PSG Institute of Technology and Applied Research, Coimbatore - 641 062

(Autonomous college affiliated to Anna University)

2025 Regulations

Regulations and Courses of Study, Scheme of Assessment, and Syllabi for all semesters

for

ME Degree Programmes

PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH
COIMBATORE - 641 062

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2025 REGULATIONS OF ME DEGREE PROGRAMMES

(For the batches of students admitted in 2025-2026 and subsequently under Choice Based Credit System)

NOTE: The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already in the middle of the programme) as may be decided by the Academic Council.

1. a. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In the following Regulations, unless the context otherwise requires

i. "Programme" means degree programme, that is ME degree programme
ii. "Branch" means specialization or discipline of ME degree programme, like Engineering Design, Structural Engineering etc.
iii. "Course" means a theory or laboratory course that is normally studied in a semester.
iv. "University" means Anna University, Chennai.

b. CONDITIONS FOR ADMISSION

Students for admission to the first semester of the ME degree programme of Anna University, Chennai will be required to satisfy the eligibility qualification for admission in section 3 or any other examination of any recognized University or authority accepted by Anna University, Chennai as equivalent thereto. The students shall also be required to satisfy all other conditions of admission thereto prescribed by the University and Government of Tamil Nadu.

2. DURATION OF THE PROGRAMME

i. **Minimum Duration:** The programme will extend over a period of two academic years for Full Time leading to the Degree of Master of Engineering ME of the University, an academic year being divided into two semesters. Each semester shall normally consist of 90 working days including examination days.

ii. **Maximum Duration:** Maximum duration is 4 years in case of full-time programme, this duration is to be reckoned from the commencement of the semester to which the student was first admitted to the programme.

3. QUALIFICATIONS FOR ADMISSION

The various ME degree programmes offered and the eligible qualifications for admission to the respective programmes are listed below:

Department	ME Degree Programme offered	Eligible Qualification for Admission *(Note 1)*	Minimum Latest Credits
Mechanical Engineering	ME - Engineering Design	As per ANNA UNIVERSITY norms	70
Civil Engineering	ME - Structural Engineering		70

Note 1: Eligible Qualification is subject to amendments as may be made by the University from time to time.

4. STRUCTURE OF PROGRAMMES

i. The course work of the odd semesters will normally be conducted only in odd semesters and that of the even semesters only in even semesters.

ii. **Curriculum:** The curriculum for each programme includes courses of study and detailed syllabi. The courses of study include twelve professional core courses (eight theory courses and four laboratory courses), four professional elective (theory) courses, one Research Methodology and IPR course (RMC), an Industrial Visit & Technical Seminar, two Audit Courses, Project Work I and Project Work II as given in section 13. The hours/week listed in section 13 for each of the course refer to periods/week, each period being of 50 minutes of duration.

Full-Time Programme: Every full-time student will normally undergo the courses of his/her programme given in section 13 in various semesters as shown below:

Semester 1:	Five professional core theory courses, two professional core laboratory courses, one audit course and one RMC course
Semester 2:	Three professional core theory courses, two professional elective courses, two professional core laboratory courses, one audit course and one Industrial Visit & Technical Seminar course
Semester 3:	Two professional elective course and Project Work I
Semester 4:	Project Work II

iii. **Core/Elective Courses:** Every student shall undergo eight professional core courses (Theory/Laboratory) and four professional elective courses as given in section 13. Every student shall opt for electives from the list of electives relating to his/her degree programme as given in section 13 in consultation with the tutor, programme coordinator and the head of department. Minimum number of credits to be earned for courses under the category ‘‘Professional Electives” is 12. However, a student may be permitted to take a maximum of two professional electives from the list of professional elective courses of other ME degree programmes with specific permission from both the head of department of student and the head of the department offering the programme.

iv. **Laboratory Courses:** Every student shall undergo four laboratory courses as given in section 13 relating to his/her degree programme.

Every laboratory course shall be evaluated based on conduct of experiments/mini projects/development of software packages and report submitted.

v. **Audit Courses:** Every student shall undergo two audit courses as given in section 13. These are the courses for the purposes of self-enrichment and academic exploration. There is no requirement on minimum number of credits to be earned for this category of courses but a **pass** is mandatory. The students will be evaluated and the Pass/ Re-appearance (RA) will be transferred to grade sheet. Assessment includes presentations on literature review from reputed journal papers, preparation of review papers, presentation of technical reports and viva voce. However, this assessment is not included in the computation of CGPA.

vi. **Project Work:** Every student shall undertake Project Work I during the third semester and Project Work II during the fourth semester. The Project Work I or Project Work II shall be undertaken in an Industrial / Research Organization or in

the College in consultation with the faculty guide and the head of department. In case of Project Work at Industrial / Research organization, the same shall be jointly supervised by a faculty guide and an expert from the organization.

vii. **Industrial Visit and Technical Seminar:** A minimum of two industrial visits are to be arranged as part of the course and the students are expected to make a presentation based on their learning on product, design, technology and manufacturing processes in the industrial visits.

Every student, shall make presentations on technology review from international journals/patents relevant to the technology used in the organization of his/her choice of industrial visit. The student shall also submit a report highlighting the summary of the presentations in an appropriate format at the end of the semester.

viii. **Online Courses (SWAYAM based NPTEL, GIAN):** Students can register and earn credits for online courses approved by department committee consisting of head of department, programme coordinator, tutor and subject expert. Students who complete relevant online courses (having 3 credits only) successfully to a maximum of 6 credits may obtain exemption from studying two Professional Electives. The list of online courses is to be approved by Chairman - Academic Council on the recommendation of head of department at the beginning of the semester if necessary, subject to ratification in the subsequent Academic Council meeting. For earning credits through online courses, students will be evaluated within the institute and will be recommended grades based on the scheme of evaluation given in Section 8, (x) h and grading system given in Section 8, (vi) b. Students may do online courses during the second semester and third semester.

ix. **Self-Study Courses**

A student can opt for self-study of a professional elective on specific approval of head of department provided the student does not have current arrears.

The students shall study on their own under the guidance of a faculty member approved by the Head of the Department who will be responsible for the periodic monitoring and evaluation of the course. No formal lectures would be delivered. The self-study course can be considered as equivalent to studying one professional elective course.

x. **One-Credit Courses:** Students can also opt for industry oriented one credit courses of 15 hours duration which will be offered by experts from industry/other institution on specialized topics apart from the prescribed courses of study of the programme. Students can complete such one credit courses during the semester two and three, as and when these courses are offered by the department. A student will also be permitted to enroll for one credit courses of other departments provided the student has fulfilled the necessary pre-requisites of the course being offered subject to approval by both the heads of departments. However, the grades earned by the students in one credit courses will not be included in the computation of CGPA.

xi. **Industrial Training / Internship**

The student may undergo Industrial Training/Internship optionally at the end of second semester and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in Industrial Training/Internship, the student may drop one Professional Elective. In such cases, Industrial Training/Internship need to be

undergone continuously from one organization only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for classification of the degree.

Duration of the training / internship	Credits
2 Weeks	1
4 Weeks	2
6 Weeks	3

xii. **One-year internship**

Students who do not have history of reappearance or redo in courses in the previous semesters and have a CGPA of 8.5 or more at the end of second semester are allowed to undergo one-year internship in their second year as a part of their Project Work I and Project Work II. The students interested in undergoing such internships with prior permission from the head of the department/institution shall complete all the courses listed in their third semester scheme by opting the following procedure after getting prior approval from the Head of the Institution:

(1) Industrial Training/Internship (section xi above) at the end of second semester for one professional elective.
(2) Completing one additional professional elective in the second semester.

They shall duly follow the evaluation procedures prescribed for such courses. They shall also undergo the internship for the entire year in a single organization/industry.

xiii. **Course Enrollment and Registration**

a) Each student, on admission shall be assigned to a Tutor who shall advise and counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

b) Each student on admission shall register for all the courses prescribed in the curriculum in the student's first semester of study.

c) From second semester onwards, a student has the option to drop a maximum of one theory course except professional core course in a semester and a student has the option to study additionally one theory course which shall be only professional electives. However, the maximum number of credits the student can register in a particular semester cannot exceed 30 credits including courses for which the student has registered for redoing.

d) In case of a student dropping a course of study (other than professional core courses) in one semester, he/she shall register for that course in the next given opportunity and earn necessary attendance in that course exclusively to become eligible to appear for the semester examination in that course.

e) The courses to be offered in a semester for candidates who need to redo (as per 5 (iii) a) etc., will be decided by head of department.

f) After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End-Semester Examinations.

The enrollment for the courses of the Semesters II to IV will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the Tutor. If the student wishes, the student may drop or add a course subject to eligibility within five working days after the commencement of the concerned semester and complete the registration process duly authorized by the Tutor.

xiv. **Credit assignment:** Each course is assigned certain number of credits based on the following:

Contact Period per week	Credits
One Lecture Period	1
One Tutorial Period	1
Two Practical Periods (Laboratory / Seminar / Project Work I & II etc.)	1
Audit Courses	No Credits

The contact periods per week for practical can only be in multiples of 2. The exact number of credits assigned to the different courses is shown in section 13.

xv. **Minimum Credits:** For the award of the degree, the student shall earn the minimum number of credits as shown in section 3 by passing the prescribed number of courses of study as shown in section 13. The prescribed credit range for the curriculum of various programmes is as in section 4 (iii).

xvi. **Medium of Instruction:** The medium of instruction, examinations, project report etc. shall be English.

5. REQUIREMENTS OF ATTENDANCE AND PROGRESS

i) A student will be qualified to appear for end semester examinations in a particular course of a semester only if

a) he / she has satisfied the attendance requirements as per the norms given below:

- Shall secure not less than 75% attendance in that course
- If a student secures attendance 65% or more but less than 75% in any course in the current semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events with prior permission from the Chairman, Sports Board and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the end semester examination of that course.

b) his / her academic progress has been satisfactory

c) his / her conduct has been satisfactory.

ii) A student shall normally be permitted to appear for End semester examination of the courses if the student has satisfied the attendance requirements (vide Section 5(i)) and has registered for examination in those courses of that semester by paying the prescribed fee.

iii) a) Students who do not satisfy section 5(i) will not be permitted to appear for the End semester Examination / Evaluation of that course/s. They have to register and redo that course/s in a subsequent semester when it is offered next, earn necessary attendance and CA mark and appear for end semester examinations.

b) If the total number of "Redo" courses at the end of any semester is more than TWO, the student will not be eligible to register for next immediate semester courses. Such students will be permitted to register for those courses only when offered next, subject to fulfillment of the above condition.

c) If a student with more than TWO "Redo" courses is in the last batch of his / her current regulations, then he / she has to redo two equivalent courses from the next regulations when it is offered. If such equivalent courses are not available in the next regulations, he/she has to complete the redo courses in a self-study mode following the guidelines given in 4 (ix).

iv) A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

6. DISCIPLINE

i) Every student is required to observe discipline and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the college. The head of the institution shall constitute a disciplinary committee to enquire into acts of indiscipline and notify the punishment.

ii) If a student indulges in malpractice in any of the examinations, he / she shall be liable for punitive action as decided by the head of the institution.

7. PROCEDURE FOR REJOINING THE PROGRAMME

A student who desires to rejoin the programme after a period of discontinuance, may rejoin the semester which he / she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of students and after obtaining the approval from the University and Commissioner of Technical education. No student will however be enrolled in more than one semester at any time.

8. ASSESSMENT AND PASSING REQUIREMENTS

i. **Assessment:** The assessment will comprise of Final Examination (FE) and / or Continuous Assessment (CA), carrying marks as specified in the scheme in section 13. The CA marks will be awarded on assessing the student continuously during the semester as per guidelines 8 (x). The assessment for theory courses carrying CA and FE components will be done on relative grading system. However, if the student's strength is less than or equal to 30 for a particular course they will be assessed by absolute grading system. Other courses (Laboratory Course, Industrial Visit and Technical Seminar, Project Work I, Project Work II, Audit Courses, Online Courses, Industrial Training / Internship, Research Methodology and IPR) will be assessed by absolute grading system. However, for the purpose of reporting the performance of a student, letter grades and grade points will be awarded as per section 8 (vi).

For Theory courses, the CA marks will be scaled down from 50 to 40 marks and the Final Examination (FE), which will be conducted for 100 marks, will be scaled down to 60 marks and the total being 100 marks (CA 40 + FE 60). For Laboratory courses including Project work, the Continuous Assessment (CA) marks will be scaled up from 50 to 60 marks and the Final Examination (FE) marks which will be conducted for 50 marks will be scaled down to 40 marks and the total being 100 marks (CA 60 + FE 40).

ii. **Semester End Examinations:** Semester end examinations will normally be conducted during October / November and during March / April of each year. Reappearance examinations may be conducted at such times as may be decided by the college.

A student will be permitted to appear for the final semester examination in a course only if he / she has completed the study of that course.

iii. **Project Work I:** Every student shall submit a report on Project Work I on dates announced by the department through the faculty guide to the head of department. If a student fails to submit the report on Project Work I on or before the specified date, he/she is deemed to have failed in it.

The student shall also present seminars about the progress of the Project Work I during the appropriate semester. The seminars shall be presented before a review committee constituted by the head of department.

The Project Work I will be evaluated based on the seminars, report and a viva voce examination. The viva voce examination will be carried out by a team of faculty appointed by the head of department in the presence of the faculty guide.

iv. **Project Work II:** Every student shall submit a report on Project Work II on dates announced by the Principal through the faculty guide to the head of department. If a student fails to submit the report on Project Work II on or before the specified date, he / she is deemed to have failed in it.

The student shall also present seminars about the progress of the Project Work II during the appropriate semester. The seminars shall be presented before a review committee constituted by the head of department.

The Project Work II will be evaluated based on the seminars, report and a viva voce examination. The viva voce examination will be carried out by a team consisting of an internal examiner, usually the faculty guide and an external examiner, appointed by the Principal.

v. **Industrial Visit & Technical Seminar:** Every student will be evaluated based on two presentations (i) technical / research papers (ii) industrial visits. A technical report submitted by the student will also be evaluated by a committee nominated by the Head of the department.

There will be a viva voce examination on the dates announced by the department to verify the depth of understanding of the student in both the technical topic and the industrial visits.

vi. **Grade and Grade Point:** Each student, based on his / her performance, will be awarded a final grade and grade point as given below for each course at the end of each semester by following relative grading system and absolute grading system.

a. Relative Grading System

In this system, the grades are awarded to the students based on their performance relative to others in Theory courses having Continuous Assessment (CA) and Final Examination (FE) components.

For each theory course, the total mark M [i.e., the sum of Continuous Assessment marks (CA) and Final examination marks (FE)] is computed for every candidate.

The students who secure a mark as detailed below are declared as fail (RA) in a theory course.

Marks scored in FE is less than 45% (or) M less than 50% of total marks	Grade: RA

Note:

- "RA" denotes reappearance in a course

After omitting the marks (M) of all failed students, if the number of students who have passed the course is more than 30, the marks obtained by all the students in that course (having the same course code) will be normalized using the BOX-COX transformation method. The grade range for each course will be computed based on the procedure given by Anna University, Chennai and the grades will be awarded for each student in a particular course.

Then letter grade and grade point to each student are awarded as given in the table below.

Letter Grade	Grade Points
O (Outstanding)	10
A + (Excellent)	9
A (Very Good)	8
B + (Good)	7
B (Average)	6
C (Satisfactory)	5
RA (Re-appearance)	0
SA (Shortage of Attendance)	0
W (Withdrawal)	0

b. Absolute Grading System

If the number of students registered for a particular theory course or if the number of students who have passed a particular theory course is less than or equal to 30, absolute grading system will be followed. Also, absolute grading system is followed for all the Laboratory Course, Industrial Visit and Technical Seminar, Industrial Training / Internship, Project Work I and II, Online Courses etc., offered under this regulation. The letter grade and mark range are given in table below.

Letter Grade	Mark Range	Grade Point, g
O	91 - 100	10
A+	81 - 90	9
A	71 - 80	8
B+	61 - 70	7
B	56 - 60	6
C	50 – 55	5
RA	< 50	0
W(Withdrawal)	0	0
SA (Shortage of Attendance)	0	0

- "RA" denotes Reappearance in a course.

The grades RA and SA will not figure in the grade sheet.

vii. **Cumulative Grade Point Average:** After the completion of the programme, the Cumulative Grade Point Average (CGPA) from the semester in which the student has joined first to the final semester is calculated using the relationship:

$$CGPA = \frac{\sum g_i \times C_i}{\sum C_i}$$

where, g_i is grade point secured for i^{th} course. C_i is credit allotted for the i^{th} course.

viii. **Passing a course:**

a. A student shall be deemed to have passed a theory course, laboratory course, Industrial Visit and Technical Seminar, Project Work I, Project Work II, Online Courses, Research Methodology and IPR with CA and FE components, if he / she secures at least 45% of the total marks in the final examination and he / she secures not less than 50% of total marks [CA and FE put together].

A student is deemed to have passed in any course carrying only continuous assessment marks or Final Examination marks like Audit course and Industrial Training / Internship, if the total mark secured by him / her is at least 50%.

b. A student who is absent or has failed in the semester end examinations in any theory course has to register for the subsequent examination in that theory course when it is offered next time, either by retaining or by not retaining the CA marks already earned.

i. A student who chooses to register as retaining CA may continue to appear for further appearances in that option or at any time can switch over to the option not retaining CA.

ii. A student who chooses the option as not retaining CA shall have to continue to register for further appearances in that option only till he / she obtains a pass. In such case, the maximum grade that will be awarded to the students who appear in the Reappearance Examination will be capped at “A”.

For students who chooses the option of not retaining CA, the following grading pattern is applicable

Range of percentage of total marks	Letter grade
71 to 100	A
61 to 70	B+
56 to 60	B
50 to 55	C
0 to 49 or less than 45% in final examination	RA

c. A student who after having earned necessary attendance, is absent for semester end examination or has failed in any other course like Laboratory Course, Industrial Visit and Technical Seminar, Industrial Training / Internship, Project Work I etc. with CA and FE components (except theory course with CA and FE components) or in any course carrying only Continuous Assessment marks will register for the examinations when it is conducted next time and will be solely assessed in the final examinations carrying the entire marks of that course.

d. A student who has earned necessary attendance in the course Project work II but does not submit the report on Project Work II on or before the date specified by the college / department, he/she shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

e. A student who has earned necessary attendance in the course Project work II but whose project report is not accepted for reasons of incompleteness or other serious deficiencies will be treated as ‘absent’ and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

f. A student who has submitted the report on Project Work II, but could not appear for the semester end examination on the scheduled date, shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, Redo and submit the project report at the end of that semester and appear for the final examinations, the CA mark earned afresh. The same shall be applicable also to candidates who fail in the Project work.

g. If a student is absent or has failed in an elective course, he/she may register for the same course as detailed in viii (b) above or for any other elective in the subsequent semester by registering afresh.

h. A student who is not eligible to write the end semester examination in any course due to lack of attendance, will be awarded grade SA and the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements as per section 5. If the course, in which the student has lack of attendance is a Professional Elective, the student may register for the same or any other Professional Elective course in the subsequent semesters.

i. A student after registering for a course may withdraw his / her registration between first & second CA Test on valid reasons.

j. Out of the required four Professional Electives to be studied, a student has to study a minimum of two Professional Electives from the list of Professional electives prescribed in their scheme of courses of study / those courses approved by the department committee with the Head of the Department as the Chairman. The remaining two Professional electives can be studied either from the list of electives prescribed in the scheme of study of the department of the student/other departments.

If a student has studied more than four professional electives totally, two Professional Elective courses with highest grade among all Professional Electives prescribed in the scheme and the two professional elective courses with next highest grade among all remaining professional elective courses will be considered for calculation of CGPA; however, the grades obtained in all other remaining professional elective courses will also appear in the grade sheet.

k. If a student does not clear an one credit course it will be treated as a course 'withdrawn' by a student; One credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for continuous assessment; out of which 75 marks will be for final test to be scheduled by the course instructor / department faculty concerned.

l. A student who is absent in the semester end examination of a course after registering for the same will be considered to have appeared and failed in that examination and awarded grade RA.

ix. **Reappearance Examinations:**

For Reappearance Examinations/ Examinations in any course under REDO category, absolute grading will be followed irrespective of whether the grading was originally under Relative Grading System or Absolute Grading System

x. **Scheme of Evaluation**

a. <u>Theory Courses with Tutorial Component (CA: 40% + FE: 60%)</u>

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Assessment Tutorial I	05 Marks
(iii) Assessment Tutorial II	05 Marks
(iv) Internal Tests (Average of 2):	30 Marks
• Test I (conducted for 50 marks)	30 Marks
• Test II (conducted for 50 marks)	30 Marks
Total	**50 Marks**
(50 Marks scaled down to 40 Marks)	
Final Examination (FE)	**100 Marks**
(100 Marks scaled down to 60 Marks)	

Note:

1. a) Theory courses with tutorial component - Separate tutorial note books / files are to be maintained by the students for regular class room tutorials and **two assessment tutorials** have to be conducted and marks entered in e-assessment.

   b) During tutorial sessions, if requested the students may be **guided** by faculty to solve problems.

b. Theory Courses without Tutorial Component (CA: 40% + FE: 60%)

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Objective Tests I (surprise type)	05 Marks
(iii) Objective Tests II (surprise type)	05 Marks
(iv) Internal Tests (Average of 2):	30 Marks
• Test I (conducted for 50 marks)	30 Marks
• Test II (conducted for 50 marks)	30 Marks
Total	**50 Marks**
(50 marks scaled down to 40 marks)	
Final Examination (FE)	**100 Marks**
(100 marks scaled down to 60 marks)	

c. Laboratory Courses (CA: 60% + FE: 40%)* **Total : 100 Marks**

CA Distribution:

(i) I Cycle (to be assessed at the end of the 3rd week)	
Preliminary report on the exposure/orientation	5 Marks
• Viva voce	5 Marks
(ii) II Cycle (to be assessed at the end of 12th week)	
Report on problem formulation and progress of work	15 Marks
• Viva voce	25 Marks
Total	**50 Marks**
Final Examination	
i. Report on the completed project	25 Marks
ii. Viva Voce	25 Marks

d. Industrial Visit & Technical Seminar (CA:60% + FE : 40%)* **Total : 100 Marks**

CA Distribution:

(i) Test/Report/Presentation	50 Marks
• Minimum of two visits to a particular industry	
• Minimum of two presentations by the students	
Final Examination	**50 Marks**
i. Report	25 Marks
ii. Viva Voce	25 Marks

e. Project Work I (CA : 60% + FE : 40%)* **Total : 100 Marks**

CA Distribution:

(i) Review - I — 20 Marks
- Guide 10 Marks
- Committee$ 10 Marks

(ii) Review - II — 30 Marks
- Guide 15 Marks
- Committee$ 15 Marks

Total **50 Marks**

(iii) **Final Examination**

Project Report Evaluation & Viva Voce **50 Marks**
- Guide 25 Marks
- Committee$ 25 Marks

f. Project Work II (CA: 60% + FE: 40%)* **Total : 100 Marks**

CA Distribution:

(i) Review - I — 10 Marks
- Guide 5 Marks
- Committee$ 5 Marks

(ii) Review – II — 20 Marks
- Guide 10 Marks
- Committee$ 10 Marks

(iii) Review – III — 20 Marks
- Guide 10 Marks
- Committee$ 10 Marks

Total **50 Marks**

Final Examination **50 Marks**

(i) External — 25 Marks
- Thesis Evaluation 10 Marks
- Presentation and Viva voce 15 Marks

(ii) Internal — 25 Marks
- Thesis Evaluation 10 Marks
- Presentation and Viva voce 15 Marks

*CA 50 marks scaled up to 60 marks, FE 50 marks scaled down to 40 marks

$ - In respect of Project Work I&II carried out and reviewed in the departments, the reviewing committee shall comprise of at least three senior faculty nominated by the Head of the Department.

In respect of Project Work II carried out in industry, the committee nominated for the second review at industry shall include one faculty deputed by the department and one mentor from respective industry.

g. Audit Course (CA: 100%) **Total: 100 Marks**

(i) Assessment - I — 50 Marks
(ii) Assessment – II — 50 Marks

h. Online courses (CA: 40% + FE: 60%) **Total: 100 Marks**

CA Distribution:

(i) Internal Tests (to be conducted within the institute)

(ii) Average of two tests 50 Marks

- Test I (conducted for 50 marks) 50 Marks
- Test II (conducted for 50 marks) 50 Marks

Total **50 Marks**

(50 Marks scaled down to 40 Marks)

Final Examination (FE) 100 Marks
(to be conducted within the institute)

100 marks scaled down to 60 Marks

i. Industrial Training / Internship (FE: 100%) **Total: 100 Marks**

At the end of Industrial Training / Internship, the student shall submit a certified report (evaluated out of 100 marks by a mentor/guide) from the organization where the student has undergone training. The Viva-Voce Examination will be conducted by a three-member committee constituted by the Head of the Department. The committee comprises of one expert from an industry/organization and two members (programme coordinator and faculty member) from the Department. Certificates issued by the organization/industry after the completion of such training/internship shall be attached to the report.

Final Examination (FE)

Report	40 marks
Presentation	30 marks
Viva voce	30 marks

9. QUALIFYING FOR THE AWARD OF DEGREE

A student shall be declared to have qualified for the award of the ME Degree provided

i) the student has successfully completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in section13 within the duration specified in section 2 and

ii) no disciplinary action is pending against the student.

10. CLASSIFICATION OF DEGREE

Classification of a student while awarding the degree will not be affected if the student has to REDO courses which are Mandatory in nature (i.e. having no credit but whose completion is compulsory for the award of degree)

A) FIRST CLASS WITH DISTINCTION:

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction.

* Should have passed the semester end examination in all the courses of all the four semesters in his/her first appearance within 3 years, which includes authorized break of study of one year. Withdrawal from examination (vide section 11) will not be considered as an appearance.
* Should have secured a CGPA of not less than 8.50

* One-year authorized break of study (if availed of) is included in the three years for award of First class with Distinction.
* Should not have been prevented from writing semester end examination due to lack of attendance in any of the courses.

B) FIRST CLASS:

A student who satisfies the following condition shall be declared to have passed the examination in First Class.

* Should have passed the examination in all the courses of all four semesters within three years.
* One-year authorized break of study (if availed of) or prevention from writing the end semester examination due to lack of attendance (if applicable) is included in the duration of three years for award of First class.
* Should have secured a CGPA of not less than 6.50

C) SECOND CLASS:

All other students (not covered in sections A and B) who qualify for the award of the degree shall be declared to have passed the examination in Second class.

D) RANK:

A student shall be eligible for award of ranking only if he/she has passed the examination in first class with distinction or first class in having passed all the courses in first attempt. Those who have availed the provision of break of study/withdrawal will not be eligible for rank.

11. WITHDRAWAL FROM EXAMINATION

i. A student may, for valid reasons, be granted permission 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, if he/she does not have any history of arrears at the time of request for withdrawal. Prior permission for withdrawal from semester examinations is to be obtained from Principal. Also, only one application for withdrawal is permitted for that semester examination in which withdrawal is sought.

ii. Withdrawal application shall be valid only if the student is otherwise eligible to write the examination and if it is made prior to the commencement of the semester examination or on the day of the examination of a course / set of courses and also recommended by the head of the department and the Principal.

12. TEMPORARY BREAK OF STUDY

i. Under Choice Based Credit System, students will have the provision to take a break of study at the beginning of a semester to re-do or complete the reappearance courses of previous semesters or on valid reasons (such as accident or hospitalization due to prolonged ill health) and rejoin the programme in a semester which he/she is eligible and he/she shall apply to the Principal through the Head of the Department stating the reasons therefore.

ii. A student permitted for break of study shall rejoin the programme at the respective semester as and when it is offered subject to the approval of Commissioner of Technical Education and Anna University, Chennai and shall be governed by the rules and regulations in force at the time of rejoining.

iii. The duration specified for passing all the courses for the purpose of classification (vide section 10) shall be increased by the period of such break of study permitted.

iv. The total period for completion of the programme reckoned from the commencement of the semester to which the student was first admitted shall not exceed the maximum period specified in section 2 (ii) irrespective of the period of break of study in order that he/she may be qualified for the award of the degree.

v. If any student is detained for want of requisite attendance, progress and conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' and section 12 (iii) is not applicable for such cases.

M.E. STRUCTURAL ENGINEERING

(Minimum No. of credits to be earned: 70)

S. No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER I										
1	MA25101	Applied Numerical Methods	3	1	0	4	40	60	100	PC
2	SE25101	Applied Elasticity and Plasticity	3	0	0	3	40	60	100	PC
3	SE25102	Computer Analysis of Structures	3	1	0	4	40	60	100	PC
4	SE25103	Advanced Reinforced Concrete Design	3	0	0	3	40	60	100	PC
5	SE25104	Advanced Structural Steel Design	3	1	0	4	40	60	100	PC
6	SE25105	Research Methodology and IPR	2	0	0	2	40	60	100	RMC
7	SE25A__	Audit Course I	2	0	0	Grade	100	0	100	MC
8	SE25111	Advanced Concrete Laboratory	0	0	4	2	60	40	100	PC
9	SE25112	Structural Engineering Laboratory	0	0	4	2	60	40	100	PC
Total 30 periods			**19**	**3**	**8**	**24**	**460**	**440**	**900**	
SEMESTER II										
1	SE25201	Finite Element Method	3	0	0	3	40	60	100	PC
2	SE25202	Structural Dynamics	3	1	0	4	40	60	100	PC
3	SE25203	Structural Stability	3	0	0	3	40	60	100	PC
4	SE25P__	Professional Elective – I	3	0	0	3	40	60	100	PE
5	SE25P__	Professional Elective – II	3	0	0	3	40	60	100	PE
6	SE25A__	Audit Course II	2	0	0	Grade	100	0	100	MC
7	SE25211	Symbolic and Numerical Computation Laboratory	0	0	4	2	60	40	100	PC
8	SE25212	Computer Aided Structural Analysis and Design Laboratory	0	0	4	2	60	40	100	PC
9	SE25213	Industry Visit and Technical Seminar	0	0	4	2	60	40	100	EEC
Total 30 periods			**17**	**1**	**12**	**22**	**480**	**420**	**900**	
SEMESTER III										
1	SE25P__	Professional Elective III	3	0	0	3	40	60	100	PE
2	SE25P__	Professional Elective IV	3	0	0	3	40	60	100	PE
3	SE25301	Project Work I	0	0	12	6	60	40	100	EEC
Total 18 periods			**6**	**0**	**12**	**12**	**140**	**160**	**300**	
SEMESTER IV										
1	SE25401	Project Work II	0	0	24	12	60	40	100	EEC
Total 24 periods			**0**	**0**	**24**	**12**	**60**	**40**	**100**	

CAT – Category; PC – Professional Core; PE - Professional Elective; RMC - Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not complete

SUMMARY OF CREDIT DISTRIBUTION

M.E. STRUCTURAL ENGINEERING						Total Credits
S. No	Course Category	Credits Per Semester				
		I	II	III	IV	
1	PC	22	14	0	0	36
2	RMC	2	0	0	0	02
3	PE	0	6	6	0	12
4	EEC	0	2	6	12	20
5	MC	-	-	-	-	-
TOTAL		**24**	**22**	**12**	**12**	**70**

PROFESSIONAL ELECTIVE THEORY COURSES (Four to be opted)

S. No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	SE25P01	Prestressed Concrete Structures	3	0	0	3	40	60	100	PE
2	SE25P02	Bridge Engineering	3	0	0	3	40	60	100	PE
3	SE25P03	Aseismic Design of Structures	3	0	0	3	40	60	100	PE
4	SE25P04	Behaviour and Design of Tall Buildings	3	0	0	3	40	60	100	PE
5	SE25P05	Advanced Concrete Technology	3	0	0	3	40	60	100	PE
6	SE25P06	Advanced Optimization Techniques	3	0	0	3	40	60	100	PE
7	SE25P07	Shell and Spatial Structures	3	0	0	3	40	60	100	PE
8	SE25P08	Experimental Techniques and Instrumentation	3	0	0	3	40	60	100	PE
9	SE25P09	Theory of Plates	3	0	0	3	40	60	100	PE
10	SE25P10	Industrial Structures	3	0	0	3	40	60	100	PE
11	SE25P11	Mechanics of Composite Materials	3	0	0	3	40	60	100	PE
12	SE25P12	Soft Computing in Structural Engineering	3	0	0	3	40	60	100	PE
13	SE25P13	Design of Steel Concrete Composite Structures	3	0	0	3	40	60	100	PE
14	SE25P14	Prefabricated Structures	3	0	0	3	40	60	100	PE
15	SE25P15	Maintenance and Rehabilitation of Structures	3	0	0	3	40	60	100	PE
16	SE25P16	Smart Materials and Smart Structures	3	0	0	3	40	60	100	PE
17	SE25P17	Structural Health Monitoring	3	0	0	3	40	60	100	PE
18	SE25P18	Foundation Structures	3	0	0	3	40	60	100	PE
19	SE25P19	Ground Improvement Techniques	3	0	0	3	40	60	100	PE
20	SE25P20	Geotechnical Earthquake Engineering	3	0	0	3	40	60	100	PE
21	SE25P21	Soil-Structure Interaction	3	0	0	3	40	60	100	PE

CAT – Category; PC – Professional Core; PE - Professional Elective; RMC - Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not complete

List of Audit Courses

S. No.	Course Code	Course Title	Hours/ Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
1	SE25A01	Sustainable Development Goals	2	0	0	Grade	100	0	100	MC
2	SE25A02	English for Research Paper Writing	2	0	0	Grade	100	0	100	MC
3	SE25A03	Disaster Management	2	0	0	Grade	100	0	100	MC
4	SE25A04	Constitution of India	2	0	0	Grade	100	0	100	MC
5	SE25A05	Building Communication Skills	2	0	0	Grade	100	0	100	MC

MA25101 APPLIED NUMERICAL METHODS
(Common to ED and SE)

3 1 0 4

NUMERICAL SOLUTION OF SYSTEM OF EQUATIONS: System of linear equations – Thomas algorithm, Gauss Jacobi and Seidel methods, successive over relaxation method, system of non-linear equations - Newton Raphson method, eigenvalues - power method and inverse power method. Curve fitting - linear regression, multiple linear regression, cubic splines – Bezier curves**.** **(12+4)**

NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS: Runge-Kutta method of fourth order**.** Boundary value problem - Shooting method. Finite difference method, derivative boundary conditions. Finite Element Method - Rayleigh-Ritz method, Collocation and Galerkin methods. **(11+4)**

NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS: Elliptic Equations - Liebmann's method for Laplace and Poisson equations, alternating direct implicit method, irregular and non-rectangular grids. Parabolic equations - explicit method and Crank-Nicolson method, second order parabolic equations – explicit method. Hyperbolic equations - explicit method. **(12+4)**

MODELLING AND SIMULATION: System modelling, system studies, principles of mathematical modelling, technique of simulation, types and components of simulation study, Monte Carlo Method, random number generation, test for randomness, test for uniform distribution. Static simulation - model for profit on sales, probabilistic simulation - inventory model: consumer demand. **(10+3)**

Total L: 45 +T:15=60 periods

REFERENCES:

1. Curtis F.G and Patrick O.W, "Applied Numerical Analysis", Pearson Education, New Delhi, 2019.
2. Richard L. B, J. Douglas F, "Numerical Analysis", Cengage Learning, New Delhi, 2019.
3. Steven C. C and Raymond P. C, "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 2021.
4. Geoffrey G, "System Simulation", Pearson Education, New Delhi, 2017.
5. Frank R. G, William P. F and Steven B. H, "First course in Mathematical Modeling", Cengage Learning, New Delhi, 2015.

COURSE OUTCOMES

At the end of the course, students will be able to:		
CO1	Explain the concepts related to numerical methods, modelling and simulation.	K2
CO2	Apply the techniques of numerical methods, modelling and simulation.to solve engineering problems.	K3
CO3	Analyze the solutions of engineering problems employing numerical methods, modelling and simulation.	K4

SE25101 APPLIED ELASTICITY AND PLASTICITY

3 0 0 3

ANALYSIS STRESS, STRAIN, STRESS STRAIN RELATIONS FORMULATION PROBLEMS: Analysis of stress (two and three dimensions) - Body force, surface forces and stresses, uniform state of stress - principal stresses - stress transformation laws - Differential equations of equilibrium. Analysis of Strain (two and three dimensions) - strain and displacement relation - compatibility equations - state of strain at a point - strain transformations - principle of superposition. - Stress strain relation - generalised Hooke's law -Lame's constants- Formulation of Problems -Methods of Formulation - Equilibrium equations in terms of displacements - Compatibility equations in terms of stresses - boundary value problems **(12)**

TWO DIMENSIONAL PROBLEMSI CARTESIAN COORDINATES: Plane Stress problem, Plane Strain Problem–Formulation- Boundary condition - examples - Airy's stress function - polynomials - Direct method of determining Airy's stress functions - solution of Bi-harmonic equation - St.Venant`s principle - Two dimensional problems in Cartesian coordinates -bending of cantilever loaded at end **(11)**

TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES & TORSION OF CYLINDRICAL BARS: General Equations In polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar co-ordinates - displacements for symmetrical stress distribution - bending of a curved bar - effect of a circular hole on stress distribution – Thick cylinder - Forces on wedges - a circular disk with diametric loading -Torsion of prismatic bars - General solution of the problem by displacement (warping function) and force (Prandtl`s stress function) approaches-Torsion of shafts of circular and non-circular cross sectional -Torsion of thin rectangular section and hollow thin-walled sections. **(11)**

INTRODUCTION TO PLASTICITY & ELASTO PLASTIC PROBLEMS: Introduction to stress strain curve - ideal plastic body -criterion of yielding - Rankine`s theory - St.Venant`s theory - Tresca criterion - Beltrami`s theory - Von Mises criterion - Mohr`s theory of yielding - yield surface - Flow rule (plastic stress - strain of relation) – Prandtl Reuss equations - Plastic work - stress -strain relation based on Tresca - Plastic potential- Elastic plastic problems of beams in bending- thick hollow spheres and cylinders subjected to internal pressure. **(11)**

Total L: 45 periods

REFERENCES:

1. Timoshenko and Goodier JN, "Theory of Elasticity", McGraw Hill Book Co., 2017.
2. Sadhu Singh, "Theory of Elasticity", Khanna Publications, New Delhi, 2015.
3. Cheap and Henry D J, "Plasticity for Structural Engineers", Springer Verlag, New York, 2009.
4. Chakrabarty, “Theory of Plasticity”, McGraw Hill, 2012.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Understand the fundamental principles of stress and strain analysis in two and three dimensions, along with stress-strain relations and problem formulation techniques.	**K2**
CO2	Analyse two-dimensional elasticity problems in Cartesian and polar coordinates, including torsion of prismatic bars and application of Airy's stress functions.	**K3/K4**
CO3	Evaluate elastoplastic behaviour of structural elements using various yield criteria and plasticity models for beams, cylinders, and spheres.	**K5**

SE25102 COMPUTER ANALYSIS OF STRUCTURES

3 1 0 4

FUNDAMENTAL CONCEPTS: Introduction – Forces and Displacement Measurements – Principle of superposition – Methods of Structural Analysis – Stiffness and Flexibility matrices of the Elements – Flexibility and Stiffness approach to spring problems – Strain energy – Betti's Law and its applications – Transformation of system force to element forces – Element flexibility to System flexibility – System displacement to element displacement – Element stiffness to System stiffness – Transformation of forces and displacement in general – Normal and orthogonal transformation. **(11+3)**

FLEXIBILITYMETHOD: Choice of redundants – Ill and well-conditioned equations – Automatic choice of redundants – Rank technique – Flexibility method – Flexibility analysis due to loads, settlement of supports, lack of fit and thermal expansion – Application to pin-jointed plane truss, continuous beams, frames and grids – Transformation of one set of redundants to another set **(11+4)**

STIFFNESS METHOD: Development of stiffness method – Difference between flexibility and stiffness – Stiffness analysis due to loads, thermal expansion, lack of fit – Application to pin-jointed plane and space trusses, continuous beams, frames and grids, space frames. **(11+4)**

SPECIAL TOPICS: Static condensation technique – Substructure technique – Symmetry and anti-symmetry of structures – Reanalysis technique – Direct stiffness approach – Application to two- and three-dimensional pin-jointed trusses, plane frames, grids. **(12+4)**

Total L: 45 +T:15=60 periods

REFERENCES:

1. Mcguire and Gallagher RH, "Matrix Structural Analysis", John Wiley, 2000.
2. Rajasekaran S and Sankarasubramanian G, "Computational Structural Mechanics", Prentice Hall of India, New Delhi, 2nd Ed. 2015.
3. Nelsm J K, Nelson K James and Mc Cormac J C, "Structural Analysis Using Classical and Matrix Methods", John Wiley & Sons, 2002.
4. Godbole P N, Sonparote R S and Dhote S U, "Matrix Methods of Structural Analysis", PHI, New Delhi, 2014.
5. Madhu B Kanchi, "Matrix Methods of Structural Analysis", New Age International, New Delhi, 2016.
6. Devadas Menon, "Advanced Structural Analysis", Narosa Publishers in India and Alpha Science International, UK,2009.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply the flexibility and stiffness matrix methods to analyze trusses, beams, and frames under various loading and boundary conditions.	**K2**
CO2	Demonstrate proficiency in developing and solving matrix formulations through computational tools for real-time structural analysis applications.	**K3/K4**

SE25103 ADVANCED REINFORCED CONCRETE DESIGN

3 0 0 3

DESIGN OF SPECIAL RC ELEMENTS: Strain compatibility analysis of flexural cross-sections - design of slender columns -design of shear walls- Design of corbels and deep beams -Tie and strut model - arch analogy. **(12)**

FLAT SLABS AND GRID FLOORS: Design of flat slabs and flat plates according to IS and ACI method – design for shear reinforcement and spandrel beams: - design of grid floors - yield line theory for slabs. **(12)**

DESIGN OF RC CHIMNEYS, **BUNKERS AND SILOS:** Design of chimneys**:** Introduction– design of RCC chimneys for combined effect of self-load, wind load and temperature-design of bunkers and silos -Janssen's theory, Airy's theory. **(12)**

INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND SLABS: Principles of moment - rotation curves, moment redistribution and Baker's method of plastic design –RC members for fire resistance and ductile detailing: Introduction –Classification–Effects of high temperature on steel and concrete – Effects of high temperature on different structural members – Structural detailing –Ultimate moment capacity Ductile Detailing**:** Concepts of ductility – factors influencing ductility–design principles and codal provisions – beam to column junction. **(9)**

Total L: 45 periods

REFERENCES:

1. Varghese P C," Advanced Reinforced Concrete", Prentice-Hall India Ltd., New Delhi, 2011.
2. McGregar G J and James K Wight, "Reinforced Concrete Mechanics and Design", Prentice hall,2012
3. Krishna Raju N and Pranesh R N, "Advanced Reinforced Concrete Design", New Age International Publishers, New Delhi, 2016.
4. Park. R and Paulay. T," Reinforced Concrete Structures", Wiley India, New Delhi, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply advanced design principles for special RC elements such as slender columns, corbels, deep beams, and shear walls using relevant codal methods.	**K3**
CO2	Analyse and design flat slabs, grid floors, chimneys, silos, and bunkers based on IS, ACI, and theoretical models such as yield line theory and Janssen's theory.	**K4**
CO3	Evaluate inelastic behaviour, moment redistribution, fire resistance, and ductile detailing of RC members and incorporate these principles into structural designs.	**K5**

SE25104 ADVANCED STRUCTURAL STEEL DESIGN

3 1 0 4

COMPRESSION MEMBERS: Introduction – Practical end conditions and effective length factors – Elastic compression members – Restrained compression members – Torsional buckling – Built-up compression members with lacings and battens – Column splices – In-plane behaviour of isolated beam-column – Design of beam-columns under biaxial loading – Column bases **(12+4)**

FLEXURALMEMBERS: Introduction–section classification–elastic analysis of beams–bending stresses–shear stresses–strength design – serviceability design – lateral buckling of beams – laterally restrained and unrestrained beams – design of plate girders and gantry girders–web and flange splices. **(12+4)**

CONNECTIONS: Introduction – Gable frame connection – beam to beam connection – beam to column connection -bolted and welded connections–framed connection–seated connection–moment resistant connections **(11+4)**

LATERALLOADANDPLASTICANALYSIS&DESIGN: Analysis of frames subjected to lateral loads–Portal method and Cantilever method; Plastic theory – plastic hinge concept – shape factor – load factor – methods of plastic analysis – plastic moment capacity of various sections– collapse load of beams and portal frames **(10+3)**

Total L:45+T:15=60 periods

REFERENCES:

1. Subramanian N, “Design of Steel Structures-Limit state method”, Oxford University Press, New Delhi, 2016.
2. Trahair N S, Brandford M A, Nethercot D M, and Gardner L, “The Behaviour and Design of SteelStructurestoEC3”, Taylor and Francis, London and Newyork,2008.
3. Bhavikatti S.S, “Design of Steel Structures”, I. K. International Publishing House Pvt. Ltd, New Delhi, 2017.
4. Duggal S.K, “Design of Steel Structures”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.
5. Ramachandra & Vivendra Gehlot, “Design of Steel Structures”, Volume I & II, Scientific Publishers (India) Jodhpur, 2016.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply design principles to compression and flexural steel members including built-up columns and plate girders.	**K3**
CO2	Analyze and design various bolted and welded connections used in steel structures.	**K4**
CO3	Evaluate structural behavior under lateral loads and perform plastic design of steel beams and frames.	**K5**

SE25105 RESEARCH METHODOLOGY AND IPR
(Common to ED and SE)

2 0 0 2

RESEARCH PROBLEM FORMULATION: Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap. **(4)**

RESEARCH DESIGN AND DATA COLLECTION: Statistical design of experiments-types and principles; data types & classification; data collection - methods and tools. **(6)**

DATA ANALYSIS, INTERPRETATION AND REPORTING: Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation-types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research. **(10)**

INTELLECTUAL PROPERTY RIGHTS AND PATENTS: Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance. Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents. **(10)**

Total L: 30 periods

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Outline the principles of research problem formulation, research design, data collection, the basic features and significance of IPR.	**K2**
CO2	Utilize research methodology principles to develop a research plan, conduct literature reviews, analyze data using appropriate statistical methods, and prepare structured research reports or proposals following ethical guidelines.	**K3**

SE25111 ADVANCED CONCRETE LABORATORY

0 0 4 2

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topics for orientation/ List of Experiments

1. Physical and chemical properties of concrete ingredients
2. Fresh properties of cement composites
3. Mechanical properties of concrete specimens
4. Mix design of high strength/ performance concrete as per IS method for M40 to M60grade,
5. Mix design - ACI method up to M80 grade.
6. Flow Characteristics of Self Compacting concrete.

CASE STUDY:

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Zonjin Li, Xiangming Zhou, Hongyan Ma, Dongshuai Hou, ‘Advanced Concrete Technology’ Wiley, Second edition, 2023
3. Michael Thomas, ‘Supplementary Cementing Materials in Concrete’, CRC press, 2017
4. Mustafa Toyay, ‘Cement and Concrete - Mineral Admixture’, CRC Press, 2016
5. Mehta P K, Pauls J M and Monteiro, “Concrete: Micro Structure, Properties and Materials”, Tata McGraw Hill Education Private limited, NewDelhi,2014

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply knowledge of materials and concrete mix design methods (IS and ACI) to evaluate physical, chemical, and mechanical properties of concrete.	**K3**
CO2	Analyse and synthesize literature and experimental results to identify a problem and develop a relevant project using orientation techniques.	**K5**
CO3	Prepare and present a detailed technical report based on experimental observations and project findings, justifying conclusions effectively.	**K6**

SE25112 STRUCTURAL ENGINEERING LABORATORY

0 0 4 2

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topics for orientation/ List of Experiments

1. Specimen preparation and testing of Under-reinforced RC beams for flexure and shear under gravity loading.
2. Short and slender reinforced concrete columns under axial compression
3. Permeability test on hardened concrete (RCPT)
4. Identification and Grid mapping of rebar location in RC member
5. Estimation of compressive strength of concrete using rebound hammer.
6. Hardened concrete core test.
7. Estimation of compressive strength of concrete using UPV
8. Analyse the quality of the concrete

CASE STUDY:

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Subramanian N, “Design of Steel Structures - Limit state method”, Oxford University Press, New Delhi, 2016.
3. Park.R and Paulay.T,” Reinforced concrete structures”, Wiley India, New Delhi, 2013.
4. Subramanian N, “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2014.
5. Sai Ram KS, “Design of Steel Structures”, Pearson, New Delhi, 2020.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply experimental techniques and tools introduced in the orientation to evaluate the behaviour of RC structural elements and concrete quality.	**K3**
CO2	Analyse a structural engineering problem using literature review and formulate a project with appropriate methodology, tools, and interpretation of results.	**K5**
CO3	Create and present a comprehensive technical report based on experimental/project findings with proper justification, analysis, and engineering conclusions.	**K6**

SE25201 FINITE ELEMENT METHOD

3 0 0 3

INTRODUCTION: Concepts – Two dimensional truss element – algorithm to generate stiffness matrix –Assembly & Boundary conditions - NUMERICAL METHODS – Gaussian elimination method – band and skyline form of storage – band solver –interpolation – Lagrangian and Hermitian – Numerical integration using Gaussian quadrature.- ENERGYPRINCIPLESANDMETHOD OF WEIGHTED RESIDUAL: Variational principles - Rayleigh Ritz method - Method of collocation – Subdomain method - Galerkin`s method - Method of least squares - CONVERGENCE & COMPATIBILITY REQUIREMENTS**:** Properties of single element -assumed displacement field – various element shapes – Pascal triangle – Melosh criteria **(12)**

TRIANGULAR, RECTANGULAR AND ISO PARAMETRIC ELEMENTS: Constant strain triangle - Element stiffness matrix -Various methods of evaluating element stiffness- Higher order triangular elements- comparison of different methods - rectangular element – serendipity family – Lagrangian family – Hermitian family. ISO PARAMETRIC ELEMENTS- sub- iso – super parametric elements – shape functions mapping – linear Iso – parametric quadrilateral. – Simple problems **(11)**

THREE DIMENSIONAL ELEMENTS & PLATE SHELL ELEMENTS: Tetrahedron element family - Hexahedron element family-ZIB8 and ZIB 20 elements – comparison. Axi-symmetric stress analysis - PLATE/SHELL ELEMENTS: Triangular and rectangular elements- BFS element–Concepts of Shell Elements-Degenerated shell elements. Introduction to Finite Strip Method **(11)**

NONLINEAR ANALYSIS: Types of non-linearities - solution techniques- stability analysis- Load deformation response considering geometric, material and both non-linearities– Newton Raphson and Riks Wempner methods – Eigen value analysis.- APPLICATION TO FIELD PROBLEMS: Finite Element Modelling - Field problems such as seepage - torsion etc. - programming organization of finite element schemes – mesh generation aspects, adaptive mesh refinement – software packages- Introduction to meshless methods – principles - applications. **(11)**

Total L: 45 periods

REFERENCES:

1. Rao S S, “The Finite Element Method in Engineering”, Elsevier, 2017.
2. Cook R D, Malkus D S, Plesha M E and Witt R J, “Concepts and Applications of Finite Element Analysis”, John Wiley &Sons,2007.
3. Rajasekaran S," Finite Element Analysis in Engineering Design", S Chand & Co., 2008.
4. Zienkiewicz O C and Taylor, R Land J.Z. Zhu, “The Finite Element Method” Elsevier Butterworth and Heimann., 2013.
5. Krishnamoorthy C S, “The Finite Element Analysis – Theory and Programming”, Tata McGraw-Hill, 2017.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Understand the fundamental principles and mathematical formulation of the finite element method including variation principles, interpolation, and numerical integration.	**K2**
CO2	Analyse structural systems using different finite elements like triangular, rectangular, iso parametric, 3D, plate, and shell elements.	**K4**
CO3	Evaluate nonlinear problems and apply FEM tools to solve field-specific structural issues including adaptive meshing and introduction to meshless methods.	**K5**

SE25202 STRUCTURAL DYNAMICS

3 1 0 4

SINGLE DEGREE OF FREEDOM SYSTEM: Introduction - vibration studies and their importance to structural engineering problems - elements of vibratory systems- simple harmonic motion - vibration with and without damping - constraints -generalized mass - D`Alembert's principle - Hamilton's principle - degree of freedom - equation of motion for single degree of freedom (SDOF) system - damped and un damped free vibrations – un damped forced vibration - critical damping – logarithmic decrement – response to support motion – response of SDOF system to harmonic excitation damped or un damped – evaluation of damping resonance - band width method to evaluate damping – force transmissibility - displacement transmissibility -vibration isolation. **(12+4)**

RESPONSE TO GENERAL DYNAMIC LOADING: Fourier Series Expression for loading-response to general dynamic loading - (blaster earthquake) - Duhamel's integral. Numerical Evaluation: Newmark's method- Wilson θ method– recurrence formula. SDOF system: Expression for generalised system properties - vibrational analysis with Rayleigh's variational method –Rayleigh- Ritz Method. **(11+4)**

MULTI DEGREES OF FREEDOM SYSTEM: Response to free and forced vibration of undamped and damped systems –application of Hamilton's principle - Lagrange equations coupling - evaluation of structural property matrices - natural vibration -solution of the eigen value problem - orthogonality and normality principles of natural modes - iteration due to Stodola – Holzer method -Transfer matrix method -Rayleigh-Ritz and Dunkerley approximation. **(12+4)**

DISTRIBUTED PARAMETER SYSTEM: Differential equation of motion – analysis of undamped free vibration of simply supported and cantilever beams - effect of axial loads - numerical evaluation of modes - frequencies and response system -vibration analysis using finite element method for beams and frames. Idealisation of multi-storied frames for dynamic analysis-modal analysis-time history analysis- wind induced vibration of structures -moving load, impact blast loading. **(10+3)**

Total L: 45+T: 15=60 periods

REFERENCES:

1. Anil K Chopra, "Dynamics of Structures- Theory and Applications to Earthquake Engineering", Prentice Hall, New Delhi, 2014.
2. Paz M, "Structural Dynamics -Theory and Computation", Springer, 2007.
3. Craig RR, "Structural Dynamics – An Introduction to Computer Methods", John Wiley & Sons, 2006.
4. Clough R W and Penzien, "Dynamics of Structures", Mc Graw Hill Book Co. Ltd, 2003.
5. Thomson WT, "Theory of Vibration", Prentice Hall of India, 2003.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental concepts of vibrations in structural systems including single and multi-degree freedom systems and distributed parameter systems.	**K2**
CO2	Analyse and solve vibration problems using analytical and numerical methods such as Duhamel's Integral, Rayleigh's method, and Newmark's method.	**K4**
CO3	Evaluate and design structures subject to dynamic loads including blast and earthquake using advanced tools like FEM, modal analysis, and time-history analysis.	**K5**

SE25203 STRUCTURAL STABILITY

3 0 0 3

CONCEPTS OF STABILITY AND COMPRESSION MEMBERS: Introduction – Stability Criteria – Equilibrium, Energy and dynamic approaches - South well Plot – Stability of link models. Higher order Differential equations – Analysis for various boundary conditions–Behaviour of imperfect column–Initially bent column–Eccentrically loaded column-Energy method-Rayleigh Ritz, Galerkin methods–Numerical techniques–Newmark's method–Finite Element Method **(13)**

STABILITY OF PLATES AND ELEMENTS OF NON-LINEAR THEORY OF BUCKLING: Governing Differential equation –Equilibrium, Energy concepts–Buckling of plates of various end conditions–Finite Difference Method–Post-buckling strength–Finite Element Method. Perfect Systems–Imperfect Systems–Imperfection in-sensitive and sensitive systems–Symmetric and Asymmetric Bifurcation–Non-linear analysis of shell and spatial structures–Basic concepts **(11)**

LATERAL STABILITY OF BEAMS AND BEAM-COLUMNS: Differential equations for lateral buckling – Lateral buckling of beams in pure bending – Lateral buckling of cantilever and simply supported 'I' beams. Beam-columns with concentrated lateral load–Distributed loads–Effect of axial loads on bending stiffness–Stability of frames–Stability functions– PΔ effect. **(11)**

IN ELASTIC BUCKLING AND BUCKLING OF THIN-WALLED OPEN & CLOSED SECTIONS: Introduction–Double modulus theory (reduced modulus) – Tangent modulus theory – Shanley's theory – Determination of double modulus for various sections. Torsional buckling–Torsional flexural buckling–Equilibrium and Energy approaches. **(10)**

Total L: 45 periods

REFERENCES:

1. Timoshenko, S.P. and Gere J.M., "Theory of Elastic Stability", 2ndEd. McGraw-Hill, 2017.
2. Alfutov N.A., "Stability of Elastic structures", Springer verlog, 2000.
3. El Naschie M.S., "Stress, Stability and Chaos in Structural Engineering: An Energy Approach", McGraw Hill International Editions, 1992.
4. Iyengar N.G.R., "Structural Stability of Columns and Plates", Affiliated East West press Pvt Ltd., New Delhi, 2007.
5. Chajes A., "Principles of Structural Stability Theory", Prentice Hall, New Jersey, 1980.
6. Gambhir, M.L., "Stability Analysis and Design of Structures", Springer, NewYork,2009.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply theoretical and numerical methods to evaluate the stability of structural elements including columns, beams, plates, and shells.	**K3**
CO2	Analyze and interpret post-buckling behavior and P-Δ effects in beam-columns through assignments or case studies.	**K4**

SE25211 SYMBOLIC AND NUMERICAL COMPUTATION LABORATORY

0 0 4 2

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topics for orientation:

1. Free and forced vibration of damped and undamped systems
2. Numerical methods – New marks – Wilson Theta methods
3. Extracting frequencies and mode shapes
4. Vibration of strings, beams and shear building
5. Application of finite element method to trusses, beams and frames
6. Response spectrum
7. Problems of base excitation

CASE STUDY:

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Anil K Chopra, "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Prentice Hall, New Delhi, 2014.
3. Craig R R, "Structural Dynamics - An Introduction to Computer Methods", John Wiley & Sons, 2006.
4. Clough R W and Penzien, "Dynamics of Structures", McGraw Hill Book Co. Ltd, 2003.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Analyze and interpret dynamic structural behavior using symbolic and numerical methods through project-based case studies involving vibrations, FEM, and response spectra.	**K4**

SE25212 COMPUTER AIDED STRUCTURAL ANALYSIS AND DESIGN LABORATORY

0 0 4 2

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

Topics for orientation:

1. Matrix methods of Structural Analysis – stiffness and flexibility approaches, direct stiffness approach
2. Structural Analysis and Design of RC Structures for gravity and lateral loads
3. Structural Analysis of Design of Steel Structures for gravity and lateral loads
4. Structural Analysis and Design of Pre-Stressed Concrete Structures
5. Study of neural network & genetic algorithms application to structural engineering problems–concepts and case studies

CASE STUDY:

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

Total P: 60 periods

REFERENCES:

1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Rajasekaran S and Sankarasubramanian G, “Computational Structural Mechanics”, Prentice Hall of India, New Delhi, 2nd Ed. 2015.
3. Krishna Raju N and Pranesh R N, "Advanced Reinforced Concrete Design", New Age International Publishers, New Delhi, 2016.
4. Subramanian N, “Design of Steel Structures - Limit state method”, Oxford University Press, New Delhi, 2016.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Analyze complex structural systems by applying computer-aided methods (matrix analysis, AI techniques, or design codes for RC/steel/prestressed concrete) through project-based case studies of industrial relevance.	**K4**

SE25213 INDUSTRIAL VISIT & TECHNICAL SEMINAR

0 0 4 2

The student will make at least four one-and-a-half-day industry visits and technical presentations. The same will be assessed by the committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his / her presentations together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

Total L: 60 periods

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Summarize and present insights gained through industry visits and technical observations using effective communication.	**K2**

SE25301 PROJECT WORK I

0 0 12 6

The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply theoretical and practical knowledge to solve problems, conduct literature reviews, develop methodology, identify research gaps with key parameters, and effectively present findings.	**K5**

SE25401 PROJECT WORK II

0 0 24 12

The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explore research in Structural Engineering, apply theoretical and practical knowledge creatively, represent data clearly, derive meaningful conclusions, and effectively report findings with structured presentation.	**K5**

SE25P01 PRESTRESSED CONCRETE STRUCTURES

3 0 0 3

ANALYSIS AND DESIGN FOR FLEXURE: Principles - types - prestressing - materials definition of Type I, Type II and Type III structures – requirements - behaviour of PSC elements - force transmitted by pretensioned and post tensioned systems-analysis - service loads - methods - losses - ultimate strength-Design for flexure And Deflection: Philosophy - limit states -concepts - collapse and serviceability - service load - basic requirements - stress range approach - Lin's approach – Magnel 's approach – cable layouts. Deflection- importance-short- and long-term deflection of un cracked and cracked members. Specifications on formwork removal. **(12)**

DESIGN FOR SHEAR, TORSION & TRANSMISSION OF PRESTRESS: Shear and principal stresses - limit state shearing resistance of cracked and un cracked sections - design of shear reinforcement by limit state approach. Behaviour under torsion - modes of failure - design for combined torsion, shear and bending. Transfer of prestress: Transmission of prestressing force by bond in pretensioned members - Transmission length - Factors affecting transmission length - check for transmission length - transverse tensile stresses - end zone reinforcement. Anchorage zone stresses in post-tensioned members - Magnel's method - Calculation of bearing stress and bursting tensile forces-code provisions- Reinforcement in anchorage zone. **(14)**

COMPOSITE CONSTRUCTION OF PRESTRESSED & INSITU CONCRETE: Need-types of composite construction- behaviour - analysis for flexural stresses- shear - differential shrinkage - design for flexure and shear. **(09)**

CIRCULAR PRESTRESSING & STATICALLY INDETERMINATE STRUCTURES: Tanks and Pipes: Circular prestressing in liquid retaining tanks - analysis for stresses - design of tank wall. PSC pipes - types - design of noncylinder pipes Methods of achieving continuity - assumptions in elastic analysis – pressure line-linear transformation-concordant cables-Guyon's theorem-analysis and design of continuous beams. **(10)**

Total L: 45 periods

REFERENCES:

1. Rajagopalan N, "Prestressed Concrete", Narosa Publishing House, New Delhi, 2010.
2. Krishna Raju N," Prestressed Concrete “, Tata Mc Graw Hill Publishing Company Ltd., New Delhi 2018.
3. Dayaratnam P, “Prestressed Concrete Structures”, Oxford& IBH, Publishing Co. Pvt., 2018.
4. Praveen Nagarajan, “Prestressed Concrete Design”, Pearson. 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply the principles of prestressing and analyze prestressed concrete members under flexure, shear, and torsion, incorporating appropriate loss calculations and deflection checks.	**K3**
CO2	Design pre-tensioned and post-tensioned structural elements, including composite and statically indeterminate systems, using relevant codal provisions and analytical methods.	**K4**

SE25P02 BRIDGE ENGINEERING

3 0 0 3

HYDRAULIC AND GEOMENTRIC DESIGN OF BRIDGES: Definition and components of a bridge – layout and planning of abridge–classification–investigation of a bridge–preliminary data collection–choice and type of a bridge hydraulic design of a bridge. Traffic design–loading–high way and railway loading–specification –Provisions of IRC: 6 **(10)**

REINFORCEDCONCRETEBRIDGES: Straight and curved bridge decks–decks of various types–slab hollow and voided slab–beam–slab box–reinforced concrete slab bridges–load distribution–Pigeaud's theory–skew slab deck–RC tee beam and slab bridge–Balanced Cantilever bridge–rigid frame bridge–box girder bridge-Provisions of IRC:112. **(13)**

PRESTRESSED CONCRETE AND STEEL BRIDGES: Pre-stressed concrete bridge – Composite beam bridge– Analysis and Design for static, moving and dynamic loading. Plate girder bridge–box Girder Bridge–truss bridge–influence lines for forces in member-cable stayed bridge-Analysis for static, moving and dynamic loading.-Provisions of IRC: 18 **(13)**

SUBSTRUCTURE DESIGN, CONSTRUCTION AND MAINTENANCE OF BRIDGES: Piers and abutments – bridge bearings – steel rocker and roller bearings – reinforced concrete rocker and roller bearings –elastomeric bearings. Construction methods–short span–long span–false work for concrete bridges–construction management–inspection and maintenance–lessons from bridge failures–rehabilitation of a bridge–load testing of bridge. **(9)**

Total L: 45 periods

REFERENCES:

1. Johnson Victor D, "Essentials of Bridge Engineering", Oxford & IBH publishing co. Pvt. Ltd., New Delhi, 2019.
2. Krishna Raju N, "Design of Bridges", Oxford Publishing co Pvt. Ltd., New Delhi, 2018.
3. Raina V K "Concrete Bridge Practice", Tata Mc Graw-Hill publishing co, New Delhi, 2014.
4. Ponnuswamy S, "Bridge Engineering", Tata Mc Graw Hill Pub co New Delhi, 2017.
5. Jagadeesh.T.T., Jayaram. M.A, "Design of Bridge Structures", PHI Learning Pvt Ltd, 2014.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply principles of hydraulic and geometric design for planning and selecting appropriate bridge types.	**K3**
CO2	Analyze and design reinforced and prestressed concrete bridges, including load distribution and IRC provisions.	**K4**
CO3	Evaluate bridge substructure systems, construction methods, and maintenance strategies for performance and safety.	**K5**

SE25P03 ASEISMIC DESIGN OF STRUCTURES

3 0 0 3

BASIC CONCEPTS AND ANALYSIS: Elements of Engineering Seismology – Indian Seismology-earthquake history-catastrophes- failures - lessons learnt in past earthquakes - time history and response spectrum method- modal analysis -earth quake response to linear systems-response spectrum characteristics - ground motion parameters - construction of design spectrum-lumped mass system - shear building - symmetrical and unsymmetrical buildings-multiple support excitation introduction to deterministic earthquake response to continuous systems on rigid base. **(13)**

STRUCTURAL DESIGN CRITERIA: Principles and design criteria for structures as per IS1893 - modal response contribution –modal participation factor-response history-spectral analysis-problems-design and construction of buildings as per IS 4326 - general principles - special construction features - types of construction - building categories - construction of masonry walls-precast floors and roofs- guidelines for earthquake resistant of low strength masonry buildings as per IS13828- behavior and design of masonry structures- behavior of masonry in fills in RC frame guidelines for improving earthquake resistance of earthen buildings as per IS13827- guidelines for repair and seismic strengthening of buildings as per IS13935. **(12)**

BEHAVIOUR OF RC STRUCTURES: Capacity design- design and detailing as per IS13920- behavior of RC structures-cyclic load - shear wall frame system - Khan and Saboron is method - Coupled shear wall system - Rosman's method – ductility requirements in concrete structures- beam column junction-pushover analysis. **(10)**

BEHAVIOUR OF STEEL STRUCTURES: Behaviour of steel under cyclic load - behavior of flexural members under cyclic loading-steel bracing systems-behavior and design aspects-ductile design of frame members-frame members subjected to axial compression and bending - beam column joints - detailing of steel connections - retrofitting and strengthening of steel frames- analysis for lateral loads – base isolation techniques. **(10)**

Total L: 45 periods

REFERENCES:

1. Anil K Chopra, "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Prentice Hall, New Delhi, 2014.
2. Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi, 2013.
3. Agarwal P and Shrikande M, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2011.
4. Chen W F and Scawthorn, "Earthquake Engineering Hand Book", CRC press, 2003.
5. Naeim F, "The Seismic Design Hand Book", Kluwer Academic Publishers, London, 2001.
6. Hand Book on Seismic Retrofitting of Buildings, published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand basic concepts, guidelines, structural criteria for aseismic design and behavior RCC and Steel structures.	**K2**

SE25P04 BEHAVIOUR AND DESIGN OF TALL BUILDINGS

3 0 0 3

LOADING AND STRUCTURAL SYSTEMS: History- Design Philosophy- Strength and Stability- Stiffness and Drift- Creep, Shrinkage and Temperature – Fire - Settlement. Loading – Gravity loading, wind loading, Earthquake loading and combinations offloading. Structural Forms - Floor Systems – RCC and Steel. Modelling for Approximate and Accurate Analysis – Reduction Techniques. **(10)**

BEHAVIOUR OF FRAMED SYSTEMS: Braced Frame-Behaviour of Bracing and Braced bents- Member Force Analysis – Drift Analysis. Rigid Frame – Behaviour- Approximate Analysis for Gravity and Lateral Loading. Drift Analysis – Flat Plate Structures - Reduction Techniques. In-filled Frame–Behaviour-Forces–Design of infill, Frame and Horizontal Deflection. **(12)**

BEHAVIOUR OF SHEAR WALL SYSTEMS: Shear Wall-Behaviour- Proportionate and Non-proportionate- Twisting and Non-Twisting - Effects of Discontinuity- Stress Analysis Coupled Shear Wall- Behaviour-Continuous Medium Method – Frame Analogy Method – Wall - Frame – Behaviour – Approximate analysis - Solution for UDL and Alternative Loading – Analysis using Graphs. **(12)**

OUTRIGGER STRUCTURES AND STABILITY OF TALL BUILDINGS: Outrigger Braced – Analysis of Forces and Horizontal Deflections – Generalized Solutions – Optimum Locations – Performance Stability –overall buckling analysis of Frames, Wall frames. Second-Order Effects –P-Delta Analysis – Translational-Torsional instability - Out of Plumb Effect Concepts and Behaviour of Core and Tubular Structures. Behaviour of Connections-Rigid and Semi rigid-Beam and Beam-Column Connections-Connections for Ductility. **(11)**

Total L:45 periods

REFERENCES:

1. Smith B. S. and Coull A., “Tall Building Structures Analysis and Design”, John Wiley and Sons, Inc, 2011.
2. Bryan Stanfford Smith, Alex Coull, “Tall Building Structures: Analysis and Design”, John Wiley and Sons, 2011.
3. Bungale. S. Taranath, “Reinforced Concrete Design of Tall Buildings”, CRC Press, 2010.
4. Mark Sarkisian, “Designing Tall Buildings: Structure as Architecture”, Taylor & Francis,2016.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Understand the structural systems, load considerations, and modelling techniques used in the design of tall buildings.	**K2**
CO2	Analyse the behaviour of different structural systems including braced frames, rigid frames, infilled frames, and shear wall systems under lateral and gravity loads.	**K4**
CO3	Evaluate the performance and stability of outrigger and tubular structures including second-order effects, torsional behaviour, and connection detailing.	**K5**

SE25P05 ADVANCED CONCRETE TECHNOLOGY

3 0 0 3

CONSTITUENTSOF CONCRETE: Composition and properties of Portland cement –hydration of cement– structure of hydrated cement paste-gel theories – Effect of cement characteristics on strength and heat of hydration – physical properties – acceptance criteria – types of cements and applications – aggregates – fine aggregate characteristics and significance –mechanical properties of coarse aggregates – acceptance criteria – influence of aggregate properties on strength of concrete - alkali-aggregate reaction – grading requirements. **(11)**

PROPERTIES OF CONCRETE: Microstructure of concrete – nanometer scale –C-S-H structure – transition zone and microcracking -Workability - Factors affecting workability - Tests for workability - segregation - bleeding - Modern trends in concrete production , placement, compaction and curing –- Vacuum dewatering and underwater concreting – special formwork -Factors affecting strength of concrete - Maturity of concrete – Rheological properties of concrete - Shrinkage - Creep of concrete – Factors affecting creep and shrinkage of concrete – Compression, Split Tension, Flexure, Bond strength – IS code provisions - Factors affecting strength test results - Accelerated strength tests - Stress strain characteristics - Determination of modulus of elasticity – Non-destructive evaluation of reinforced concrete – load test on structural components **(12)**

DURABILITY ASPECTS AND MIX DESIGN: Permeability – causes of concrete deterioration – Chemical attack – Sulphate Attack - Quality of water - Marine environment – effect of fire- frost action-thermal properties of concrete - fire resistance and corrosion protection – Methods to improve durability – Mix design – Basic considerations – frequency of sampling – nominal and design mixes – quality control and acceptance criteria – Factors in the choice of mix proportions – Mix design methods -ACI method, IS method – Mix proportions for weigh batching and volume batching – correction for moisture content and bulking – yield of concrete – design of high strength concrete (Shacklok and Entroy). **(11)**

ADMIXTURES AND SPECIAL CONCRETES : Classification of admixtures- uses of chemical and mineral admixtures-influences of admixtures on properties of concrete- Lightweight concrete - Fibre reinforced concrete - Polymer concrete – High Performance Concrete and future trends – Pumpable concrete – Self compacting concrete – tests for key properties and aspects of mix design – pre placed concrete – smart concrete – geopolymer concrete – concrete using industrial, agro and construction & demolition waste materials – sprayed concrete- reactive powder concrete – ready mixed concrete – high toughness and ductile concrete – concrete composites-post tensioned concrete **(11)**

Total L: 45 periods

REFERENCES:

1. Neville A M and Brooks J J, “Concrete Technology”, Pearson Education Asia Pvt. Ltd, 2018.
2. Mehta P K, Pauls J M and Monteiro, “Concrete: Micro Structure, Properties and Materials”, Tata McGraw Hill Education Private limited, New Delhi,2014.
3. Zongjin Li, “Advanced Concrete Technology”, John-Wiley & Sonsinc, New York, 2012.
4. Jayant D Bapat, “Mineral Admixtures in Cement and Concrete”, CRC Press, New Delhi, 2017.
5. Malhotra V M and Carino N J, “Hand book on Non-destructive Testing of Concrete”, CRC Press,2003.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Explain the composition, properties, and behavior of concrete constituents including cement, aggregates, and admixtures with respect to strength and durability.	**K2**
CO2	Analyze the fresh and hardened properties of concrete, including microstructure, workability, strength, and rheological behavior, and apply IS code provisions and testing methods.	**K4**
CO3	Evaluate and design durable and sustainable concrete mixes for various applications using ACI and IS methods, incorporating special concretes and innovative materials.	**K5**

SE25P06 ADVANCED OPTIMIZATION TECHNIQUES

3 0 0 3

CONCEPTS OF OPTIMIZATION AND LINEAR PROGRAMMING: Introduction – Engineering applications of optimization –statement of an optimization problem- classification of optimization problems. Standard form of a Linear Programming Problem – plastic design of frames – Graphical method – Simplex method – Basic solution – computation – maximization and minimization. Duality in Linear Programming – General Primal – Dual relations – Dual simplex method – Transportation problem–Assignment method. **(13)**

NONLINEAR PROGRAMMING: One dimensional minimization method – Dichotomous search, Fibonacci method and Golden section method. Unconstrained optimization techniques – Classification – Direct search, Pattern search, Cauchy's steepest Descent method, Conjugate Gradient method and Davidon Fletcher Powell method–Constrained function of a single variable–several variables **(13)**

DYNAMIC PROGRAMMING: Bellman's principle of optimality - Multistage decision processes – representation and types –concept of sub optimization problems using Classical and Tabular methods – conversion of a final value problem into an initial value problem–Linear Programming as a case of dynamic Programming **(10)**

GENETIC ALGORITHM, EVOLUTION STRATEGIES AND ANT COLONY OPTIMIZATION: Introduction–Representation of design variables, objective function and constraints – Choice of population – Genetic operators – survival of the fittest – generation – generation history – application to trusses. Probability – finding the shortest path – pheromone trail – travelling salesman problem – Application to structural engineering problems. **(9)**

Total L: 45 periods

REFERENCES:

1. Rajasekaran S. and Vijayalakshmi Pai G.A, "Neural Networks, Fuzzy Systems and evolutionary Algorithms: Synthesis and applications", Prentice Hall of India, NewDelhi,2017.
2. K. Deb, "Multi – objective Optimization using Evolutionary Algorithms", John Wiley and Sons, 2009.
3. Goldberg D.E., "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2008.
4. Iyengar N.G.R and Gupta S.K, "Structural Design Optimization", Affiliated East West Press Ltd., New Delhi, 1997.
5. Rao S.S. "Optimization Theory and Applications", Wiley Eastern, 2000.
6. R.T. Hafta and Z. Gurdal, "Elements of Structural Optimization",3rdEd. KluwerAcademicPublishers,1996.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the concepts related to optimization techniques.	K2
CO2	Apply the optimization techniques to solve engineering problems.	K3
CO3	Analyze the solutions of engineering problems employing optimization techniques	K4

SE25P07 SHELL AND SPATIAL STRUCTURES

3 0 0 3

THEORY OF SHELLS AND SPATIAL STRUCTURES: Definition - Historical development - types - materials – practical difficulties – construction – support conditions – cladding – aesthetics – Structural behaviour of thin shells – General specification of shells - Analysis of shells - Membrane theory of shells - Edge disturbances - classification of shells - methods of generating the surface of different shells like conoid, hyperbolic and elliptic paraboloid-form exdata generation of space structure **(11)**

DESIGN OF CYLINDRICAL AND HYPERBOLIC PARABOLOID SHELLS: Surface definition - Design of cylindrical shells with edge beam using theory for long shells – Design of cylindrical shell with ASCE manual coefficients – Detailing of reinforcement in shells and edge beams. Geometry of hypar shell- Analysis of membrane forces and moments- Determination of forces in the edge members - types of hyperbolic paraboloid roofs - Design of hypar shell roof of the inverted and tilted inverted umbrella types. **(12)**

SINGLE AND MULTI-LAYER GRIDS AND DOMES: Advantages - cladding - water drainage - progressive collapse and composite space trusses - Network domes - geodesic domes - double dome - ice dome - erection - connectors - ORS**:** Classification - ball joint systems - socket joint - plate joint - slot joint - shell joint - modular system - composite system - prefabricated systems. **(12)**

STRESSEDSKIN-CABLE SUSPENDED STRUCTURES: Stressed skin steel buildings – stressed skin grids-cable suspended roofs - design of cable roofs - erection of cable roofs - Finite element analysis of skeletal structures - approximate methods - optimal design of space structures-Failure of shell and space structures-case histories. **(10)**

Total L: 45 periods

REFERENCES:

1. Ramaswamy. S, "Design and Construction of Concrete Shell roofs", CBS Publishers & Distributors, New Delhi, 2005.
2. Ramaswamy G. S., Eekhout M. and Suresh G. R., “Analysis, Design and Constructions of Space Structures” ,Thomas Telford, 2002.
3. Subramanian N., “Space Structures: Principles and Practice”, Multi – Science Publishing, Co. Ltd.,2008.
4. Chatterjee B. K., "Theory and Design of Concrete Shells", Chapman and Hall Ltd., London,1990.
5. Varghese, P.C, “Design of Reinforced Concrete Shells and Folded Plates”, PHI Learning Pvt.Ltd.,2010.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Understand the behaviour, classification, and analytical principles of shells and spatial structures including membrane theory and geometric generation of shell surfaces.	**K2**
CO2	Analyse and design cylindrical and hyperbolic paraboloid shells using membrane theory and applicable codes including reinforcement detailing.	**K4**
CO3	Evaluate and develop advanced spatial structures such as domes, cable suspended systems, and stressed skin structures through optimal and finite element-based approaches.	**K5**

SE25P08 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

300 3

FORCES AND STRAIN MEASUREMENT: Measurement system: purpose system and elements-characteristics of measurement system - accuracy, precision, repeatability, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges - Electronic load cells – Proving Rings - Calibration of Testing Machines - Long term monitoring-vibrating wire sensors - fiber optic sensors - Introduction to structural modeling. **(12)**

MEASUREMENT OF VIBRATION AND WIND FLOW: Characteristics of Structural Vibrations - Linear Variable Differential Transformer (LVDT) - Transducers for velocity and acceleration measurements. Vibration meter - Seismographs – Vibration Analyzer - Display and recording of signals - Cathode Ray Oscilloscope ― wind tunnels-flow meter-venturimeter - Digital Data Acquisition Systems. **(10)**

DISTRESSMEASUREMENTS AND ITS CONTROL: Diagnosis of distress in structures-crack observation and measurements Corrosion of reinforcement in concrete-Half cell, construction and use-damage assessment -techniques for residual stress measurements-structural health monitoring. **(11)**

NON DESTRUCTIVE TESTING METHODS: Load testing on structures, buildings, bridges and towers - IS 516 provisions- Rebound Hammer –acoustic emission-ultrasonictestingprinciplesandapplication-Holography-useoflaserforstructuraltesting-Brittlecoating- Advance NDT methods - ultrasonic pulse echo, impact echo, impulse radar techniques, advanced rebar corrosion rate determination system, ground penetrating radar (GPR) - Applications of NDT for quality assessment and damage detection of structures and materials, probability application in NDT, statistical quality control. **(12)**

Total L: 45 periods

REFERENCES:

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2006.
2. Ganesan T P, “Model analysis of Structures”, University Press, 2000.
3. Srinath et.al L.S, "Experimental Stress Analysis", Tata Mc Graw Hill Company, New Delhi, 2003.
4. Sirohi RS, Radhakrishna H C, "Mechanical Measurements", New Age International (P) Ltd., 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply instrumentation principles to select and operate measurement systems (strain gauges, LVDTs, NDT methods) for structural forces, vibrations, and distress diagnostics.	**K3**
CO2	Analyze experimental data from case studies/mini-projects involving structural health monitoring or NDT to evaluate structural integrity and propose mitigation strategies.	**K4**

SE25P09 THEORY OF PLATES

3 0 0 3

ELEMENTS OF PLATE - BENDING THEORY AND BENDING OF ISOTROPIC RECTANGULAR PLATES: General behaviour of plates - Small deflection theory of thin plates - Governing differential equation for deflection of plates – Boundary conditions – Kirchoff's theory - Navier solution for an all - round simply supported rectangular plate subjected to uniformly distributed load, sinusoidal load and Patch load - Levy's solution for a rectangular plate with different boundary conditions and subjected to uniformly distributed load. **(13)**

BENDING OF CIRCULAR PLATES: Symmetrical bending of circular plates - Simply supported solid circular plate subjected to an uniformly distributed load, an end moment and a partially distributed load. **(11)**

NUMERICAL METHODS: Finite difference method - Isotropic Rectangular plates - Boundary conditions - All round simply supported square plate and fixed square plate subjected to uniformly distributed load. Plates of various shapes – Rectangular plate -All round clamped square plate subjected to an uniform load. **(12)**

ANISOTROPIC PLATES: Bending of anisotropic plates- large deflection theory of plates - Plates on elastic foundation. **(9)**

Total L: 45 periods

REFERENCES:

1. Timoshenko S and Kreiger S.W., "Theory of Plates and Shells", McGraw Hill Book Company, India, 2010.
2. Chandrasekhara, K., "Theory of Plates", Universities Press (India) Ltd., Hyderabad, 2001.
3. Ansel C. Ugural, "Plates and shells - theory and analysis", CRC press, Taylor and Francis Inc 2018.
4. Reddy J.N. "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Co., 2006.
5. Gambhir, M.L. "Stability Analysis and Design of Structures", Springer, New York, 2013.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the fundamental theories and behaviour of isotropic and anisotropic plates under various loading and boundary conditions	**K2**
CO2	Apply classical analytical methods (Navier and Levy solutions) and numerical methods (Finite Difference Method) to solve plate bending problems.	**K3/K4**
CO3	Evaluate the complex behaviour of plates including large deflections, anisotropic behaviour, and plates on elastic foundations to support structural design.	**K5**

SE25P10 INDUSTRIAL STRUCTURES

3 0 0 3

PLANNING AND FUNCTIONAL REQUIREMENTS: Classification of Industries and Industrial Structures – planning for layout requirements regarding lighting, ventilation and fire safety - protection against noise and vibration – industrial flooring- guidelines from factories act - material handling systems-structural loads - Estimation of wind load. **(10)**

SINGLE STOREY INDUSTRIALSTRUCTURES: Types of roofing – roofing sheets – purlins – light gauge sections–built-up sections–roof trusses–pre-engineered structures. Foundations for industrial structures. **(13)**

MATERIAL HANDLING SYSTEMS: Design Philosophy and practices - Cranes – Types design of EOT overhead travelling cranes, zib cranes and Goaliath cranes. Design of Gantry girders for overhead cranes. Conveyor systems – Supports for conveyor systems-Foot Bridge-Transmission line towers. **(10)**

INDUSTRIAL STORAGE & ENVIRONMENTAL CONTROL STRUCTURES: Silos, Bins and Bunkers – Design of supporting system for storage hoppers and bunkers - Electro Static Precipitators – Wet and dry Scrubbers – Chimneys –Self-supporting Guyed and Braced chimneys – Corrosion protection of steel structures - Fire and Fatigue resistant design. **(12)**

Total L: 45 periods

REFERENCES:

1. Shiyekar M.R, “Limit State Design in Structural Steel”, PHI Learning private limited, New Delhi, 2017.
2. Subramanian N, “Design of Steel Structures”, Oxford university press, New Delhi, 2016.
3. Karuna Moy Ghosh, “Analysis and Design Practice of Steel Structures”, PHI Learning private limited, New Delhi, 2014.
4. Sai Ram KS, “Design of Steel Structures” Pearson, New Delhi, 2020.
5. Alexander Newman, “Metal Building Systems– Design and Specifications”, McGraw-Hill, New Delhi, 2014. Switzerland, 2003.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Apply instrumentation principles to select and operate measurement systems (strain gauges, LVDTs, NDT methods) for structural forces, vibrations, and distress diagnostics.	**K3**
CO2	Analyze experimental data from case studies/mini-projects involving structural health monitoring or NDT to evaluate structural integrity and propose mitigation strategies.	**K4**

SE25P11 MECHANICS OF COMPOSITE MATERIALS

3 0 0 3

BASICS AND MACROMECHANICS OF COMPOSITES: Classification – polymer - metal – ceramic – carbon-carbon –recycling of fiber reinforced composites–mechanics terminology–advantages Stress and strain–Hooke's law- Engineering Constants of angle lamina-Hydrothermal stresses. **(12)**

MICROMECHANICAL ANALYSIS OF A LAMINA: Volume and mass fraction – density – evaluation of elastic moduli – semi-empirical models–elasticity approach–ultimate strength of uni-directional lamina–coefficients of thermal expansion. **(10)**

MICROMECHANICAL ANALYSIS OF LAMINATE: Introduction – laminate code – stress – strain for a laminate – in-plane and flexural modulus of a laminate–hydrothermal effects–warpage of laminates **(12)**

FAILURE, ANALYSIS AND DESIGN OF LAMINA & LAMINATES: Special cases of laminates–symmetric–cross-ply, angle–ply, antisymmetric, Balanced, Quasi-isotropic – strength failure theories – Tsai – Hill failure theory – Tsai –Wu failure theory – failure criterion - design of a laminated **(11)**

Total L: 45 periods

REFERENCES:

1. Kollar L. P .and Springer G.S., "Mechanics of Composite Structures", Cambridge University Press,2009.
2. Reddy J.N., "Mechanics of Laminated Composite Plates – Theory and Analysis", CRC Press, USA, 2003.
3. Jones R.M., "Mechanics of Composite Materials", CRC Press, USA, 2018.
4. Kaw A.K., "Mechanics of Composite Materials", CRC Press, 2006, USA.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Understand the classification, mechanical behaviour, and stress-strain characteristics of composite materials at both macro and micro levels.	**K2**
CO2	Analyse the micromechanical and macro mechanical behaviour of laminated composites including hydrothermal effects and laminate warpage.	**K4**
CO3	Apply failure theories and design principles to evaluate and develop laminated composite structures for various engineering applications.	**K5**

SE25P12 SOFT COMPUTING IN STRUCTURAL ENGINEERING

3 0 0 3

NEURAL NETWORKS, ASSOCIATIVE MEMORY AND ADAPTIVE RESONANCE THEORY: Basic Concepts–Artificial Neural Network (ANN) Architecture - Learning Methods - Back Propagation Network (BPN) - Single layer ANN - Multilayer ANN- Learning Method of Effect of tuning parameters. Kosko's Discrete (Bi-directional Associative Memory) BAM - input normalization - Evolution Equation - vector quantization - Architecture of ART1 and ART2 - Application to structural engineering problems **(13)**

FUZZYLOGIC: Fuzzy sets and relations –Fuzzy sets and Crispsets-Predicatelogic-Fuzzyquantifiers-FuzzyRulebasedsystems–FuzzificationandDefuzzificationmethods-Applicationto controllers-Application to structural Engineering problems **(11)**

GENETICALGORITHMS: Basic concepts – Representation of design variables, objective function and constraints –Genetic operators - reproduction - selection - cross over - mutation — Choice of population — Survival of the fittest — generation —generation history- convergence of GA- optimal design using GA-Application to structural engineering problems **(12)**

HYBRID SYSTEMS AND SUPPORT VECTOR MACHINES: Neuro - Fuzzy Hybrids - Fuzzy genetic hybrids - Neuro genetic hybrid- Fuzzy BPN- Fuzzy Art Map-Fuzzy controlled GA. Support vector regression—Classifications. Introduction to Artificial Intelligence and machine learning **(9)**

Total L:45 periods

REFERENCES:

1. Rajasekaran S. And Vijayalakshmi Pai G.A., "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India, New Delhi,2017.
2. Goldberg D. E., "Genetic Algorithms in Search Optimization and Machine Learning", Addison Wesley, Rading Mass, USA, 2013.
3. Tsoukalas H.L. and Uhrig E.R., "Fuzzy in Neural Approaches in Engineering", John Wiley and Sons, USA, 2007.
4. Adeli H. and Hung S. L.," Machine Learning, Neural Networks, Genetic Algorithms and Fuzzy Systems, John Wiley and Sons, New York, 2005.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply soft computing techniques (neural networks, fuzzy logic, genetic algorithms) to model, optimize, and solve structural engineering problems such as design optimization, damage detection, or adaptive control systems.	**K3**
CO2	Design and evaluate hybrid soft computing models (e.g., neuro-fuzzy, genetic-neural) through case studies/mini-projects for complex structural scenarios, comparing performance against conventional methods.	**K6**

SE25P13 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

3 0 0 3

CONNECTIONS: Introduction – limit states of composite sections –Design philosophies-codes of practice- shear connectors –types of shear connectors–degree of shear connection–partial and complete shear connections–Load bearing mechanism-strength of shear connectors-standard tests for shear connectors. **(10)**

COMPOSITE BEAMS: Elastic behavior of composite beams-Ultimate load behavior-Full Types of Profile steel sheeting-Design of composite beam propped and un propped construction– simply supported and continuous beams– beam with profile sheeted deck slab-Analysis and design of composite beams without profile sheet **(10)**

COMPOSITE SLABS: Introduction of composite floors-shear transferring mechanism in profile deck system–resistance to longitudinal shear-resistance to vertical shear-Bending resistance of composite slab-Design considerations of composite floor profiled sheeting – sheeting parallel to span – sheeting perpendicular to span –analysis and design of composite floor system-limit state of serviceability **(13)**

COMPOSITE COLUMNS AND COMPOSITE CONSTRUCTION: Types–design of composite columns–Relative slenderness-resistance to axial, uniaxial and biaxial loading-Transverse and longitudinal shear- in-filled and encased columns-Design Philosophy. Case studies on steel concrete composite construction in buildings- beam column joints-classification of joints-Effects of Temperature, shrinkage, creep and vibration on composite beams **(12)**

Total L: 45 periods

REFERENCES:

1. Qing Quan Liang," Analysis and Design of Steel and Composite Structures", CRC Press, Taylor and Francis Group,2015.
2. Johnson R.P, "Composite Structures of Steel and Concrete", Wiley India Pvt. Ltd, India, 2013.
3. Sai Ram K S, "Design of Steel Structures", Pearson Education, 2010.
4. Oehers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental Behaviour", Permagon Press, Oxford, 2013.
5. Teaching resource material for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
6. Narayanan R, "Composite Steel Structures–Advances, Design and Construction", Elsevier, Applied Science, UK, 1987.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply design philosophies and codes to analyze and design shear connectors and composite connections.	**K3**
CO2	Analyze and design composite beams and slab systems considering load transfer mechanisms and serviceability requirements.	**K4**
CO3	Evaluate structural behavior under lateral loads and perform plastic design of steel beams and frames.	**K5**

SE25P14 PREFABRICATED STRUCTURES

3 0 0 3

DESIGN PRINCIPLES: Road to industrialization in buildings – History - Standardization and Components - Types of prefabrication – Prefabrication systems - Disuniting of structures - IS Code Specifications - Construction principles –Manufacture of prefabricated components – Transport and Erection of structural components – Finishing and Fitting –up operations–Dimensional deviation and Tolerance–Principles of structural design of prefabricated **(11)**

ROOF, FLOOR UNITS AND WALL PANELS: Roofing slabs – Large slab type roof components – Floor units – Structural design of roof and floor units – Manufacture of roof and floor units– Dimensional variations–General consideration on external wall construction - Types of wall panels - Load bearing walls – Wind bracing (shear wall) – Curtain walls – Window panels –Connections and joints for wall panels–External wall panel examples–Manufacture, transport and erection of wall panels –Structural design and problems. **(12)**

INDUSTRIALBUILDINGS: Structural Systems-Single bay-Multi-bay buildings-Low rise buildings-Applications-Design and Detailing-Crane track beams -Columns–Frames-Structural Connections-Execution of construction work –Structural design and stability problems **(10)**

SEISMIC DESIGN OF PRECAST CONCRETE BUILDING STRUCTURES: Lessons from previous earthquakes-Demand versus capacity Assessment-Ductility provisions for structural members- Lateral Force resisting systems-Diaphragms- Seismic Detailing of Diaphragms-Inelastic behaviour of connections between precast structural elements **(12)**

Total L: 45 periods

REFERENCES:

1. Handbook on Precast Concrete Buildings, Indian Concrete Institute, 2016.
2. Kim S. Elliot, Collin K. Jolly, “Multi storey Precast Concrete Framed Structures”, Wiley Black well, Hoboken, United States, 2013.
3. Kim S. Elliot, “Precast concrete structures”, CRC Press (Taylor and Francis Group), London,2016.
4. PCI Design Handbook, Precast/Prestressed Institute, Eighth Edition, 2015.
5. Fib27, “Seismic design of precast concrete building structures,” International federation for structural concrete (Fib), Switzerland, 2003.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Understand the basic principles, manufacturing and design various precast structural elements for residential and industrial buildings as per IS Codes and standards.	**K3**

SE25P15 MAINTENANCE AND REHABILITATION OF STRUCTURES

3 0 0 3

DIAGONOSIS AND CONDITIONAL ASSESSMENT OF EXISTING STRUCTURES: Types of maintenance—Routine maintenance works in buildings– Inspection–Structural appraisal. Crack–principal sources for crack formation-Durability aspects. Conditional survey–visual inspection–field and laboratory testing stage–concrete strength assessment **(11)**

SELECTION OF REPAIR MATERIALS & DEMOLITION TECHNIQUES: Construction chemicals–repair chemicals–epoxies–polymers and latex– acrylic polymers–polyester resins-corrosion inhibitors as admixture–bondingcoatsforreinforcement–shrinkagecompensatingcompounds –waterproofing compounds. Special materials for construction and repair of buildings and special methods of placing concrete–Demolition Technique

(11)

REPAIR OF STRUCTURAL ELEMENTS & NON-STRUCTURAL ELEMENTS: Repair against rising dampness and efflorescence in masonry wall, repair of cracks in masonry wall and concrete member. Repair against rainwater leakage in building, renovation of water proofing works of RC flat roofs against rain, repair of valley gutters of sloping roof, leakage in bathing area of toilets, sunken floors of toilets in multistoried building.

(11)

STRENGTHENING OF EXISTING STRUCTURES: Strengthening of superstructure - Conversion to composite construction –Post stressing – Jacketing – Bonded overlays – Addition of reinforcement – Strengthening of substructure – Underpinning **(12)**

Total L: 45 periods

REFERENCES:

1. Poonam I. Modi &Chirag N Patel," Repair and Rehabilitation of Concrete Structures", PHI, Delhi2016.
2. Varghese P. C, "Maintenance, Repair and Rehabilitation & Minor works of Buildings", PHI Learning Pvt. Ltd., Delhi, 2014.
3. Malhotra V. M, "Handbook on Non-Destructive testing of Concrete", CRC Press,2014.
4. Allen R.T.L and Edwards S.C., "The repair of Concrete Structures", Thompson Press (India) Ltd., Delhi,2019.
5. Bhattacharjee, "Concrete Structure Repair Rehabilitation & Retrofitting, CBS, 2005.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Apply diagnostic and repair techniques to assess structural distress (cracks, dampness, corrosion) and select appropriate rehabilitation materials (epoxies, polymers, inhibitors) for buildings and infrastructure.	**K3**
CO2	Design rehabilitation strategies through case studies/mini-projects involving structural strengthening (jacketing, underpinning) or leakage remediation for distressed RC/masonry structures.	**K6**

SE25P16 SMART MATERIALS AND SMART STRUCTURES

3 0 0 3

INTRODUCTION AND MEASURING TECHNIQUES: Properties of smart materials - mechanisms – instrumented structures functions and response sensing system–self-diagnosis–signal processing consideration–actuation systems and effectors. Strain measuring techniques using electrical strain gauges, types–resistance-capacitance–inductance–Wheatstone bridges- pressure transducers- load cells-temperature compensation–strain rosettes **(13)**

SENSORS AND ACTUATORS: Sensing technology – types of sensors – physical measurement using piezo electric strain measurement – inductively read transducers – LVDT – fiber techniques - fiber optic strain sensors - Actuator techniques –Actuator and Actuator materials - piezo electric and electro resistive material – magneto structure material – shape memory alloys electrorheological fluids (ER)–electromagnetic actuation–role of actuators and actuator materials **(12)**

SIGNAL PROCESSING AND CONTROL SYSTEMS: Data Acquisition and processing – signal processing and control for smart structures–sensors as geometrical processors–signal processing–control system–linear and nonlinear **(9)**

INTRODUCTION TO STRUCTURAL HEALTH MONITORING (SHM): Definition and characters of SHM, SHM and biomimetic, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS — basic components of SHM–Applications–SHM of a bridge–applications for external posttensioned cables, monitoring historical buildings **(11)**

Total L: 45 periods

REFERENCES:

1. Gauenzi, P., “Smart structures”, Wiley, 2009.
2. Hand Book on Seismic Retrofitting of Buildings, Published by PWD & Indian Building Congress in Association with IIT, Madras, Narosa PublishingHouse,2008.
3. Daniel Balageas, Claus Peter Fritzenam I Alfredo Guemes, Structural Health Monitoring, Published by ISTE Ltd., U.K.2006.
4. Brain Culshaw, “Smart Structures and Materials”, Artech House, London, 2004.
5. L. S. Srinath, “Experimental Stress Analysis”, Tata Mc GrawHill,2001.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Grasp the core concepts of smart materials and structures, including their properties, sensing techniques (e.g., strain gauges, fiber optics), and actuation systems.	**K3**
CO2	Apply knowledge through case studies and mini-projects to design solutions for real-world problems like structural health monitoring (SHM) in bridges or historical buildings.	**K6**

SE25P17 STRUCTURAL HEALTH MONITORING

3 0 0 3

INTRODUCTION AND VIBRATION BASED TECHNIQUES FOR SHM: Definition and characters of SHM, SHM as a way of making materials and structures smart, SHM and Biomimetics, Process and pre-usage monitoring as a part of SHM, Passive and active SHM, NDE, SHM and NDECS. Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State-space description of mechanical systems, Modeling of damaged structural elements, Damage identification in non-linear systems **(13)**

FIBER-OPTIC SENSORS: Classification of fiber optic sensors, Photo-elasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/Egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain and stress variations, Examples of applications in civil engineering **(10)**

SHM WITH PIEZOELECTRIC SENSORS: The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, New concepts in acoustic emission, State of the-art and main trends in piezoelectric transducer-based acousto- ultrasonic SHM research, Acousto-ultrasonic signal and data reduction methods **(9)**

SHMUSING ELECTRICAL RESISTANCE and LOW FREQUENCY ELECTROMAGNETIC TECHNIQUES: Composited damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, unidirectional and Multidirectional laminates, Damage localization. Theoretical considerations on electromagnetic theory, Maxwell‘s equations, Applications to the NDE/NDT domain and SHM domain, General principles, Magnetic method, Electric method and Hybrid methods. (13)

Total L: 45 periods

REFERENCES:

1. Douglas E Adams, “Health Monitoring of Structural Materials and Components Methods with Applications”, John Wiley and Sons, 2007.
2. Hua-Peng Chen, “Structural Health Monitoring of Large Civil Engineering Structures”, Wiley Publishers, 2018
3. Huston D, “Structural Sensing, Health Monitoring and Performance Evaluation”, CRC Press, A Taylor & Francis book, 2011
4. Victor Giurglutiu, “Structural Health Monitoring with Piezoelectric Wafer Active Sensors”, Academic Press Inc,2014.
5. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, “Structural Health Monitoring”, Wiley-ISTE,2006.
6. J.P. Ou, H. Li and Z. D. Duan, “Structural Health Monitoring and Intelligent Infrastructure”, Vol-1, Taylor and Francis Group, London, U.K, 2006

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Learn to analyze and apply SHM methods to detect and characterize damage in structures using various sensor technologies.	**K3**
CO2	Design and apply SHM systems to real-world problems, effectively selecting sensors, managing data, and interpreting results for structural assessment.	**K6**

SE25P18 FOUNDATION STRUCTURES

3 0 0 3

SHALLOW FOUNDATIONS: Site investigation – Field penetration tests – Bearing capacity based on N-value - Choice of shallow foundations for different situations – Proportioning of foundations for equal settlement, Sizing of foundations based on bearing capacity–strip, isolated, combined and strap–raft foundation. **(9)**

DEEP FOUNDATIONS: Pile foundation- Provisions of IS 2911 (Part1 and Part3) on structural design of piles-Structural design of straight piles - Different shapes of pile cap - Structural design of pile cap - selection of rig for piling - Well foundation - Different types based on shape in plan – Grip length – Load carrying capacity based on SPT results – Thickness of staining and bottom plug – Forces acting on the well–Stability of well subjected to lateral load by Terzaghi's approach–Methods to rectify tilt of well foundation. **(14)**

SHEET PILE WALL AND ANCHORED BULKHEADS: Different types of sheet pile – Cantilever sheet pile wall in granular soils, in cohesive soils with granular backfill– Anchored bulk head-Free earth and Fixed earth support methods–in cohesive soils, in cohesive soil with cohesion less backfill. **(10)**

INTRODUCTION TO MACHINE FOUNDATIONS, SOIL-STRUCTURE INTERACTION PROBLEMS AND SHELLFOUNDATION : Fundamentals of soil dynamics –Determination of dynamic properties of soil based on Block Vibration Test and Cyclic plate load test – Barkan's method of design of block foundation subjected to vertical vibrations – Vibration Isolation –Transmissibility–Methods of Isolation–Modulus of sub grade reaction–Winkler model–Analysis of infinite beams resting on elastic medium and subjected to point load, Uniformly distributed load and moment– Introduction to shell foundation. **(12)**

Total L: 45 periods

REFERENCES:

1. Kurian KP, "Design of Foundation Systems", Narosa Publishing House, New Delhi, 2014.
2. Varghese PC, "Foundation Engineering", Prentice Hall of India Ltd., New Delhi, 2013.
3. Murthy V N S, "Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series", CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2017.
4. Bowles JE, "Foundation Analysis and Design", Mc Graw-Hill International Editions, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Illustrate the fundamental principles of various foundation systems, including shallow and deep foundations, sheet pile walls, machine foundations, and the associated soil-structure interaction concepts.	**K2**
CO2	Utilize appropriate design methods and standards to determine the type, proportioning, and structural design of foundation elements, and analyze soil-structure interaction effects in practical engineering scenarios.	**K3**

SE25P19 GROUND IMPROVEMENT TECHNIQUES

3 0 0 3

INTRODUCTION AND MECHANICAL MODIFICATION: Need for ground improvement - methods of ground improvement -geotechnical problems in alluvial and black cotton soils — selection of suitable ground improvement techniques based on soil conditions; Methods of compaction, principles of soil densification, properties of compacted soil, dynamic compaction, Pre-consolidate on technique **(12)**

SOILNAILING AND MICRO PILING: Introduction – functions and applications of soil nailing – methods of construction of soil nailed cut – components of sail nail system; Reinforcing mechanism of micro pile – installation of micro pile. **(11)**

GEOSYNTHETICS AND DEWATERING SYTEMS: Introduction – functions of geo-synthetics – types of geo synthetics –properties of geosynthetics and its applications; Dewatering techniques-well points – vacuum and electroosmatic methods **(11)**

GROUTING TECHNIQUES AND SOIL STABILIZATION: Types of grouts, grouting equipment and machinery, injection methods, grout monitoring — applications of grouting; Lime stabilization - Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing **(11)**

Total L: 45 periods

REFERENCES:

1. Satyendra Mittal, "An Introduction to Ground Improvement Techniques", Scientific International Pvt. Ltd., New Delhi, 2013.
2. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
3. Purushothama Raj P, “Ground Improvement Techniques”, Laxmi Publications (P) Ltd., 2016.
4. Sivakumar Babu G L, “An Introduction to Soil Reinforcement and Geosynthetics”, Universities Press, Hyderabad, 2013.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Explain the principles and mechanisms of different ground improvement techniques, including mechanical modification, soil nailing, micro piling, geosynthetics, dewatering systems, grouting, and stabilization methods	**K2**
CO2	Apply appropriate ground improvement techniques for specific soil conditions, selecting suitable methods to address geotechnical challenges in alluvial and black cotton soils	**K3**

SE25P20 GEOTECHNICAL EARTHQUAKE ENGINEERING

3 0 0 3

ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMIC SOIL PROPERTIES: Mechanism of earthquakes, causes of earthquake, earthquake fault sources, elastic rebound theory, seismic wave in earthquake shaking, definition of earthquake terms, Quantification of earthquakes — Dynamic soil properties — Representation of state of stresses by Mohr circle, Measurement of soil properties–Field and laboratory tests. **(12)**

LIQUEFACTION AND DYNAMIC ANALYSIS OF SOLID WASTE LANDFILLS AND LINING SYSTEMS: Liquefaction and its related phenomena, Evaluation of liquefaction hazards, Liquefaction susceptibility — Historical, geologic, compositional and state criteria — Initiation of liquefaction, Effects of liquefaction — Alteration of ground motion, sand boils, settlement and instability. Performance of solid waste landfills during earthquakes, Analysis of solid waste landfills stability during earthquakes, Monitoring and safety control of landfills, Safety and risk analyses **(13)**

SEISMIC SLOPE STABILITY: Types of earthquake induced landslides, Earthquake induced landslide activity, Evaluation of slope stability. Review of static slope stability analysis, Seismic slope stability analysis — Analysis for inertial and weakening instability **(10)**

SEISMIC DESIGN OF RETAINING WALLS: Review of calculation of static pressures on retaining walls, Dynamic response of retaining walls, Seismic pressures on retaining walls — Yielding and non-yielding walls, Effect of water, finite element analysis, Seismic displacements on retaining walls, seismic design considerations. **(10)**

Total L: 45 periods

REFERENCES:

1. Swamisaran, Soil Dynamics and Machine Foundations, Galgotia Publications Pvt. Ltd., New Delhi, 2017.
2. Prasad B. B., “Fundamentals of Soil Dynamics and Earthquake Engineering”, PHI Learning Private Limited, NewDelhi,2013.
3. Ansal A., “Recent Advances in Earthquake Geotechnical Engineering and Microzonation", Kluwer Academic Publishers, The Netherlands,2011.
4. Kramer S. L., “Geotechnical Earthquake Engineering", Pearson Education (Singapore) Private Ltd. (Indian Branch), NewDelhi,2007.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Outline the fundamental concepts of earthquake seismology, dynamic soil properties, liquefaction phenomena, seismic slope stability, and seismic design of retaining walls in geotechnical earthquake engineering.	**K2**
CO2	Organize principles of earthquake engineering and geotechnical analysis to evaluate liquefaction potential, analyze seismic slope stability, and design retaining structures and landfill systems for earthquake-resistant performance.	**K3**

SE25P21 SOIL STRUCTURE INTERACTION

3 0 0 3

SOIL-FOUNDATION INTERACTION: Introduction to soil – foundation interaction problems— Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter models, Elastic plastic behaviour, Time dependent behavior **(10)**

BEAM ON ELASTIC FOUNDATION-SOIL MODELS: Infinite beams, two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams based on their stiffness **(11)**

PLATE ON ELASTIC MEDIUM: Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates—Simple solutions. **(11)**

ELASTIC ANALYSIS OF PILE: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap. Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Pile draft system, Solutions by influence charts. **(13)**

Total L: 45 periods

REFERENCES:

1. Timoshenko S.P and Young D. H., “Theory of Structures”, McGraw Hill International Editions, 2017.
2. Poulos H.G. and Davis, E.H. “Pile Foundation Analysis and Design”, John Wiley,2008.
3. Selvadurai A. P. S., “Elastic Analysis of Soil Foundation Interaction”, Elsevier, 2013.
4. Bowles J E, “Foundation Analysis and Design”, Mc Graw-Hill International Editions, 2017.

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom’s Level**
CO1	Illustrate the fundamental concepts of soil-foundation interaction, foundation behavior, interface behavior, and various soil response models such as Winkler, elastic continuum, and two-parameter models.	**K2**
CO2	Apply analytical techniques to solve practical problems involving elastic foundations, including the analysis of settlement, load distribution in pile groups, and prediction of load-deflection behavior of laterally loaded piles	**K3**
CO3	Analyze the interaction effects between soil and foundation systems on elastic media, and interpreting load-settlement behavior in single piles and pile groups under various loading and boundary conditions.	**K3**

AUDIT COURSES

SE25A01 SUSTAINABLE DEVELOPMENT GOALS

2 0 0 0

MODULE 1: The "5P's" of the SDGs – People, Planet, Prosperity, Peace, Partnership - No Poverty, End poverty in all its forms everywhere – Zero Hunger, End hunger, achieve food security and improved nutrition and promote sustainable agriculture –Good Health and Well-Being, ensure healthy lives and promote well-being for all at all ages. **(8)**

MODULE 2: Quality Education, promote lifelong learning opportunities for all – Gender Equality, Achieve gender equality and empower all girls and women – Clean Water and Sanitation – Affordable and Clean Energy, Ensure access to affordable, reliable, sustainable and modern energy for all – Decent Work and Economic Growth. **(7)**

MODULE 3: Industry, Innovation and Infrastructure, Build resilient infrastructure, promote sustainable industrialization and foster innovation – Reduced Inequalities – Sustainable Cities and Communities – Responsible Consumption and Production, Ensure sustainable consumption and production patterns. **(7)**

MODULE 4: Climate Action, Take urgent action to combat climate change and its impacts – Life below Water, Conserve and sustainably use our oceans, seas and marine resources – Life on Land, Sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss – Promote just, peaceful and inclusive societies **(8)**

Total L: 30 periods

REFERENCES:

1. The United Nations, "The Sustainable Development Goals", The United Nations, 1st Edition, 2017.
2. Stephen Browne, "Sustainable Development Goals and Un Goal-Setting", Routledge, 1st Edition, 2017.
3. Korbla P. Puplampu, Kobena Hanso, Timothy Shaw, Kobena T. Hanson, and Timothy M. Shaw, "From Millennium Development Goals to Sustainable Development Goals", Routledge, 1st Edition, 2021.
4. Julia Walker, Alma Pekmezovic and Gordon Walker, "Sustainable Development Goals", John Wiley& Sons Limited, 1st Edition, 2019.
5. Rianne Mahon, Susan Horton, Simon Dalby and Diana Thomaz, "Achieving the Sustainable Development Goals", Routledge, 1st Edition, 2019.

ONLINE RESOURCES:

1. https://sustainabledevelopment.un.org/resourcelibrary
2. https://en.unesco.org/themes/education/sdgs/material
3. https://www.unicef.org/sdgs/resources
4. https://www.undp.org/content/undp/en/home/sustainable-development-goals/resources.html
5. https://sdghub.com/resources/

COURSE OUTCOMES

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the significance of Sustainable Development Goals (SDGs) in global, national, and local development contexts.	**K2**
CO2	Analyze real-world issues through case studies and propose sustainable solutions aligned with relevant SDGs.	**K4**

SE25A02 ENGLISH FOR RESEARCH PAPER WRITING

2 0 0 0

INTRODUCTION TO RESEARCH PAPER WRITING: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. **(6)**

PRESENTATION SKILLS: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

(6)

TITLE WRITING SKILLS: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check **(6)**

RESULT WRITING SKILLS: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions **(6)**

VERIFICATION SKILLS: Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission **(6)**

Total L: 30 periods

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006.
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the principles of academic writing, including clarity, conciseness, proper structuring of sentences, and the avoidance of ambiguity, redundancy, and plagiarism in research papers.	K2
CO2	Apply effective writing and presentation skills to prepare well-structured sections of a research paper (title, abstract, introduction, methods, results, and discussion), ensuring academic integrity and readiness for publication.	K3

SE25A03 DISASTER MANAGEMENT

2 0 0 0

INTRODUCTION TO DISASTERS: Disaster: Definition, Factors and Significance – Difference between Hazard and Disaster – Natural and Manmade Disasters: Differences, Nature, Types and Magnitude. **(8)**

IMPACTS AND TYPES OF DISASTERS: Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystems – Natural Disasters: Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches – Man-made Disasters: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. **(7)**

DISASTER VULNERABILITY AND PREPAREDNESS IN INDIA: Disaster-Prone Areas in India: Seismic Zones, Areas Prone to Floods, Droughts, Landslides, Avalanches, Cyclones, and Coastal Hazards (with special reference to Tsunami) – Post-Disaster Diseases and Epidemics – Preparedness: Monitoring of Phenomena Triggering Disasters, Risk Evaluation, Use of Remote Sensing, Meteorological Data, Media Reports – Government and Community Preparedness. **(8)**

DISASTER RISK ASSESSMENT AND MANAGEMENT STRATEGIES: Disaster Risk: Concept and Elements – Disaster Risk Reduction – Global and National Disaster Risk Situations – Techniques of Risk Assessment – Global Cooperation and Early Warning Systems – People's Participation – Strategies for Survival. **(7)**

REFERENCES:

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company, 2007.
3. Sahni and Pardeep. ," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.

Total L: 30 periods

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the nature, types, and impacts of natural and man-made disasters, along with India's disaster-prone regions and their vulnerabilities.	K2
CO2	Apply disaster preparedness and risk assessment strategies using tools such as remote sensing, meteorological data, and community participation to propose suitable management practices.	K3

SE25A04 CONSTITUTION OF INDIA

2 0 0 0

HISTORY AND PHILOSOPHY OF THE CONSTITUTION: History of the Indian Constitution – Drafting Committee: Composition and Working – Philosophy of the Constitution – Preamble – Salient Features. **(8)**

FUNDAMENTAL RIGHTS AND DUTIES: Fundamental Rights – Right to Equality – Right to Freedom – Right against Exploitation – Right to Freedom of Religion – Cultural and Educational Rights – Right to Constitutional Remedies – Directive Principles of State Policy – Fundamental Duties. **(7)**

STRUCTURE OF GOVERNANCE: Organs of Governance: Parliament – Composition, Qualifications and Disqualifications – Powers and Functions – Executive: President, Governor, Council of Ministers – Judiciary: Appointment and Transfer of Judges – Qualifications, Powers and Functions. **(8)**

LOCAL ADMINISTRATION AND ELECTORAL PROCESS: Local Administration: District Administration – Role of District Collector – Municipalities – Mayor and Elected Representatives – Municipal Commissioner – Panchayati Raj Institutions (PRI): Zila Panchayat, Block Level, Village Level – Roles of Elected and Appointed Officials – Importance of Grassroots Democracy – Election Commission: Role and Functions – Chief Election Commissioner and Election Commissioners – Institutions for the Welfare of SC/ST/OBC and Women. **(7)**

Total L: 30 periods

REFERENCES:

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Explain the historical evolution, philosophy, and salient features of the Indian Constitution, including its fundamental rights, duties, and directive principles.	K2
CO2	Evaluate the structure and functioning of governance, local administration, and electoral processes in India, and assess their role in ensuring democracy, justice, and social welfare at both national and grassroots levels.	K2

SE25A05 BUILDING COMMUNICATION SKILLS

INTRODUCTION: This course is aimed at enhancing the students' ability to land internships through improved communication skills. This course will cover two crucial elements –

1. Communication skills enhancement and
2. Career skills orientation with broader career guidance

At the end of this course, the students will

- be able to confidently communicate in English with improved outcomes in internships, and other career pathways
- have an orientation to the necessary digital tools & resources that can enhance communication skills
- have an understanding of best practices in professional communication
- have increasing digital literacy and understand the important of digital communication both in personal and professional lives

MODULE 1: Communication Skills (18 hours)

In this module, essential communication skills required for the workplace are covered in a multi-part lecture series. This includes skill sets in Writing, Speaking, Vocabulary & Grammar.

MODULE 2: Career Skills (12 hours)

In this module, an overall career orientation approach is taken to introduce students to the essential skills required to plan and progress towards crucial career choices. Sessions on profile building, workplace communication, reasoning & critical thinking, social media, privacy, digital communication, workplace communication tools & etiquette are discussed. The module concludes with a session on career planning and milestone tracking.

Total L: 30 periods

REFERENCES:

1. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary by Norman Lewis
2. The Elements of Style (Fourth Edition or later) by William Strunk Jr and E B White
3. Idioms & Phrasal Verbs List (Various sources and provided in class)
4. The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century by Steven Pinker (Optional Resource)

COURSE OUTCOMES:

At the end of the course, students will be able to:		**Bloom's Level**
CO1	Demonstrate improved oral and written communication skills applicable in internships and workplace environments.	**K3**
CO2	Analyze and apply career development strategies including digital tools, professional etiquette, and personal branding.	**K4**