capacity of Urban/Rural Highway, With or without access control, Basic freeway segments: Service flow rate of LOS, Lane width or Lateral clearance adjustment; Heavy vehicle adjustment; Driver population adjustment.

Vertical clearances, Peak hour factor

16 hours

Unit III

Signal Designing and Road Accident Studies

Fixed Time signals, Determination of Optimum Cycle length and Signal setting for Fixed Time signals, Warrants for Signals, Saturation flow rate, and Adjustment factors, Vehicle Actuated Signals, Signal Coordination. Accident analysis and modelling, Road Safety Auditing, Measures to increase Road safety.

Conflict Points, Chi-square test

16 hours

Unit IV

Transportation System Management

Measures for Improving vehicular flow, one-way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes; Reducing Peak Period Traffic; Strategies for working hours.

Congestion pricing, Geofencing

16 hours
Total: 64 hours

Textbook (s)

1. L.R. Kadiyali, Khanna Publishers, Traffic Engineering and Transportation Planning. 1999.
2. C.S. Papacostas, Prentice Hall India, Fundamentals of Transportation Engineering. 3rd edition 2002.
3. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019
4. Louis J. Pignataro, Prentice Hall Publication, Traffic Engineering – Theory & Practice. 1973.

Reference (s)

1. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018.
2. Roger P. Roess, William R. Mc. Shane, Elena S.Prassas, Traffic Engineering, Prentice Hall, 1977
3. Highway Capacity Manual -2010

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	40	40	50
Apply	40	40	50
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List the two factors considered by HCM in LOS.
2. List traffic signals coordination systems.

Understand

1. Derive the relationships between the following and represent diagrammatically.
(i) Flow and concentration. (ii) Speed and flow. (iii) Speed and concentration
2. Indicate the factors effecting level of service.
3. Indicate the warrants for traffic signals installation.

Apply

1. Twenty-five spot speed observations were taken and are as 50 40 60 54 45 31 72 58 43 52 46 56 4365 33 69 34 51 47 41 62 43 55 40 49 calculate(i)Time mean speed. (ii) Space mean speed and verify between the two.
2. Predict Design standards of Multi Story Car Parking Facility
3. A fixed time 2-phase signal is to be provided at an intersection having a north-south and an east west road where only straight-ahead traffic is permitted. The design hour flows from the various arms and the saturation flows for these arms are as following

	North	South	East	West
Design hour flow in PCU/hr	800	400	750	600
Saturation flow in PCUs/hour	2400	1900	3000	3000

- Calculate the optimum cycle time and green times for the minimum overall delay. The time lost per phase due to starting delays can be assumed to be 2 seconds. The value of the amber period is 2.
4. Inspection of a freeway data set reveals a free flow speed of 60 mph, a jam density of 180 vehicles per mile per lane, and an observed maximum flow of 1900 vehicles per hour. Determine the linear equation for velocity for these conditions, and determine the speed and density at maximum flow conditions. How do the theoretical and observed conditions compare?

23CEH24 Planning and Design of Airport

4 0 0 4

Course Outcomes

1. Explain the growth of air transport, airport classifications, and aircraft characteristics to analyze their impact on airport planning and design.
2. Analyze the factors affecting runway, gate, and taxiway capacity to optimize airport operations and minimize delays.
3. Apply airport design principles, including site selection, runway orientation, and noise control measures, to enhance airport efficiency and safety.
4. Explain planning and functional requirements of airport terminal facilities, including aprons, parking, and hangars, to optimize passenger and aircraft operations.
5. Analyze airport drainage system design and construction methods to ensure efficient stormwater management and prevent runway flooding.
6. Apply traffic control aids such as runway markings, lighting systems, and Instrument Landing Systems (ILS) to enhance airport safety and operational efficiency.

COs-POs Mapping

COs	PO1	PO3	PO7	PO12	PSO2
1	3	2	1	2	2
2	3	3	2	2	3
3	3	3	2	2	3
4	3	2	2	2	3
5	3	3	3	3	3
6	3	2	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Growth and Characteristics of Airport and Aircraft

Growth of air transport, Airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas. Aircraft Components, size turning radius, speed, airport characteristics.

Zones, turning radius

16 Hours

Unit II

Design of Airport Components

Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, and Taxiway Capacity Airport Site Selection, Orientation of runways, Runway length and width, longitudinal and transverse grades, runway intersections, taxiways, clearances, noise control, Problems.

Runway numbering, Sight distances

16 Hours

Unit III

Planning of Airport Terminal

Airport terminal building facilities, Operational concepts, space relationships and area requirements, vehicular traffic, parking at airports, aprons, Grading of airport area, Clinometer, hydrology.

Hanger, Blast fences

16 Hours

Unit IV

Airport Drainage & Traffic Control Aids

Design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system, Problems. Runways and taxiways markings, day and night landing aids, airport lighting and other associated aids.

Landing information system, ILS

16 Hours

Total: 64 Hours

Textbook (s)

1. Khanna, Arora and Jain. "Airport Planning and Design", Sixth Ed., Nem Chand and Bros., Roorkee, 2017
2. Rangwala, "Airport Engineering", 17thEd, Charotar Publishers, Gujarat, 2018

Reference (s)

1. Virender Kumar and Satish Chandra, "Airport Planning and Design", First Ed., Galotia Publication, 2012
2. Robert Horenjeff, "Planning and Design of Airports", 5th Ed., McGraw Hill Book Co. 2010

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	30	--
Understand	40	60	70
Apply	40	10	30
Analyze			--
Evaluate	--		--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)**Remember**

1. Differentiate between basic and design runway length.
2. What are the design factors to be considered for determining the thickness of airport pavements?

Understand

1. What are the functions of taxiway and hanger in airport layout?
2. What do you understand by littoral drift?
3. Describe how the optimum runway orientation is determined. **(For Open Book Examination and not for semester end examination)**

Apply

1. Discuss the application of wind rose diagram based on site condition.
2. The length of a runway under standard conditions is 2100m. The airport is to be provided at an elevation of 500 m above mean sea level. The airport reference temperature is 20°C. The construction plan provides gradients of +1.00 %, -0.5%, +0.5%, +0.4 % and -0.1% at chainages 300, 800, 1200, 1600 and 2000 to 2500 m from one end. Determine the actual length of runway to be provided based on ICAO recommendations. **(For Open Book Examination and not for semester end examination)**
3. Design a runway pavement section for a wheel load of 27000kg with a tire pressure of 11kg/cm². For this purpose the plate bearing test with 75cm diameter was carried out on soil subgrade and the plate yielded a pressure of 2kg/cm² at 0.5cm deflection after ten load repetitions. **(For Open Book Examination and not for semester end examination)**

23CEH31 Elements of Rock Mechanics

4 0 0 4

Course Outcomes

1. Explain the properties and characteristics of different rocks
2. Demonstrate the rock strength analysis and failure modes
3. Describe the wave propagation in rock bodies
4. Discuss the stress- strain relationships in rocks and deformability of rocks
5. Demonstrate the importance of grouting in rocks
6. Illustrate the practical application of rock engineering principles

COs – POs Mappings

COs	PO1	PO2	PO7	PSO1	PSO2
1	3	2	1	1	2
2	3	3	2	2	3
3	3	2	2	1	3
4	3	3	2	2	3
5	3	2	2	1	3
6	3	3	2	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Index Properties of Rocks

Introduction – Physical and Mechanical Properties of Rocks – Elastic Parameters of Rocks – Dynamic Properties of Rocks – Static and Dynamic Module.

Importance of rock mechanics, application of rock mechanics

16 Hours

Unit II

Rock Strength

Types of Waves – Theory of Wave Propagation – Factors influencing Wave Velocity in Rock Mass – Modes of Rock Failure – Strength of Rock – Shear – Tensile – Compressive – Measurements.

Principal stresses and strains, Wave Velocity

16 Hours

Unit III

Deformability of Rocks and Stress

Stress - Strain behaviour – Initial Stress – Influence of Joints – Distribution of Stresses – Measurements of Initial Stresses.

Stresses and strains in rock, Principal stresses

16 Hours

Unit IV

Rock Grouting and Introduction to Rock Engineering

Introduction – Grouting – Types of Grouting – Rock Bolt – Types – Systems – Rock Engineering: Introduction – Merits and Demerits – Tunneling – Rock Openings – Rocks for Mining Subsidence, Dam, Road Cuts, Slabs and Foundations.

Testing of Rock Bolts, Application of rock engineering,

16 Hours

Total: 64 Hours

Textbook (s)

1. Jaeger .C, Rock Mechanics and Engineering, 2ndEd., Cambridge University Press, 2011.
2. Verma.B.P, Rock Mechanics for Engineers, 3rd Ed., Khanna Publication, 1997.

Reference (s)

1. Goodman .P.E, Introduction to Rock Mechanics, 2nd Ed., John Wiley and Sons, 1989.
2. Stillburg, Professional User Handbook for Rock Bolting, Tran Tech Publications, 1989.
3. Brow .E.T, Rock Characterisation, Testing and Monitoring, 4th Ed., Pergman Press, 1981.
4. Hock and Bray,J, Rock Slope Engineering, Institute of Mining and Metallurgy, 2004.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	--	--
Understand	30	20	--
Apply	50	80	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

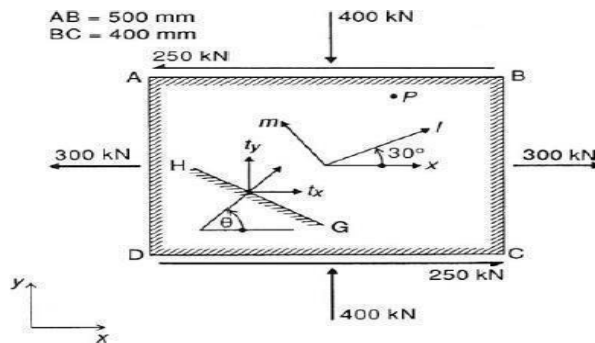
1. Define Hardness of Rocks.
2. Define Creep in rocks.
3. Define porosity and permeability of rocks.
4. Write Terzaghi’s Rock mass Classification.

Understand

1. Explain about the use of information on elasticity and plasticity of a rock mass help in designing structures over them.
2. Discuss Mohr’s Scale of Hardness.
3. Explain the factors that are responsible for rock strength.
4. Explain static and dynamic moduli of elasticity.
5. Explain swelling and anisotropy in rocks.
6. Explain the cable jacking test.

Apply

1. The rectangular plate shown in the figure below has the given loads uniformly distributed over the edges. The plate is 50 mm thick, AB is 500 mm and BC is 400 mm.
 - (a) Determine the shear forces which must operate on the edges BC, DA, to maintain the equilibrium of the plate.
 - (b) Relative to the x, y reference axes, determine the state of stress at any point P in the interior of the plate.
 - (c) For the l, m axes oriented as shown, determine the stress components $\sigma_{ll}, \sigma_{mm}, \sigma_{lm}$.
 - (d) Determine the magnitudes of the principal stresses, and the orientation of the major principal stress axis to the x axis
 - (e) For the surface GH, whose outward normal is inclined at θ° to the x axis determine expressions for the component tractions, t_x, t_y , operating on it as a function of $\sigma_{xx}, \sigma_{yy}, \sigma_{xy}$ and θ . Determine values of t_x, t_y for $\theta = 0^\circ, 60^\circ, 90^\circ$ respectively. Determine the resultant stress on the plane for which $\theta = 60^\circ$. **(For Open Book Examination and not for semester end examination)**



23CEH32 Construction in Expansive Soils**4 0 0 4****Course Outcomes**

1. Compare the properties and characteristics of clay mineralogy
2. Explain the behaviour of expansive soils
3. Discuss the analysis and prediction of swelling characteristics of the soils
4. Illustrate the applications of foundation practices
5. Suggest the suitable methods of stabilization for expansive soils
6. Explain the analysis of shear strength in expansive soils

COs - POs Mappings

COs	PO1	PO2	PO3	PO7	PS02
1	3	1	2	1	3
2	3	2	3	2	2
3	3	1	3	2	3
4	3	1	3	1	3
5	3	2	3	3	3
6	3	2	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Clay mineralogy**

Introduction, Classification of Clay Minerals, Clay Mineral Groups, Crystal Structure of Clay Minerals, Clay Mineral Properties, Thermal Methods, Base Exchange Capacity, Industrial Applications, Clay Mineral Equilibrium.

Formation of Soil, Origin of Clay

16 Hours**Unit II****Swelling characteristics**

Swelling - factors effecting swelling - swell potential- methods of determination of swell pressure – factors affecting swelling potential and swell pressure – Heave - methods of determination of heave.

Properties of expansive soils, factors affecting heave

16 Hours**Unit III****Foundation Practices in Expansive Clays**

Sand cushion – Belled Piers – CNS layer technique – Under – reamed pile foundations – Construction techniques – design specifications – Load -carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands – granular pile Anchors. Lime soil columns – Vertical and Horizontal Moisture Barriers. Methods of stabilization.

Preponding, Lime slurry pressure injection

16 Hours**Unit IV****Shear strength of expansive soils**

Kattis concept of bilinear strength envelope- Stress state variables in partly saturated soils- Fredlunds strength parameters- determination of matrix suction by axis translation technique- field suction measurement.

Shear strength parameters, Tests to determine Shear strength parameters

16 Hours**Total: 64 Hours****Textbook (s)**

1. F.H.Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York, 1988
2. J. D. Nelson and D. J. Miller, "Expansive Soils: Problems and Practice in Foundation and Pavement Engineering," John Wiley and Sons Inc., New York, 1992.
3. Gopal Ranjan and AS Rao, 3rd Ed. Basic and Applied Soil Mechanics, New Age International Publishers, New Delhi. 2016.

Reference (s)

1. D.G. Fredlund and H.Rahardjo, Soil Mechanics for Unsaturated Soils, 1 st Ed. WILEY Inter science Publication, John Wiley & Sons, Inc. 1993
2. D.R. Katti, AR Katti, Behaviour of Saturated Expansive Soils and Control methods, 1 st Ed. Taylor and Francis. 2002
3. Hand Book on Under reamed and Bored Compaction Pile Foundations – CBRI, Roorkee.
4. IS: 2719(Part XLI) – 1977 Measurement of Swelling Pressure of Soils.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	30	30	
Understand	50	50	
Apply	20	20	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is an expansive soil and its general characteristics?
2. Define swelling potential.
3. What is an underreamed pile?
4. Define collapse potential.

Understand

1. How do you identify an expansive soil from its index properties?
2. What are the effects of swelling on buildings?
3. Explain the design of a drilled pier in an expansive soil.

Apply

1. How do you identify a collapsible soil from its liquid limit and dry unit weight?
2. How would you design a foundation on an expansive not susceptible to wetting?
3. If an expansive soil susceptible to wetting, what are the alternatives would you recommend. A structure is constructed over expansive soil without investigation, how you examine the safety of structure and if it is prone to uncertainties what are the loss mitigation methods you would adopt.

(For Open Book Examination and not for semester end examination)

23CEH33 Geosynthetics in Soil Structures

4 0 0 4

Course Outcomes

1. Explain the fundamental concepts that govern the behavior of soils reinforced with geosynthetics.
2. Summarize the types of geosynthetic products, their functions, applications, and suitability in different scenarios.
3. Examine the stability and material requirements of reinforced earth retaining walls to construct effective designs.
4. Classify different types of reinforced embankments based on their structural performance under varying conditions.
5. Distinguish the load-bearing characteristics of reinforced soil beds to determine their suitability for different applications.
6. Compare the structural behavior of reinforced pavements to analyze their performance and optimize design.

COs – POs Mappings

COs	PO1	PO2	PO3	PO7	PSO1
1	3	1	2	2	3
2	3	2	3	2	2
3	3	1	3	2	3
4	3	1	3	2	3
5	3	2	3	2	3
6	3	1	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Reinforced Earth

Concept, Effects of Reinforcement on soils – Equal Confining and Psuedo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory determination, Factors affecting friction coefficient; Geosynthetics: Types, Functions, Tests on Geosynthetics, Durability aspects

Application of Reinforced Earth, Application of Geosynthetics

16 Hours

Unit II

Reinforced Earth Retaining Walls

Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall, Reinforced slope & design, Advantages over conventional Retaining Walls.

Failure Mechanisms, Cost benefit ratio

16 Hours

Unit III

Reinforced Embankments and Soil Beds

Introduction, Design of Reinforced Embankment, Foundation mattress below the embankment, Design of Reinforced Mattress

Soil Beds: Introduction, Factors affecting the Behaviour of Reinforced Soil Beds, Analysis and Design.

Embankments over soft soils, BC analysis of Reinforced soil beds

16 Hours

Unit IV

Reinforced Pavements

Benefits of placing reinforcement in flexible pavement layers, design of reinforced pavements by Groud and Noiray approach and modified CBR Method.

Field identification of CBR value, geosynthetic stabilisation of roads on expansive soils

16 Hours

Total: 64 Hours

Textbook (s)

1. An Introduction to Soil Reinforcement and Geosynthetics” by G.L. Siva Kumar Babu (2006), University Press, Hyderabad.
2. Reinforced Soil and Its Engineering Applications” by Swami Saran (2017), I.K. International Pvt Ltd, New Delhi.
3. Designing with Geosynthetics” by Robert M Koerner (2012), Xlibris, United States of America.

Reference (s)

1. Venkatappa Rao, G. and Suryanarayana Raju, G.V.S. (1990), “Engineering with Geosynthetics”, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Construction and Geotechnical Engineering using Synthetic Fabrics” by Robert M. Koerner and Joseph P. Welsh (1980), John Willey and Sons, New York.
3. BS 8006:1910, “Code of practice for strengthened/reinforced soils and other fills
4. FHWA-NH1-00-043, (2014) “Mechanically stabilized earth walls and reinforced soil slopes design and construction guidelines”.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	20	20	-
Understand	40	40	-
Apply	40	40	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)
Remember

1. What are the effects of reinforcement on soil?
2. What is RERW?
3. What are the advantages of placing reinforcement in flexible pavement?

Understand

1. Explain the concept of Psuedo Cohesion. Derive expressions for its determination.
2. Explain different application of Geosynthetics.
3. Discuss the advantages of RERW over conventional Retaining Walls.
4. Discuss in brief about modified CBR Method.

Apply

1. Demonstrate stability mechanisms and its importance in designing Reinforced Earth Retaining Wall.
2. Classify various types of geosynthetics according to their suitability and application.
3. Illustrate with an example factors affecting the Behavior of Reinforced Soil Beds.

Analyze

1. It is required to design the reinforcement for a steep embankment resting on a competent soil. The height of the slope is 8 m and constructed with a slope angle of 70° . The properties of the soil are $c=0$, $\phi=35^\circ$ and $\gamma=20\text{kN/m}^3$. A uniform surcharge of 25 kPa acts on top of the slope. What is the total resistance force to be provided by the reinforcement layers to increase the factor of safety to 1.5. Perform the analysis by planar wedge method.
2. Reinforced soil retaining wall is constructed of steel strips. The details of the system are as follows: Height of the wall = 8 m with horizontal backfill soil. Properties of backfill and reinforced soil are $c=0$, $\phi=30^\circ$, $\gamma=20\text{kN/m}^3$, $c=0$, $\phi=30^\circ$, $\gamma=20\text{kN/m}^3$. Assume that the allowable bearing pressure on the foundation soil is 300 kPa. The steel strips are 50 mm wide and 6 mm thick. The yield strength of the steel is 415 N/mm^2 . Apply a reduction factor of 1.1 on the yield strength of steel strips. The design life of the structure is 119 years. Assume that the steel strips are galvanized and the structure is a land based structure. The steel strips are placed at horizontal spacing of 0.5 m c/c. There are totally 11 number of reinforcement layers at the following depths from the surface (z): 0.25, 1.0, 1.75, 2.5, 3.25, 4, 4.75, 5.5, 6.25, 7.0, 7.75m. The permanent surcharge on the wall is 25 kPa and the live load surcharge is 18 kPa. A bridge abutment is supported on the wall with a footing width of 2m, placed at a front

distance of 1.5m. The vertical load on the footing is 500 kN (treat it as permanent load) and the horizontal load is 45 kN/m.

- (a) What is the cross-sectional area of the steel strips at the end of design life
- (b) What is the vertical pressure due to bridge abutment load at a depth of 1m
- (c) What is the factor of safety against rupture of the reinforcement

23CEH34 Soil Dynamics

4 0 0 4

Course Outcomes

1. Demonstrate the scope and significance of soil dynamics.
2. Summarize the basic dynamic properties of soils.
3. Apply the principles of wave propagation to analyze the dynamics of continuous systems.
4. Examine the factors influencing dynamic response analysis and evaluate their effects on soil behavior.
5. Distinguish between various liquefaction phenomena and assess their impact on soil stability.
6. Dissect the basic theory of vibrations to identify its influence on geotechnical applications.

COs - POs Mappings

COs	PO1	PO2	PO3	PO7	PSO1
1	3	2	1	2	3
2	3	3	1	2	2
3	3	3	2	2	3
4	3	3	1	2	3
5	3	3	2	2	3
6	3	3	2	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Fundamentals of Vibration

Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Logarithmic decrement, Determination of viscous damping.

Transmissibility, Vibration measuring instruments.

16 Hours

Unit II

Wave Propagation

Longitudinal and torsional waves in infinitely long rod; Solution for one-dimensional and three-dimensional equations of motion; Earthquake waves – P-wave, S- wave, Rayleigh wave and Love wave; Locating earthquake's epicentre.

Waves in semi-infinite body, Waves in layered medium;

16 Hours

Unit III

Dynamic soil properties

Laboratory and field testing techniques (Seismic Reflection and MASW methods), Elastic constants of soils. Evaluation of Liquefaction using simple methods and methods for mitigating liquefaction of soils.

Elastic constants of soils, Introduction to Liquefaction of soils.

16 Hours

Unit IV

Vibration Analyses

Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation. Introduction to the design of reciprocating, impact, turbo generator machine foundations.

Definition of Allowable soil pressure, Definition of Vibration isolation

16 Hours

Total: 64 Hours

Textbook (s)

1. Swami Saran, Soil Dynamics and Machine Foundation, 3rd Ed., Galgotia Publications Pvt. Ltd., 2016
2. Prakash. S., Soil Dynamics, 3rd Ed. McGraw Hill, 1981
3. Kramer S. L., Geotechnical Earthquake Engineering, 1st Ed. Prentice Hall, 2003

Reference (s)

1. Das, B. M., Principles of Soil Dynamics, 2nd Ed. PWS KENT publishing Company, Boston, 2014.
2. Richart, F. E. Hall J. R and Woods R. D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
3. Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, 1st Ed., PHI Learning Pvt. Limited, New Delhi, 2010.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	30	20	-
Understand	40	30	-
Apply	10	10	40
Analyze	20	40	60
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is ‘Logarithmic Decrement’?
2. What is viscous damping? Explain the effect of damping on amplitude of vibrations.
3. What are the considerations involved in design of pile foundations subjected to dynamic loads?
4. Describe cyclic plate load test used in determination of coefficient of elastic uniform compression of soils.

Understand

1. Explain the terms, damped natural frequency, magnification factor and logarithmic decrement.
2. Explain the Pressure bulb concept used in determination of mass of co-vibrating soil for determination of natural frequency of foundation-soil system.
3. Derive expressions for its determination.
4. Explain the different types of waves that propagate through semi-infinite elastic medium.
5. Explain dynamic bearing capacity theory of soils.

Apply

1. From first principles obtain the equation of motion for over damped, critically damped and under damped systems.
2. Describe the development of mass spring dashpot model from elastic half space theory.

Analyze

1. In a block test according to Indian standards, resonant frequency of 18 Hz was observed in the vertical direction. The base size of concrete test block was 1.5m X 0.75m. The thickness of the block was 0.75m. Unit weight of concrete = 24kN/m³. Determine Cu. If a machine weighing 100kN is to be supported on a rigid block 6m X 8m X 2.5m, what is the natural frequency in the vertical direction?
2. Distinguish between Longitudinal and torsional vibrations of elastic rods.
3. A foundation block of weight 30 kN rests on soil for which stiffness may be assumed as 25000 kN/m. The machine is vibrated vertically by an exciting force of 3Sin 30t kN. Find the natural frequency, period, natural circular frequency and the amplitude of vertical displacement.
4. Determine the natural frequency of a machine foundation that has a base area of 6m² and a weight of 175kN including weight of machine. The coefficient of elastic uniform compression of soil is 4 x 10⁴ kN/m³. Use Barkan’s method.
5. A block vibration test was performed on a concrete block of size 1m x 1m x 1m using vertical excitation. The results are tabulated. Assuming unit weight of concrete as 24kN/m³, determine the value of damping Factor (D). **(For Open Book Examination and not for semester end examination).**

Frequency (rpm)	500	600	700	750	850	950	1000	1190
Amplitude (mm)	0.2	0.6	1.5	2.5	3.2	2.5	1.5	0.6

23CEH41 Modern Construction Material**4 0 0 4****Course Outcomes**

1. Analyze the behavior, properties, and advantages of fiber-reinforced concrete, and self-compacting concrete.
2. Evaluate the applications of ternary blend concrete and temperature-controlled concrete and discuss alternate Materials on high performance & high Strength concrete.
3. Examine the properties, advantages, and applications of different steels, aluminum products, and reinforcement coatings, including fusion-bonded epoxy-coated rebars (FBEC).
4. Analyze the properties, manufacturing processes, and advantages of reinforced polymers, including different types of fiber-reinforced plastics (FRP) and their applications in structural elements.
5. Evaluate the role of carbon fiber-reinforced polymers and metal matrix composites in enhancing material performance for various engineering applications and classify smart and intelligent construction materials.
6. Explore the characteristics, differences, and applications of smart and intelligent materials, including photovoltaic materials and temperature-responsive polymers, through case studies.

COs-POs Mapping

COs	PO1	PO2	PO4	PO7	PO12	PSO2
1	3	3	2	2	2	1
2	3	3	2	3	2	1
3	3	3	2	3	2	2
4	3	2	2	3	2	2
5	3	3	2	3	2	2
6	3	3	2	3	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I**Special Concretes**

Behaviour of concretes – Properties and Advantages of High Strength and High-Performance Concrete – Properties and Applications of Fiber Reinforced Concrete, Self-compacting concrete, Alternate Materials on high performance & high Strength concrete.

Ternary Blend Concrete, Temperature Controlled Concrete

16 Hours**Unit II****Metals**

Types of Steels – Advantages of new alloy steels – Properties and advantages of aluminium and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.

Manufacturing process of steel, Fusion Bonded Epoxy Coated Rebars (FBEC)

16 Hours**Unit III****Composites**

Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements- Applications of FRP.

Carbon Fiber reinforced polymer, Metal matrix composite.

16 Hours**Unit IV****Smart and Intelligent Materials**

Types & Differences between Smart and Intelligent Materials – Special features –Case studies showing the applications of smart & Intelligent Materials.

Applications of Photovoltaic materials, Temperature-responsive polymers

16 Hours**Total: 64 Hours**

Textbook (s)

1. Santhakumar.A.R., "Concrete Technology", Oxford University press, 2018
2. Shan Somayaji, "Civil Engineering Materials", Prentice Hall Inc., 2001
3. Shetty M.S, "Concrete Technology: Theory and Practice", S.Chand & Company Ltd., 2019,Eighth revised edition
4. Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.

Reference (s)

1. ACI Report 440.2R-02, "Guide for the design and construction of externally bonded RP systems for strengthening concrete structures", American Concrete Institute, 2002.
2. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, "Materials for civil and Highway Engineers", Prentice Hall Inc., 1998.
3. Mamlouk, M.S. and Zaniewski, J.P., "Materials for Civil and Construction Engineers", Prentice Hall Inc., 1999.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down about Self-compacting concrete.
2. Enumerates the list of different types of Plastics.

Understand

1. Explain about applications of FRP.
2. Differentiate between Smart and Intelligent Materials. **(For Open Book Examination and not for semester end examination).**

23CEH42 Construction Planning and Project Management

4 0 0 4

Course Outcomes

1. Analyze the project life cycle, types of construction, financing, legal requirements, and the role of project managers in strategic planning and feasibility studies.
2. Evaluate project clearance procedures, environmental and social impact assessments, and documentation requirements for major construction projects.
3. Develop construction plans by selecting appropriate technologies, defining work tasks, estimating resource requirements, and applying simulation models for project risk analysis.
4. Apply scheduling techniques, including the Critical Path Method (CPM) and resource-constrained scheduling, to optimize construction project timelines and utilize project management tools like MS Project and Navisworks for construction activities.
5. Develop efficient project information management systems using databases, centralized management approaches, and conceptual data models.
6. Explain the different databases that can be maintained in the construction industry using computers and integrate Building Information Modeling (BIM) into construction projects.

COs-POs Mappings

COs	PO1	PO2	PO7	PO10	PO11	PO12	PSO2
1	3	3	2	2	3	3	1
2	3	3	3	2	3	3	1
3	3	3	3	3	3	3	2
4	2	3	3	3	3	3	2
5	2	2	3	3	3	3	1
6	3	2	3	2	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Project Management

Project life cycle, Types of construction, Selection of professional services, Construction contractors, Financing of constructed facilities, Legal and regulatory requirements, Role of project managers, Strategic planning, Feasibility studies, DPR, Techno Economic analysis, Environmental and Social impact analysis, Project clearance procedures and documentation for major works.

Organization of Project Participants, Owner Builder Operations

16 Hours

Unit II

Construction Planning and Management

Basic concepts in the development of construction plans, Choice of technology and Construction method, defining work tasks, Work breakdown structure, Definition, precedence relationships among activities, estimating activity durations, Estimating resource requirements for work activities, coding systems. Site mobilization, demobilization aspects, resources management, Project Risk analysis.

Design and Construction as an Integrated System, Simulation models for project risk analysis.

16 Hours

Unit III

Scheduling Procedures and Techniques

Construction schedules, Critical path method, Scheduling calculations, Float, presenting project schedules, Scheduling for Activity-on-Arrow and with Leads, Lags, and Windows, Scheduling with resource constraints and precedence's, use of advanced scheduling techniques, Scheduling with uncertain durations, Crashing and Time/Cost Trade-offs, Improving the Scheduling process.

Scheduling of a small construction project using tools like MS project, Virtual progress tracking of small construction project using Navisworks.

16 Hours

Unit IV

Organization and Use of Project Information

Types of project information, Accuracy and Use of Information, Computerized organization and use of Information, Organizing information in databases, relational model of data bases, Other conceptual Models

of Databases, Centralized database Management systems, Databases and application programs, Information transfer and Flow.

Design of a simple equipment information system for a construction project, Introduction to Building information Modelling (BIM) – Demo only

16 Hours
Total: 64 Hours

Textbook (s)

1. P S Gahlot & B M Dhir, Construction Planning & Management, New Age International Limited Publishers (India) 2018.
2. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA, 2017.
3. Chitkara K K., Construction project management, planning, scheduling and control, McGraw Hill (INDIA) publishers, New Delhi, third edition 2014.

Reference (s)

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
3. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remembering	40	25	--
Understanding	50	40	70
Application	--	25	30
Analysis	--	--	--
Evaluate	10	10	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Identify the various resources used for construction project.
2. Define construction planning.
3. How will you create an activity node and activity event?
4. Define DBMS
5. Define Project Life cycle.

Understand

1. Differentiate financial and managerial accounting.
2. Distinguish between PERT & CPM.
3. Discuss about the constraints in scheduling.
4. Describe the significance of choice of technology
5. Explain, why time cost trade-off is necessary?

Evaluate

1. Evaluate survey-based demand forecasting methods with appropriate examples.
2. Prepare a generalized report on stages of planning by different agencies.
3. Create a MIS on residential project for safety elements which is carried out on the site.
4. The logical sequence of management functions cannot be subordinated even by one function. Do you agree? Support your answer **(For Open Book Examination and not for semester end examination)**

23CEH43 Quality Control and Assurance in Construction

4 0 0 4

Course Outcomes

1. Identify the requirement of quality management guidelines and quality system standards in construction
2. Apply the quality concepts, ergonomics and methods in construction industry
3. Discuss and model the statistical techniques and construction programming and its processes
4. Apply quality assurance and control techniques in construction
5. Explain the major failure aspects and failure mode analysis of a structure
6. Apply the various quality improvement techniques, life cycle costing and Value engineering.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO6	PS01
1	3	3	1	2	1	3
2	3	3	2	2	1	3
3	3	3	3	2	1	3
4	3	3	2	2	1	3
5	3	3	3	3	1	3
6	3	3	3	3	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Quality Management and System

Introduction – Definitions and objectives – Factors influencing construction quality – Responsibilities and authority – Quality plan – Quality Management Guidelines – Quality circles. Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

Factors influencing construction quality, Implementing a Quality system

16 Hours

Unit II

Quality Planning

Quality Policy, Objectives and methods in Construction industry - Consumer’s satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi’s concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.

Statistical tolerance, Inspection procedures

16 Hours

Unit III

Quality Assurance and Control

Objectives – Regularity agent, owner, design, contract and construction-oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals, Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, – Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction.

contract and construction-oriented objectives, Stability methods and tools

16 Hours

Unit IV

Quality Improvement Techniques

Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.

Selection of new materials, Natural causes and speed of construction

16 Hours

Total: 64 Hours

Textbook (s)

1. Hutchins.G, ISO 9000 : A Comprehensive Guide to Registration, Audit Guidelines and Successful Certification, Viva Books Pvt. Ltd., 1994.
2. James, J.O' Brian, "Construction Inspection Handbook" – Total Quality Management, Van Nostrand, 1997

Reference (s)

1. John L. Ashford, "The Management of Quality in Construction", E & F.N.Spon, 1989.
2. Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", McGraw Hill, 2001
3. Kwaku.A., Tena, Jose, M. Guevara, "Fundamentals of Construction Management and Organisation", Reston Publishing Co., Inc., 1985.
4. Steven McCabe, "Quality Improvement Techniques in Construction", Addison Wesley Longman Ltd, 1998.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define the term quality management
2. List the Factors influencing construction quality
3. What is the main objectives of quality assurance?
4. Define life cycle costing.
5. What do you mean by third party Certification?

Understand

1. Discuss the various requirement of ISO9000.
2. Explain briefly about Taguchi’s concept of quality.
3. Describe the term reliability testing.
4. Explain the quality related training programme.
5. Elaborate the total quality management in construction. **(For Open Book Examination and not for semester end examination)**

23CEH44 Safety in Construction

4 0 0 4

Course Outcomes

1. Apply safety regulations and BOCW Act guidelines to mitigate hazards in the construction industry.
2. Identify excavation and scaffold hazards and recommend appropriate control measures.
3. Analyze different types of hazards in construction and implement preventive measures.
4. Operate and maintain earth-moving machinery following safety protocols and investigate accidents.
5. Develop safe demolition procedures for industrial sites considering different demolition types.
6. Design safe demolition procedures for domestic sites considering different demolition types.

COs-POs Mapping

COs	PO1	PO2	PO3	PO4	PO6	PS01
1	3	3	1	2	3	3
2	3	3	2	2	3	3
3	3	3	3	2	3	3
4	3	3	2	3	3	3
5	3	3	3	3	3	3
6	3	3	3	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Accidents Causes and Management Systems

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – the building and other construction workers act and rules 1996- Pre contract activities, preconstruction meeting - design aids for safe construction – permits to work – tool box meeting- quality assurance in construction – compensation.

Recording of accidents and safety measures – Education and training.

Industrial Accidents,
 Classification of Accidents,
 Need for the Analysis of Accidents,
 Accidents Reports,
 Methods Adopted for Reducing Accidents,
 Investigation of Accidents,
 Safety Slogans,

16 Hours

Unit II

Hazards of Construction and Prevention

Excavations, basement and wide excavation,- scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunnelling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.

Trenches, shafts

16 Hours

Unit III

Construction Machinery

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder’s hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

Drills, grinding tools

16 Hours

Unit IV

Safety in Demolition Work

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition -- first aid – fire hazards and preventing methods – Case studies.

Indian standard trusses, girders and beams

16 Hours

Total: 64 Hours

Textbook (s)

1. Davies V J and Tomasin K “Construction Safety Hand Book”, Thomas Telford Ltd., London, 1990.
2. Sharma S C and Vineet kumar,“ Safety, Occupational Health and Environmental Management in Construction”, Khanna Publishers, 1 st Edition,2013.

Reference (s)

1. Charles D Reese and James V Edison, “Handbook of OSHA Construction Safety and Health”, CRC press,2006
2. King R W and Hudson R, “Construction hazard and Safety Hand book”, Butter Worth- Heinemann, 1985.
3. Bhattacharajee S K, “Safety Management in Construction”, Khanna Publishers, 2013.
4. Health and Safety in Construction ,HSE publications,3rd Edition,2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List the types and causes of construction accidents.
2. Define false work.
3. Define demolition.
4. List the various construction machinery.
5. Compare pre blast and post blast inspection techniques.

Understand

1. Explain the safety scenario of the modern Indian construction industry, mentioning the problem areas
2. Write a note on the occupational health issues common to construction site workers.
3. Explain the factors that affect productivity in a construction site.
4. Explain the different types of demolition techniques.
5. Discuss the roles of various groups or agencies related to construction so far as they influence safety in construction works. **(For Open Book Examination and not for semester end examination)**