

*Regulations 2025
Curriculum and Syllabi
(As approved by the 24th Academic Council)
August - 2025*

**M.Tech.
(Structural Engineering)**



REGULATIONS 2025 CURRICULUM AND SYLLABI
(As approved by 24th Academic Council)
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M.TECH. STRUCTURAL ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

B.S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio- Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

**DEPARTMENT OF CIVIL ENGINEERING SCHOOL OF
INFRASTRUCTURE VISION AND MISSION**

VISION

To be a leading Department for Education, Training and Research in Civil Engineering for a better future of society and overall socio-economic progress of the country in a sustainable manner.

MISSION

- To offer world class undergraduate, postgraduate and research programs of industrial and societal relevance in civil engineering.
- To nurture ethically strong civil engineers to address global challenges through quality education and application-oriented research with emphasis on sustainability.
- To educate students on design, construction, and maintenance of infrastructure projects, and advancements in civil engineering for providing solutions to the advancement of society.
- To prepare competitive and responsible future citizens with good communication, leadership and managerial skills.
- To advance the best practices in various areas of civil & allied engineering through collaborations with Institutions of Excellence, Industries and Research Organizations.
- To provide a conducive environment for teaching, research, consultancy and extension activities.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.TECH. STRUCTURAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Exhibit expertise in analysis and design of Reinforced Concrete and steel structures with an emphasis on economy, sustainability and society.

PEO 2: Develop and practice cost-effective solutions to structural engineering problems in real-time projects with care for the environment.

PEO 3: Evaluate the performance of new or distressed structures with scientific approach by using state of the art software tools.

PEO 4: Pursue innovative research in the field of Structural Engineering to cater the changing needs of society and environment.

PEO 5: Demonstrate leadership in a team by exhibiting ethical approach, good communication skills and time management.

PROGRAMME OUTCOMES

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level of higher than the requirements in the appropriate bachelor program.

PO4: An ability to apply engineering principles and techniques for structural engineering problems with emphasis on society and sustainability.

**B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND
TECHNOLOGY, CHENNAI – 600 048.**

REGULATIONS 2025

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

- i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)
- ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.
- iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.
- iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.
- v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.
- vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.
- vii) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare, conduct of co-curricular, extra-curricular events and discipline in the campus.
- viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.
- ix) **"Dean of the School"** means the Dean of the School of the department concerned.

- x) **“Head of the Department”** means the Head of the Department concerned.

2.0 ADMISSION REQUIREMENTS

- 2.1** Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.
- 2.2** The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 BRANCHES OF STUDY

- 3.1** The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

3.2 Programmes offered

S. No.	Name of the Department	Programmes offered
1.	Aeronautical Engineering	M.Tech. (Avionics)
2.	Civil Engineering	M.Tech. (Structural Engineering)
		M. Tech. (Construction Engineering and Project Management)
3.	Mechanical Engineering	M.Tech. (CAD/CAM)
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)

S. No.	Name of the Department	Programmes offered
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)
		M.Tech. (Artificial Intelligence and Data Science)
7.	Information Technology	M.Tech. (Information Technology)
8.	Computer Applications	MCA
9.	Mathematics	M.Sc. (Actuarial Science)
10.	Physics	M.Sc.(Physics)
11.	Chemistry	M.Sc.(Chemistry)
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology
		M.Sc. Biotechnology
		M.Sc. Microbiology
		M.Sc. Stem Cell Technology
		M.Sc. Clinical Embryology
		M.Tech. Biotechnology
		M.Tech. Food Biotechnology
13.	Commerce	M.Com
14.	Arabic and Islamic Studies	M.A. Islamic Studies

3.3 Eligible entry qualifications for admission to programmes

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	M. Tech. (Construction Engineering and Project Management)	B.Tech. in Mechanical / Civil / Electrical and Electronics / Geo Informatics / B Plan / B. Des, and B.Arch.
3.	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
	M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
7.	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
8.	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2 level or equivalent degree in relevant field.
9.	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation or Equivalent degree in

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		relevant field.
11.	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Stem Cell Technology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Clinical Embryology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
	M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial Biotechnology or Equivalent degree in relevant field.
13. .	M.Com	B.Com. / BBA
14. .	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or) Any under graduate degree with Aalim Sanad / Diploma / Certificate in Arabic or Islamic Studies.

4.0. STRUCTURE OF THE PROGRAMME

4.1. The PG. programmes consist of the following components as prescribed in the respective curriculum:

- i. Core courses
- ii. Elective courses
- iii. Laboratory integrated theory courses
- iv. Project work
- v. Laboratory courses
- vi. Open elective courses
- vii. Seminar
- viii. Mini Project
- ix. Industry Internship
- x. MOOC courses (NPTEL- Swayam, Coursera etc.)
- xi. Value added courses

4.1.1. The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

4.1.2. For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

4.1.3. The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Range of credits
M.Tech.	80 - 86
MCA	80 - 86
M.Sc.	80 - 85
M.Com.	80 - 88
M.A.	80 - 84

4.1.4. Credits will be assigned to the courses for all programmes as given below:

- ❖ One credit for one lecture period per week or 15 periods of lecture per semester.
- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

4.1.5. The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 32	18 to 26
MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

4.1.6 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

4.1.7 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

4.1.8 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, alter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

4.1.9. Online courses

Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 Project work

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

5.0 DURATION OF THE PROGRAMME

5.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

5.2 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

5.3 Medium of instruction, examinations and project report shall be in English.

6.0 REGISTRATION AND ENROLLMENT

6.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

6.2 Change of a Elective Course

A student can change an enrolled elective course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

6.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

6.4 A student can enroll for a maximum of 36 credits during a semester including Redo / Predo courses.

7.0 BREAK OF STUDY FROM PROGRAMME

- 7.1** A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:
- 7.1.1 Medical or other valid grounds
 - 7.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance
 - 7.1.3 Debarred due to any act of indiscipline
- 7.2** The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).
- 7.3** A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).
- 7.4** During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

8.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

9.0 COURSE COMMITTEE

9.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

10.0 CLASS COMMITTEE

10.1 A class committee comprising faculty members handling the courses, student representatives and a senior faculty member not handling any courses for that class as chairman will be constituted in every semester:

10.2 The composition of the class committee will be as follows:

- i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department
- ii) Faculty members of all courses of the semester
- iii) All the students of the class
- iv) Faculty advisor and class advisor
- v) Head of the Department – Ex officio member

10.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after

the date of first assessment report, to review the students' performance and for follow up action.

10.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi of courses.

10.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

11.0 CREDIT REQUIREMENTS TO REGISTER FOR PROJECT WORK

11.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

11.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Weightage of Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory (LIT) Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component (for a 4 credit LIT Course). Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

Component	Maximum Marks	Weightage for Final Grade	Mode of Assessment
Theory Component	100	75%	CAT1 (25%) + CAT2 (25%) + SEE (50%)

Practical Component	100	25%	Continuous assessment only
Final Grade Basis	Consolidated	100%	75% Theory + 25% Practical
Pass Requirement	-	-	Minimum 40% in Semester-End Theory Exam (SEE)

Note:

1. Proportionate weightage shall be assigned to LIT courses based on their credit value, whether 2 or 3 credits.
2. In Lab-Integrated Professional Elective courses, the laboratory component shall be assessed by the course faculty.

12.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

Mini project work, shall be carried out individually or as a group activity involving a maximum of three students.

Each group shall identify a suitable topic within their domain, either disciplinary or interdisciplinary, based on the students' abilities and in consultation with the faculty mentor. The topic must lead to the development of a small-scale system or application.

The progress of the mini project shall be evaluated through three periodic reviews: two interim reviews and one final review. A project report shall be submitted by the end of the semester. The reviews shall be conducted by a committee of faculty members constituted by

the Head of the Department / Dean of the School.

An oral examination (viva voce) shall be conducted as the semester-end examination by an internal examiner approved by the Controller of Examinations, based on the project report.

The weightage for assessment shall be as follows:

- Periodic Reviews: 50%
 - 25% by the Project Guide
 - 25% by the Review Committee
- Project Report: 20%
- Viva Voce Examination: 30%

The Project shall be carried out individually or as a group activity, involving a maximum of two or three students.

A committee of faculty members, constituted by the Head of the Department / Dean of the School, shall conduct three periodic reviews during the semester to monitor and assess the progress of the project.

At the end of the semester, students shall submit a project report, based on which a semester-end oral examination (viva voce) shall be conducted by an external examiner approved by the Controller of Examinations.

The assessment weightage shall be as follows:

- Periodic Reviews – 50%
 - 25% by the Project Guide
 - 25% by the Review Committee
- Project Report – 20%
- Viva Voce Examination – 30%

12.8 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. **There shall be no arrear or improvement examination for lab components.**

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However, there is no substitute examination for semester end examination.

13.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However, the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the scheduled contact hours (such as lectures, tutorials, labs, etc.) for that course. However, a relaxation of up to 25% in attendance may be granted to account for valid reasons such as medical emergencies, participation in co-

curricular or extracurricular activities with prior approval, or other genuine circumstances.

If a student's attendance falls below 75% in a particular course, even after considering the permissible relaxation, they will not be allowed to appear for the semester-end examination in that course. Instead, the student will be awarded an "I" grade (Incomplete) for the course

14.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student's attendance in any course falls between 65% and 75% due to medical reasons (e.g., hospitalization, illness) or participation in institution-approved events, they may be granted exemption from the minimum attendance requirement and allowed to appear for the semester-end exam. The student must submit valid documents to the class advisor upon rejoining, with approval from the HoD/Dean. Final approval for **condonation** will be granted by the Vice Chancellor based on the Dean (Academic Affairs)'s recommendation.

14.4 A student who has obtained an "I" grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall **repeat** all the courses of the semester in the subsequent academic year. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

14.5 The student awarded "I" grade, shall enroll and repeat the course when it is offered next. In case of "I" grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.

- 14.6** A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to **redo** the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.
- 14.7** If a student with “U” grade, who **prefers to redo** any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

15.0 REDO / PRE-DO COURSES

- 15.1** A student can register for a maximum of three redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the concerned department, based on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.
- 15.2** The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is **no provision for any substitute examination and withdrawal from a redo course**.
- 15.3** A student shall be permitted to pre-do a course offered by the concerned department, provided it does not affect the regular semester class schedule. Such permission shall be granted based on the availability of faculty members, the maximum permissible credit limit of the semester, and the student’s fulfillment of the necessary prerequisites for the course. The proposal shall be recommended by

the Dean of the School and the Head of the Department, and shall require final approval from the Dean (Academic Affairs).

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis.

The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-
PA	-
FA	-

"W"- denotes withdrawal from the course

"I" - denotes "Incomplete" ie. inadequate attendance in the course and prevention from appearance of semester end examination

"U" - denotes unsuccessful performance in the course.

"PA" - denotes the 'Pass' of the zero credit courses.

"FA" - denotes the 'Fail' of the zero credit courses.

16.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be **repeated by the student for improvement of grade.**

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the School offered the course shall constitute a revaluation committee consisting of chairman of the class committee as convener, the faculty member of the course and a senior faculty member having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from the first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i is the number of credits assigned for the i^{th} course and GPI is

$$GPA = \frac{\sum_{i=1}^n (C_i)(GPI)}{\sum_{i=1}^n C_i}$$

the Grade Point in the i^{th} course,

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I”, “W”, “PA” and “FA” grades are excluded for calculating GPA.

“U”, “I”, “W”, “PA” and “FA” grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage equivalent of marks = CGPA X 10

16.6 After successful completion of the programme, the degree shall be awarded to the students with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students can apply for supplementary examination for a maximum of **three** courses thus providing an opportunity to complete their degree programme. Likewise, students with less credit can also apply for supplementary examination for a maximum of **three** courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semesters.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

18.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

19.0 MULTI ENTRY AND MULTI EXIT (MEME) FRAMEWORK *

In accordance with the provisions of the National Education Policy (NEP) 2020, the programme shall support a Multi Entry – Multi Exit (ME-ME) framework to provide flexibility in the academic pathway of students.

*** At present (AY 2025-26), it is applicable only for all M.Tech. Programmes.**

19.1. Exit Option:

19.1.1 Credit Requirement for Award of M.Tech. Degree

To qualify for the award of a M.Tech. degree from the Institute, a student must successfully complete the total credit requirements as prescribed in the approved curriculum of the respective programme. The specific credit requirements are determined by the programme curriculum.

19.1.2 Provision for Multiple Exit

In alignment with NEP 2020 guidelines, the Institute provides students enrolled in postgraduate programmes with the option of multiple exits, subject to the following conditions:

a. Exit at the End of First Year

Students may choose to exit the programme at the end of the first year, provided they have fulfilled the prescribed academic

requirements.

b. Application for Exit

A student intending to exit must submit a formal written application in the prescribed format at least **eight weeks prior to the scheduled end of the academic year.**

c. Departmental Recommendation

1. Upon receipt of the application, the concerned Department shall evaluate the academic record of the student and recommend the award of a **Post Graduate Diploma**, based on the credits earned.

2. In the case of arrear courses, the post graduate diploma will be conferred only after successful clearance of all pending arrears.

d. Notification of Completion

Once a student has fulfilled the requirements for the award of post graduate diploma, the Department shall notify the same to controller of examinations for further processing and issuance.

19.1.3 Award of Qualifications under Multiple Exit Scheme

Post graduate diploma: Awarded after successful completion of the first year, subject to earning the prescribed cumulative credits as per the respective programme curriculum (e.g., 44 credits from the first year) along with 3 credits of Skill Based Courses.

19.1.4 Conditions Governing Exit

1. The multiple exit facility is intended strictly for **genuine and exceptional circumstances**, such as prolonged illness, or securing an employment opportunity necessitating a temporary withdrawal from the programme.

2. Students opting for a temporary exit after the first year must obtain **prior approval from the Registrar through Dean (Academics)**, based on the recommendation of the respective Head of the Department.

19.1.5 Expectation of Programme Continuity

While the option for multiple exits exists, it is generally expected that students admitted to a post graduate programme shall pursue their studies continuously until completion of the final degree requirements.

19.2. Entry Option:

Students seeking re-entry into the programme (multi-entry) must submit an application through the proper channel at the beginning of the odd semester. Admission shall be subject to fulfilment of institutional guidelines, credit mapping, and availability of seats.

19.3. Credits Requirement for the Certifications

Name of the Certificate Programme	Required Credits
Post graduate Diploma (Level 6.5 as per NEP 2020)	40* - 45

* The minimum number of credits that a student must earn (as per the respective curriculum) in order to get the above certification program

20.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

20.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

- i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the maximum period of 8 semesters from the date of admission, including break of study.
- ii. No disciplinary action is pending against him/her.
- iii. Enrolled and completed at least one value added course.
- iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

20.2 The award of the degree must have been approved by the Institute.

21.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

REGULATIONS 2025

CURRICULUM & SYLLABI FOR M. TECH. (STRUCTURAL ENGINEERING)

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MAF 6183	Probability, Optimization and Matrix Theory	3	1	0	4
2.	CEF 6101	Advanced Design of Concrete Structures	3	0	0	3
3.	CEF 6102	Dynamics of Structures	3	0	0	3
4.	CEF 6103	Experimental Methods and Techniques	2	0	2	3
5.	CEF 6104	Seismic Resistant Design of Structures	3	0	0	3
6.		Professional Electives Courses				3
Credits						19

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	GEF 6201	Research Methodology and IPR for Engineers	2	0	0	2
2.	CEF 6201	Finite Element Analysis in Structural engineering	3	0	0	3
3.	CEF 6202	Advanced Design of Steel Structures	3	1	0	4
4.	CEF 6203	Structural Engineering Studio	0	0	4	2
5.	ENF 6281	Professional Communication	0	0	2	1
6.	CEF 6204	Mini Project	0	0	6	3
7.		Professional Electives Courses				6
Credits						21

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Open Elective Courses	3	0	0	3
2.		Professional Elective Courses				6
3.	CEF 7102	Industry Internship	0	0	4	2
4.	CEF 7101	Project Work - Phase I	0	0	22	11*
5.		1 MOOC Course (related to project domain)				-
Credits						11

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEF 7101	Project Work - Phase II	0	0	35	18 [#]
Credits						11 + 18 = 29

Overall Total Credits - 80

* Industrial training will be undertaken during the first-year of summer vacation for 30 days. The credit will be awarded in the 3rd Semester.

Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

PROFESSIONAL ELECTIVES COURSES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEFY 01	Advanced Concrete Technology	3	0	0	3
2.	CEFY 02	Design of Bridges	3	0	0	3
3.	CEFY 03	Design of Steel Concrete Composite Structures	3	0	0	3
4.	CEFY 04	Matrix Methods of Structural Analysis	3	0	0	3
5.	CEFY 05	Maintenance and Rehabilitation of Constructed Facilities	3	0	0	3
6.	CEFY 06	Theory of Elasticity and Plasticity	3	0	0	3
7.	CEFY 07	Corrosion Control in RC Structures	2	0	2	3
8.	CEFY 08	Design of Prestressed Concrete Structures	3	0	0	3
9.	CEFY 09	Water Proofing of Concrete and Masonry Structures	3	0	0	3
10.	CEFY 10	Design and Construction of Precast Concrete Buildings	3	0	0	3
11.	CEFY 11	Advanced Foundation Design	3	0	0	3
12.	CEFY 12	Design of Industrial Structures	3	0	0	3
13.	CEFY 13	Tall Structures	3	0	0	3
14.	CEFY 14	Theory of Plates and Shells	3	0	0	3
15.	CEFY 15	Stability of Structures	3	0	0	3
16.	CEFY 58	Circular Economy in Construction Industry	3	0	0	3
17.	CEFY 16	Optimization in Structural Design	3	0	0	3
18.	CEFY 17	3D Printing of Concrete Structures	3	0	0	3
19.	CEFY 18	Structural Safety and Reliability	3	0	0	3
20.	CEFY 19	Applications of AI and ML in Structural Engineering	3	0	0	3

SEMESTER – I

MAF 6183	PROBABILITY, OPTIMIZATION AND	L	T	P	C
SDG: 04	MATRIX THEORY	3	1	0	4

COURSE OBJECTIVES:

- COB1:** To carry out probability calculations and identify probability distributions.
- COB2:** To gain the knowledge of the multidimensional random variables.
- COB3:** To formulate and solve linear programming, transportation, and assignment problem.
- COB4:** To apply matrix factorizations (LU, Cholesky, QR, SVD) and pseudo-inverse for linear systems.
- COB5:** To solve variational problems including higher-order and constrained cases using Euler's method.

MODULE I RANDOM VARIABLE AND DISTRIBUTIONS 9+3

Random variable - expectations - moments – variances, Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Normal distributions.

MODULE II MULTIDIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression - Partial, Multiple correlations and regressions.

MODULE III OPTIMIZATION TECHNIQUES 9+3

Linear Programming – formulation, simplex method and duality, Transportation problems, Assignment problems.

MODULE IV MATRIX DECOMPOSITION TECHNIQUES 9+3

Matrix norms – singular value decomposition – LU decomposition – Cholesky decomposition - QR decomposition – pseudo inverse.

MODULE V CALCULUS OF VARIATIONS 9+3

Variation and its properties – Euler's equation – functional dependent on first and higher order derivatives – functional dependent on functions of several independent

variables – variational problems with moving boundaries – isoperimetric problems.

L - 45; T - 15; Total Hours - 60

TEXT BOOKS:

1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition, Academic Press, 2020
2. Richard A. Johnson, "Probability and Statistics for Engineers", 9th Edition, Pearson, 2017.
3. Hamdy A. Taha, "Operations Research: An Introduction", 11th Edition, Pearson, 2022.
4. David W. Lewis, "Matrix Theory", Allied Publishers (Chennai), 2011 reprint of 1995 work.
5. A. S. Gupta, "Calculus of Variations with Applications", PHI, 2011.

REFERENCES:

1. T. Veerarajan, "Probability, Statistics and Random Processes", 3rd Edition, McGraw Hill, 2008.
2. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition., Sultan Chand, 2014.
3. Horn and Johnson, "Matrix Analysis", 2nd Edition, Cambridge, 2012.
4. Hillier and Lieberman, "Introduction to Operations Research", 10th Edition, McGraw Hill, 2014.

COURSE OUTCOMES:

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

- CO1:** select and use appropriate discrete and continuous probability models for engineering data.
- CO2:** analyze multidimensional distributions, calculate covariance, correlation, and perform regressions
- CO3:** translate real-world problems into LP models and solve them via simplex, dual, transportation, and assignment methods.
- CO4:** decompose matrices (LU, Cholesky, QR, SVD), compute pseudo-inverses, and apply to least-squares solutions.
- CO5:** formulate and solve calculus of variations problems—including isoperimetric and boundary-moving cases—using Euler's equations.

Board of Studies (BoS):

17th BOS of Department of Mathematics and Actuarial Science held on 23.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO 1	PO 2	PO 3	PO 4
CO 1	2	1		
CO 2	2	1		
CO 3	2	1		
CO 4	2	2		
CO 5	2	2		

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 4: Quality Education: Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Statement: Learning of probability, distributions and calculus of variations will lead to knowledge of applications in Engineering.

CEF 6101	ADVANCED DESIGN OF CONCRETE	L	T	P	C
SDG: 9 & 11	STRUCTURES	3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the design of RCC beams under combined shear, torsion and bending and limit the state of serviceability for the structural members.

COB2: To provide exposure to the design of slender columns, RC walls, deep beams and corbels.

COB3: To understand the concept of yield line analysis and gain knowledge on the design of flat slabs and grid floors.

COB4: To expand the knowledge on the inelastic response of reinforced concrete beams.

MODULE I TORSION IN BEAMS & LIMIT STATE OF 9
SERVICEABILITY

Review on the basic concepts - Strength and deformation of members with combined bending, shear and torsion - Serviceability limit states: Estimation of deflection and crack widths in RC members.

MODULE II DESIGN OF SLENDER RC COLUMNS 9

Behavior of slender RCC Columns - Failure modes - Design moments for braced and unbraced columns - Design of slender columns as per IS 456.

MODULE III DESIGN OF SPECIAL STRUCTURAL ELEMENTS 9

Design of plain and R.C walls - Strut and tie method of analysis & design of corbels - Design of deep beams.

MODULE IV DESIGN OF STRUCTURAL SLAB SYSTEMS 9

Design of grid floor - Design of flat slabs and flat plates — Check for shear - Yield line theory of slabs.

MODULE V INELASTIC ANALYSIS OF CONCRETE 9
BEAMS

Inelastic behavior of reinforced concrete — Moment curvature relationship - Strength and ductility of concrete beams - Plastic hinge formation - Redistribution of moments - Moment redistribution for a single span and two span continuous beam.

L – 45; TOTAL HOURS- 45**REFERENCES:**

1. Krishna Raju, N. "Advanced Reinforced Concrete Design (IS 456-2000)", CBS Publishers & Distributors, New Delhi, 2010
2. Park. R., & Paulay .T., "Reinforced Concrete Structures", John Wiley & Sons, 1975.
3. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw-Hill, 1986.
4. Subramanian. N, "Design of Reinforced Concrete Structures", Oxford University Press, 2013.
5. Unnikrishna Pillai and Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
6. Varghese, P.C. "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.

COURSE OUTCOMES:

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

CO1: Describe the behaviour of beams under combined bending, shear & torsion and compute the deflection & crack width for RC members as per codal provisions.

CO2: Employ the Indian standard code of practice for the design of slender RC columns.

CO3: Design the special structural elements such as RC walls, deep beams, and corbels.

CO4: Appropriately choose and design the structural slab systems for buildings.

CO5: Critically describe the inelastic behaviour of reinforced concrete beams.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	3
CO2	2	2	3	3
CO3	2	2	3	3
CO4	2	2	3	3

CO5	2	2	3	3
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Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Design of concrete structures is imperative for safe and sustainable construction.

CEF 6102	DYNAMICS OF STRUCTURES	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

- COB1:** To impart knowledge on the theory of vibrations and vibration parameters.
- COB2:** To analyze the single, two and multi degree of freedom system under dynamic forces.
- COB3:** To understand the design concepts of buildings for blast and impact forces as per BIS codes of practice.

MODULE I INTRODUCTION TO VIBRATION AND DAMPING 9

Simple harmonic motion - Dynamic equation of motion - D'Alembert's principle, Mathematical model of Single Degree of Freedom (SDOF) systems - Free and forced vibration of SDOF systems, Effect of damping, Evaluation of damping, Transmissibility.

MODULE II TWO DEGREE OF FREEDOM SYSTEMS 9

Mathematical model of two-degree of freedom systems, free and forced vibrations of two-degree systems, normal modes of vibration - Concept of shear building

MODULE III MULTI-DEGREE OF FREEDOM SYSTEMS 9

Mathematical model of multi-degree of freedom systems, free and forced vibrations of multi-degree of freedom systems- Orthogonality of normal modes, Mode superposition technique, Nonlinear MDOF systems, step-by-step numerical integration algorithms.

MODULE IV CONTINUOUS SYSTEMS 9

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh-Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work- Applications.

MODULE V DESIGN CONCEPTS AGAINST BLAST AND IMPACT 9

Characteristics of internal and external blast - Impact and impulse loads - Pressure distribution on buildings above ground due to external blast - Response using Duhamel's Integral - Underground explosion - Design principles of buildings for blast and impact as per BIS codes of practice.

L – 45; Total Hours: 45**TEXT BOOKS:**

1. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Prentice Hall, Englewood Cliffs, New Jersey, Second Edition, 2001.
2. Cheng, F.Y., "Matrix Analysis of Structural Dynamics", CRC Press, New York, 2001.
3. Clough, R.W. and Penzien. J., "Dynamics of Structures", Computers and Structures, Incorporated, 2003, 2nd Edition, 2003.
4. Roy R. Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.

REFERENCES:

1. Hurty.W.C, Rubinstein. M.F," Dynamic of Structures", Prentice Hall of India Pvt Ltd. New Delhi, 2002
2. M. Y. H. Bangash, T. Bangash, "Explosion-Resistant Buildings: Design, Analysis, and Case Studies", Springer –Verlag Berlin Heidelberg, Germany, 2006.
3. Donald O. Dusenberry, "Handbook for Blast-Resistant Design of Buildings", John Wiley & Sons, Inc, 2010.
4. IS 4991 (1968): Criteria for blast resistant design of structures for explosions above ground

COURSE OUTCOMES:

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

- CO1:** develop the equation of motion for single-degree-of-freedom systems.
- CO2:** analyse the response of two-degree freedom systems.
- CO3:** find the dynamic response of multiple degrees of freedom systems.
- CO4:** analyse the response of continuous systems.
- CO5:** apply the design principles against blast and impact forces on buildings using BIS codes of practice

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	3
CO2	2	2	3	3
CO3	2	2	3	3
CO4	2	2	3	3
CO5	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: Dynamic analysis of structures is more essential to ensure safe and sustainable building.

CEF 6103	EXPERIMENTAL METHODS AND TECHNIQUES	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

- COB1:** To understand the role of experimentation in validating structural behavior and performance.
- COB2:** To gain knowledge of instrumentation, material testing, and structural modeling techniques.
- COB3:** To develop skills in planning, executing, and interpreting experimental tests on materials and structural elements.
- COB4:** To familiarize with advanced and non-destructive testing techniques for health monitoring with case studies.

MODULE I FUNDAMENTALS OF EXPERIMENTAL METHODS 7

Importance and scope of experimental methods in structural engineering - Types of testing: static, dynamic, in-situ - Introduction to sensors and instrumentation: strain gauges, LVDTs, load cells, accelerometers - Data acquisition systems: hardware, signal processing, and software interfaces - Test objectives, setup, safety measures and protocols - Statistical techniques for data interpretation

MODULE II MATERIAL TESTING AND CHARACTERIZATION 7

Determination of material properties using IS standards - strength parameters, elasticity, and Poisson's ratio - Failure modes. Material characterization – FTIR - Scanning Electron Microscope (SEM), X-Ray Diffraction (XRD) – Working Mechanism - Sample/specimen preparation for tests and testing standards (IS/ASTM codes)

MODULE III STRUCTURAL MODELING AND ADVANCED TESTING 8

Physical modeling and similitude principles - Strain and displacement measurement techniques - Testing of structural elements like RC beams and columns - Instrumentation for large-scale testing – Plastic Analysis of frames. Advanced testing of concrete for creep and shrinkage – Fatigue analysis of members.

MODULE IV SPECIALIZED TECHNIQUES AND APPLICATIONS 8

Non-destructive testing (NDT) techniques - ultrasonic, radiographic, digital image correlation (DIC) - Structural health monitoring techniques - Retrofitting assessment and

seismic performance evaluation of structures - Case studies on Buildings and systems.

List of Experiments:

30 hours

1. Calibration of basic testing equipment's and use of strain gauges
2. Experiment on Data Acquisition using LVDT and Load Cell
3. Vibration Test on Horizontal shake table
4. Testing of large beams for deflection analysis using data acquisition systems
5. Analysis of beam column connections
6. Fatigue analysis of composite sections.
7. Structural Assessment of concrete elements using advanced techniques

L – 30; P – 30; Total Hours: 60

REFERENCES:

1. J. M. Gere, Experimental Stress Analysis. Brooks/Cole, 1990.
2. J. W. Dally and W. F. Riley, Experimental Stress Analysis. McGraw-Hill, 1991.
3. S. Singh, Experimental Stress Analysis. Khanna Publishers, 2009.
4. IS/ASTM Standards for Material Testing and Instrumentation, Bureau of Indian Standards & ASTM International, various editions.
- 5.

COURSE OUTCOMES:

- CO1:** Explain the significance of experimental methods in structural engineering.
- CO2:** Identify and operate appropriate instrumentation for material testing and characterization.
- CO3:** Create models and Interpret mechanical behavior under different loading conditions
- CO4:** Apply non-destructive techniques and analyze structural performance using case studies.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	1	1	3
CO2	3	2	2	2
CO3	3	2	2	3
CO4	3	3	2	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: To select and operate instrumentation, design testing setups, and apply non-destructive evaluation methods, the course supports the development of reliable, efficient, and innovative infrastructure systems.

CEF 6104	SEISMIC RESISTANT DESIGN OF STRUCTURES	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

- COB1:** To introduce the concepts of earthquakes, their measurement, and the factors influencing the design of buildings in seismic regions.
- COB2:** To educate on the basic principles of load calculations for different structural systems, as well as the design and detailing considerations for structures subjected to earthquake forces.
- COB3:** To deliver valuable insights into seismic retrofitting techniques and the systems for controlling structural responses during seismic events.

MODULE I THEORIES OF ENGINEERING SEISMOLOGY 9

Internal structure of the Earth, Mechanisms of continental drift and plate tectonics, faults, Elastic rebound theory, characteristics of seismic waves, Liquefaction – effects and mitigation – Seismic load-bearing capacity of foundations – Earthquake magnitude – Measurement of intensity – Seismographic instruments, robust ground motion, Seismic zoning map of India, Assessment of seismic hazards.

MODULE II PRINCIPLES OF SEISMIC ENGINEERING 9

Seismic design philosophy - Principles of earthquake resistant design – Seismic load on simple buildings - Load pathways – Floor and roof diaphragms – Architecture design for seismic resistance - Plan configuration – Vertical configuration – Pounding impacts - Irregularities in mass and stiffness – Flexible and rigid structural systems – Torsional behavior in structural system.

MODULE III SEISMIC ANALYSIS AND DESIGN 9

Criteria for Seismic Design – Earthquake load specifications - Seismic analysis methodologies – Seismic coefficient method – Load combinations - Analysis using response spectrum - Factors affecting seismic analysis – Modal analysis – Time history method - Seismic load design - Framed structures - Masonry structures - Structural walls and non-structural components.

MODULE IV SEISMIC PERFORMANCE AND DUCTILE DETAILING OF STRUCTURAL MEMBERS 9

Provisions of Indian Seismic Code IS:1893, IS:4326 and IS:13920 - Ductile Detailing – Building systems – frames – shear wall – braced frames – layout design of Moment Resisting Frames (MRF) - Design of Masonry structures - Seismic performance of beam-column joints, beams, columns, footings, slabs and staircases.

MODULE V SEISMIC RETROFITTING TECHNIQUES AND VIBRATION CONTROL SYSTEMS 9

Seismic retrofitting techniques - Damages in structures - Materials for seismic strengthening - Retrofitting techniques - GOI guidelines on Seismic Retrofitting of Deficient Buildings and Structures - Vibration control systems – Base isolation - Active, passive, semi-active & hybrid systems - Seismic Dampers – Principles and application - Case studies.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Duggal, S.K., "Earthquake Resistant Design of Structures", Oxford University Press, 2nd Edition, New Delhi, 2013.
2. Pankaj Agrawal, Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning Pvt. Ltd., New Delhi, 2006.
3. Muhammad Hadi and Mehmet Eren Uz, "Earthquake Resistant Design of Buildings", CRC Press, Florida, 2017.

REFERENCES:

1. Chopra, A.K., "Dynamics of Structures - Theory and Applications to Earthquake Engineering" Pearson, 5th Edition, London, 2017.
2. Paulay, T., and Priestly, M.N.J., "Seismic Design of Reinforced Concrete and Masonry Building", John Wiley and Sons, New York, 1992.
3. Mohiuddin Ali Khan, "Earthquake-Resistant Structures: Design, Build, and Retrofit", Butterworth-Heinemann, London, 2013.
4. IS: 1893:2016 (Part 1), Criteria for earthquake resistant design of structures.
5. IS:4326: 2013, Earthquake Resistant Design and Construction of Buildings
6. IS:13920: 2016, Ductile Design and Detailing of reinforced concrete structures

subjected to seismic forces.

COURSE OUTCOMES:

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

- CO1:** Identify the various types of seismic waves, measure the magnitude of earthquakes, and outline the characteristics of ground motion.
- CO2:** Describe the conceptual design of structural systems that are designed to withstand seismic activity.
- CO3:** Perform seismic analysis of structures through various analytical methods.
- CO4:** Discuss the seismic behaviour and design considerations for masonry, reinforced concrete, and steel structures.
- CO5:** Propose suitable retrofitting and strengthening methods for structural members, and explain the principles of seismic base isolation and passive energy dissipation for controlling the seismic response of civil engineering structures.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of seismic analysis of beam columns and frames leads to development of sustainable buildings.

SEMESTER – II

GEF 6201	RESEARCH METHODOLOGY AND IPR FOR	L	T	P	C
SDG: 4, 8, 9	ENGINEERS	2	0	0	2

COURSE OBJECTIVES:

- COB1:** To apply a perspective on research
- COB2:** To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation
- COB3:** To analyze the research design by using optimization techniques.
- COB4:** To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN 8

Research - objectives – types - Research process, solving engineering problems - Identification of research topic - Formulation of the research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modeling - Simulation, validation, and experimentation.

MODULE II DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA 8

Sources of Data, Use of the Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Importance of statistics in research - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES 6

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV INTELLECTUAL PROPERTY RIGHTS 8

The Research Report - Purpose of the written report - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference

Management Software, Software for detection of Plagiarism –Thesis writing, - Organization of contents - style of writing- graphs, charts, and Presentation tool - Referencing, Oral presentation, and defense - Ethics in research - Patenting, Intellectual Property Rights - Patents, Industrial Designs, Copyrights, Trade Marks, Geographical Indications-Validity of IPR, Method of Patenting, procedures, Patent Search

L – 30; Total Hours: 30

TEXT BOOKS:

1. Ganesan R., "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
2. George E. Dieter., "Engineering Design", McGraw Hill – International edition, 2020.
3. Kothari C.R., "Research Methodology" – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb., "Genetic Algorithms for optimization", Kangal report, No.2001002.
5. Rajkumar S. Adukia, "Handbook on Intellectual Property Rights in India", TMH Publishers, 2020.

REFERENCES:

1. Holeman, J.P., "Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2. Govt. of India, "Intellectual Property Laws; Acts, Rules & Regulations", Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.
3. R Radha Krishnan & S Balasubramanian, "Intellectual Property Rights". 1st Edition, Excel Books, 2012.
4. Derek Bosworth and Elizabeth Webster. "The Management of Intellectual Property", Edward Elgar Publishing Ltd., 2013

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- COB1:** Formulate the research problem
- COB2:** Design and Analyse the research methodology
- COB3:** Analyse and interpret the data to construct and optimize the research hypothesis
- COB4:** Report the research findings as publications, copyright, trademarks and

IPR

Board of Studies (BoS) :20th BoS of Civil held on 08.07.2025**Academic Council:**24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	1	2	1
CO2	2	3	3	2
CO3	3	2	2	3
CO4	1	3	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.

Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements.

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.

Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.

Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

CEF 6201	FINITE ELEMENT ANALYSIS IN STRUCTURAL	L	T	P	C
SDG: 9 &11	ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

- COB1:** To introduce the fundamental concepts of finite element method and numerical tool for the solution of different classes of problems
- COB2:** To understand the elemental properties and to incorporate numerical evaluation of 2-D and 3-D problems
- COB3:** To impart knowledge on analysis of trusses , beams and frames using FE techniques.
- COB4:** To understand the concepts of mesh generation and providing solutions to the critical problems

MODULE I FUNDAMENTAL CONCEPTS 9

Stresses and equilibrium – Boundary conditions – Potential energy and equilibrium – Weighted integral and weak formulation – Variational approach – Rayleigh-Ritz method – Galerkin's method - Basic Concepts of Finite Element Analysis - Steps in Finite Element Analysis

MODULE II ELEMENT PROPERTIES AND ISOPARAMETRIC FORMULATION 9

Natural Coordinates - Triangular Elements - Rectangular Elements - Solid Elements – shape functions- Lagrange and Serendipity Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements

MODULE III TWO AND THREE DIMENSIONAL SOLIDS 9

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems.

MODULE IV ANALYSIS OF TRUSSES , BEAMS AND FRAMES 12

Stiffness of Truss Members - Analysis of Truss - Stiffness of Beam Members- Analysis of Beams - Analysis of Rigid Frames - Analysis of Continuous Beam – Plane Frame Analysis

MODULE V MESHING AND SOLUTION PROBLEMS 6

Pre and post-processor interpretations - p and h methods of refinement - Ill-conditioned

elements - Discretization errors – Patch test - Auto and adaptive mesh generation techniques - Gaussian Formulation.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. “Concepts and Applications of Finite Element Analysis”, Wiley Students Edition, 2004.
2. Reddy, J.N, “An Introduction to the Finite Element Method”, McGraw Hill International Edition, New York, 3rd edition, 2008.
3. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
4. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Fourth Edition, Prentice Hall of India, 2015

REFERENCES:

5. Seshu, P., “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
6. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Seventh Edition, McGraw – Hill, 2013.
7. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 2020.

COURSE OUTCOMES:

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

- CO1:** solve the boundary value problems using approximate methods.
- CO2:** select the appropriate element for modelling and derive the elemental equations and shape functions for elements.
- CO3:** evaluate element stiffness and computation of stresses two and three dimensional solids
- CO4:** analyse trusses , beams and frames using finite element approach
- CO5:** describe the mesh refinement and Gaussian formulation.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	3
CO2	2	2	3	3
CO3	2	2	3	3
CO4	2	2	3	3
CO5	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Finite Element analysis of structures is essential to ensure safe and sustainable building.

COURSE OBJECTIVES: The objective of this course is to impart adequate knowledge on

COB1: the design of structural components of industrial buildings

COB2: the behavior and design of connections for efficient force and moment transmission

COB3: the design of cold-formed steel compression members

COB4: the design of cold-formed steel flexural members

COB5: the design of self-supporting and guyed chimneys

Planning – Selection of materials – Structural framing – Types of roof trusses and configurations – Codal provisions of IS 875 – Loading on roof truss – Load combination for design – Wind load calculation – Design of industrial buildings: truss, purlin, and stanchion. Introduction to transmission towers and design principles.

Types of connection - Importance and behaviour - Codal provisions as per IS: 800 –
Design of connections – Basic examples, efficiency of joints - Design of bracket
connection - Unstiffened and stiffened seated connections – Framed connections -
Connections for force and moment transmission – T-stub and end plate connections -
Stiffeners and other reinforcement.

Introduction to cold-formed steel – Configurations – Unstiffened, stiffened and multiple stiffened compression members - Codal provisions: IS 801 - Design of compression members - Behaviour of compression elements - Concept of local buckling and effective width - Analysis and design of stiffened and unstiffened compression elements.

55

Design of web of beams - Web crippling – Degree of restraint against rotation of the web – Single unreinforced web - Design of flexural members - Economic design for beam strength - Concept of lateral buckling of beams – Bracing requirements for beams – Concept of shear lag and flange curling - Design of wall studs and connection details.

MODULE V ANALYSIS AND DESIGN OF STEEL CHIMNEY

9+3

Design of self-supporting chimney (lined and unlined) - code provisions of IS 6533 - Stresses due to wind – Design of base plate, anchor bolts and foundation - Check for deflection - Design for dynamic effects on chimney - Gust factor method - Design of guyed chimneys.

L – 45 ; T – 15; TOTAL HOURS –**60**

TEXT BOOK:

1. N. Subramanian, Steel Structures - Design and practice, Oxford University Press, 2011.

REFERENCES:

1. Bhavikatti, S.S., Design of Steel Structures: By Limit State Method as Per IS: 800 – 2007, I.K. International Pvt. Ltd. 2017.
2. Dayaratnam, P., Design of Steel Structures, S Chand Publishing, 2012.
3. Salmon, C.G., Johnson, J.E., and Malhas F.A., Steel Structures-Design and Behaviour, Harper and Row, 2009.
4. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2010.
5. Wie - Wen Yu., Cold-formed Steel Structures, John Wiley & Sons, 2010.

DATA BOOKS/ CODES/ STANDARDS (Latest versions):

1. IS: 456: 2000, "Indian standard Plain and reinforced concrete: Code of practice," Bureau of Indian Standards, New Delhi, India
2. IS: 800: 2007, "Indian standard code of practice for general construction in steel," Bureau of Indian Standards, New Delhi, India
3. IS: 801: 1975, "Indian standard code of practice for use of cold-formed light gauge steel structural member's in general building construction," Bureau of Indian Standards, New Delhi, India
4. IS: 808: 2021, "Indian standard hot rolled steel beam, column, channel and angle sections – Dimensions and properties," Bureau of Indian Standards, New Delhi, India

5. IS: 875 (Part-1): 1987, "Indian standard code of practice for design loads (Other than earthquake loads) for buildings and structures, Part I – Dead loads – Unit weight of building materials and stored materials," Bureau of Indian Standards, New Delhi, India
6. IS: 875 (Part-2): 1987, "Indian standard code of practice for design loads (Other than earthquake loads) for buildings and structures, Part II – Imposed loads," Bureau of Indian Standards, New Delhi, India
7. IS: 875 (Part-3): 2015, "Indian standard code of practice for design loads (Other than earthquake loads) for buildings and structures, Part II – Wind loads," Bureau of Indian Standards, New Delhi, India
8. IS: 6533 (Part 1), "Design and construction of steel chimney - Code of practice, Part I - Mechanical Aspect," Bureau of Indian Standards, New Delhi, India
9. IS: 6533 (Part 2), "Design and construction of steel chimney - Code of practice, Part 2 - Structural Aspect," Bureau of Indian Standards, New Delhi, India.

COURSE OUTCOMES:

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

CO1: design industrial building components such as trusses, purlins, and stanchions as per IS 875

CO2: design and detail various steel connections including seated, bracket, and framed connections using IS 800 guidelines

CO3: design stiffened and unstiffened sections of cold-formed compression members as per IS 801

CO4: design cold-formed steel flexural members by addressing web crippling, lateral torsional buckling and shear lag effects as per IS 801

CO5: design chimneys (self-supporting and guyed) considering static and dynamic wind loads.

Academic Council:

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	2	3	2
CO2	3	2	3	2
CO3	3	2	3	2
CO4	3	2	3	2
CO5	3	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The design of steel structures as per codal provisions ensure construction of safe and resilient infrastructure by giving emphasis to sustainability and innovation.

CEF 6203	STRUCTURAL ENGINEERING STUDIO	L	T	P	C
SDG: 9 &11		0	0	2	1

COURSE OBJECTIVES:

The objective of the course is to impart adequate knowledge on

COB1: The analysis of concrete and steel structures using STAAD Pro and ETABS software..

COB2: The software and manual design of concrete and steel structures

MODULE I	ANALYSIS AND DESIGN OF RC BUILDING USING STAAD PRO	9
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AutoCAD plan G+3 - Analysis of G+3 RC building using STAAD Pro - Design of G+3 RC building using STAAD Pro – Manual design practice using MS excel – Detailing Diagram of RC elements.

MODULE II	ANALYSIS OF STEEL TRUSS USING STAAD PRO	6
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Analysis of steel truss - Design of steel truss.

MODULE III	ANALYSIS AND DESIGN OF G+10 RC BUILDING USING ETABS	9
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AutoCAD plan G+10 - Analysis of G+10 RC building using ETABS - Design of G+10 RC building using ETABS

MODULE IV	INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM)	6
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Introduction to Building Information Modelling - Roles and Impacts of BIM in the Design, Construction Engineering and Management, Infrastructure Engineering, and Facility Management - BIM 3D, 4D, 5D, 6D & 7D.

LIST OF EXPERIMENTS

1. Create a G+3 and G+10 building column layout plan using AutoCAD.
2. Analyze and design the G+3 RC building using STAAD Pro.
3. Design of RC structural elements using MS excel.
4. Create detailing diagram for the RC elements.
5. Analyze and design a steel truss using STAAD Pro.

6. Analyze and design a G+10 RC building using ETABS.
7. Introduction to BIM.

P -30; TOTAL HOURS –30

REFERENCES:

1. T.S.Sarma, Staad Pro v8i for beginners, Notion Press, 2014.
2. T.S. Sarma, Design of Industrial Steel Buildings Using Staad Pro, Notion Press, 2020.
3. Syed Mohd Abid, ETABS FOR BEGINNERS: A Comprehensive Guide to Structural Analysis and Design, 2023.
4. Gaurav Verma, ETABS V20 Black Book, CAD/CAM/CAE Works, 2022.

COURSE OUTCOMES:

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

CO1: Analyze and design reinforced concrete buildings using STAAD Pro software.

CO2: Analyze and design the steel truss using STAAD Pro software.

CO3: Analyze and design reinforced concrete buildings using ETABS software.

CO4: Understand concepts of Building Information Modelling.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	3	2	3	3
CO3	3	2	3	3
CO4	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: Holistic Understanding of structural modelling and analysis is more essential to ensure safe and sustainable building.

ENF 6281	PROFESSIONAL COMMUNICATION	L	T	P	C
SDG: 4 & 8		0	0	2	1

COURSE OBJECTIVES:

- COB1:** To introduce the fundamentals of professional communication in workplace contexts.
- COB2:** To develop structured presentation and public speaking skills.
- COB3:** To develop students' proficiency in written correspondence, including emails, and reports.
- COB4:** To enhance awareness and use of body language in professional settings
- COB5:** To instill appropriate workplace etiquette and digital professionalism.

MODULE I COMMUNICATION AT THE WORKPLACE P: 6

Language and communication fundamentals, Types of workplace communication, Formal and informal Communication, Direction and flow of communication- Organizational communication and interpersonal dynamics, 7 Cs of Communication - Ethical use of AI assisted communication tools

MODULE II PRESENTATION & PUBLIC SPEAKING SKILLS P: 6

Importance of presentation skills, Managing public speaking anxiety, Structured planning and delivery of presentations, Use of visual aids and technology - Interactive tools

MODULE III CORRESPONDENCE AT WORK P: 9

Digital correspondence - Email Writing and Etiquette, Report Writing: Incident Reports, Feasibility Reports, and Executive Summaries

MODULE IV BODY LANGUAGE P: 5

Fundamentals of body language in professional communication, Types of non-verbal cues, posture -Interpreting and responding to non-verbal signals in interpersonal and group contexts, Cultural variations in body language and their implications in global communication

MODULE V WORKPLACE ETIQUETTE**P: 4**

Workplace etiquette, Cultural sensitivity in globalized work environments, Gender sensitivity and inclusivity, DEI, Netiquette and digital professionalism - video conferencing, Professional networking (Social media, LinkedIn, etc.), Virtual team dynamics

P – 30; Total Hours:30**TEXT BOOKS:**

1. Course material by the Department of English

REFERENCES:

1. Bovee, C. L., & Thill, J. V. *Business Communication Today* (14th ed.). Pearson, 2021.
2. Cardon, P. W., & Marshall, B. The hype and reality of social media use for work collaboration and team communication. *International Journal of Business Communication*, 52(3), 2015, 273–293.
3. Guffey, M. E., & Loewy, D. *Essentials of Business Communication* (11th ed.). Cengage Learning, 2020.
4. Jones, D. A., & Pittman, M. The digital professionalism paradox: Workplace norms and expectations in the era of online communication. *Journal of Applied Communication Research*, 49(3), 2021, 283–301.
5. Keyton, J., & Smith, F. L. M. Communication practices of work teams: Task, social, and identity functions. *Journal of Business Communication*, 46(4), 2009, 402–426.
6. Krizan, A. C., Merrier, P., Logan, J., & Williams, K. *Business Communication* (9th ed.). Cengage Learning, 2016.
7. Lesikar, R. V., Flatley, M. E., Rentz, K., & Lentz, P. *Lesikar's Business Communication: Connecting in a Digital World* (13th ed.). McGraw-Hill Education, 2019.
8. Madlock, P. E. The link between leadership style, communicator competence, and employee satisfaction. *Journal of Business Communication*, 45(1), 2008, 61–78.
9. Raman, M., & Sharma, S. Technical communication: Principles and practice (3rd ed.). Oxford University Press, 2015.
10. Robles, M. M. Executive perceptions of the top 10 soft skills needed in today's workplace. *Business Communication Quarterly*, 75(4), 2012, 453–465. <https://doi.org/10.1177/1080569912460400>

COURSE OUTCOMES:

On completion of the course, students will be able to

- CO1:** Demonstrate clarity in professional communication by selecting appropriate modes and formats for workplace interactions.
- CO2:** Deliver structured presentations with confidence, using relevant verbal and visual communication techniques.
- CO3:** Produce clear and effective written correspondence, including emails, and formal reports.
- CO4:** Interpret and apply non-verbal communication cues appropriately in professional contexts.
- CO5:** Exhibit workplace etiquette, digital conduct, and cultural sensitivity in professional environments.

Board of Studies (BoS):

18th BoS of the Department of English held on
04.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	3	2	2
CO2	2	3	2	2
CO3	2	3	-	-
CO4	2	3	2	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: This course ensures that the students acquire quality education and are also made eligible to obtain productive and decent employment.

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: This course equips students with the competencies required for employment in a dynamic global workforce.

CEF 6204**MINI PROJECT****L T P C****SDG: 11****0 0 6 3****COURSE OBJECTIVES:****COB1:** To enhance knowledge in the area of design and detailing of structures**COB2:** To ascertain structural engineering problems through a literature review**GENERAL GUIDELINES:**

The Mini Project will feature a mid-semester presentation and an end-semester presentation. The mid-semester presentation will cover the identification of design problems based on the latest trends and the analysis of the structural system using different techniques.

Students can select minor issues in the design engineering sector for their mini project. This could relate to providing solutions to engineering problems, verifying and analyzing available experimental data, conducting experiments on various engineering topics, material characterization, or examining a software tool for solving an engineering issue, etc.

The end-semester presentation must be accompanied by a report that includes the identification of the topic for the work and the methodology used for the analysis / design and detailing of the complete structural system.

The departmental committee will monitor the continuous assessment of the Design Project.

COURSE OUTCOMES:

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

CO1: identify issues in structural engineering and to understand the different loads and load combinations.

CO2: Acquire practical experience in the analysis, design, and drafting of structural drawings for the whole structure as per IS codes.

CO3: Exhibit proficient communication and report writing skills.

Board of Studies (BoS) :20th BoS of Civil held on 08.07.2025**Academic Council:**24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	-	3	1
CO2	2	-	3	2
CO3	-	3	-	-

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Holistic Understanding (materials and behavior of structural elements supported by analytical investigation) is more essential to ensure safe and sustainable building.

SEMESTER – III

CEF 7102	INDUSTRY INTERNSHIP	L	T	P	C
SDG: 9 &11		0	0	4	2

GENERAL GUIDELINES:

- The course carries two credits with a minimum duration of 30 days.
- The students are encouraged to pursue Internship in Industry (Government departments / Private Constructions Companies / Private consulting firms etc.,) / Research organizations (SERC, PMI, CBRI etc.,) / Eminent Academic Institutions (IIT/ NIT/ Government or Private Universities) in the summer vacation after first year of study.
- The students shall obtain permission from Head of the Department / Dean of School by submitting an 'induction to internship certificate' provided by the organization (as per the given template) before commencement of Internship.
- The students shall submit a report of internship elaborating knowledge acquired during the internship period at the beginning of III Semester.
- The student shall also submit the internship completion certificate issued by the Industry/ Research Organization / Academic Institution along with confidential feedback provided by them (in a specified format) in a sealed cover to the Class Advisor.
- A committee comprising of faculty members constituted by the Head of the Department / Dean of School shall evaluate the Internship report, and shall conduct internship midterm reviews in the III semester of study followed by semester end oral examination.
- The weightage of marks for internship report and viva-voce examination are 60 % and 40% respectively.
- Based on the assessment of internship report, and performance of the students in end semester oral examination, relative grade is awarded.

COURSE OUTCOMES:

At the end of the internship, the students will be able to

CO1: Understand salient activities of Industry/ Research organization to provide feasible solution for a problem.

CO2: Correlate the application of theoretical knowledge in day to day activities of Industry, research organization.

CO3: Offer suggestions/ remarks for solving a Industry / research problem.

CO4: Exhibit good communication and report writing skills.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	-	2	2
CO2	2	-	3	2
CO3	2	-	2	2
CO4	-	3	2	-

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG — 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The industry internship shall impart the students a holistic understanding of structural Engineering domain with the skills to integrate sustainability principles into the design and construction of structures.

CEF 7101**PROJECT WORK (PHASE I)****L****T****P****C****SDG: 11****0****0****22****11*****COURSE OBJECTIVE:**

The Project work aims to provide opportunity for the students to exhibit their capacity in executing a project work which deals with study on materials/ analysis / design / experimental works related to structural engineering domain.

GENERAL GUIDELINES:

- At post-graduate level, project work shall be carried out by the student individually.
- The students are encouraged to execute their project work (Phase I & II) in collaboration with Industry, R&D organization, Eminent Academic Institutions etc.
- The students will be given opportunity to select a project topic of his/her interest and are advised to interact with potential faculty members to discuss their project ideas for better understanding.
- A project coordinator is identified in the beginning of III semester for every batch who coordinates various activities viz. dissemination of research thrust areas of structural engineering domain, faculty expertise, allocation of project guides, conduct of periodic reviews and monitoring the performance of the students throughout the project period.
- The project guide is nominated based on the preference of students and consent of the faculty concerned.
- The Project work Phase — I, shall be carried out by the students under the guidance of allotted Guide.
- In case, the students pursuing their project in the Industry / R & D organization / Eminent academia, a competent person from the project offering organization is assigned as co-guide as per the discretion of the head of the firm, in addition to the Department allotted guide.
- In the Project work — Phase I, the students are expected to identify the project topic, refer related literatures / data / information to identify the research problem (i.e., need for the present study). The students shall conduct meticulous literature review to identify the research gap, and frame the objectives to address the same.

- The students are encouraged (i) to frame the methodology to achieve the desired objectives, (ii) to conduct study on properties of various materials used in the study as per relevant codal provisions, (iii) to acquire knowledge on relevant software (if applicable) to conduct analytical investigation, (iv) to acquire knowledge on various experiments / techniques to conduct experimental experimentation etc.
- The Head of the Department / Dean of School shall constitute a project progress review committee comprising competent senior faculty members as members to continuously monitor the progress made by students during the Project Phase I.
- The project coordinator shall arrange to conduct three progress review meetings to ascertain the progress of the work and award the marks based on the performance on expected metrics.
- At the end of phase –I period, students shall submit a project report covering the various aspects of project work. The typical components of the project report in Phase I shall objectives, include Introduction, Need for the present study, scope for investigation, literature review and methodology.
- An oral examination (viva voce) shall be conducted as semester end examination. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.
- The project co-ordinator shall arrange for final viva-voce examination to ascertain the overall performance in Project work.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: identify research problem in the area of Structural Engineering, conduct review of literature, frame objectives and methodology to address the research gap.

CO2: exhibit competency to conduct core scientific/ application oriented research in the field of Structural Engineering by employing relevant software tools/ experimental investigation as per codal provisions.

CO3: exhibit good communication and report writing skills.

Board of Studies (BoS) :20th BoS of Civil held on 08.07.2025**Academic Council:**24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	-	3	1
CO2	2	-	3	2
CO3	-	3	-	-

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Holistic Understanding (materials and behavior of structural elements supported by analytical investigation) is more essential to ensure safe and sustainable building.

SEMESTER – IV

CEF 7101	PROJECT WORK (PHASE II)	L	T	P	C
SDG: 11		0	0	35	18

COURSE OBJECTIVE:

The Project aims to provide an opportunity for the students to exhibit their capacity in executing a project work which deals with the study of materials/analysis/design/experimental works related to the structural engineering domain.

GENERAL GUIDELINES:

- Project work phase II is a continuation of phase I following the same guidelines.
- The project co-coordinator shall arrange to conduct three reviews to ascertain the progress of the work and award the marks based on the performance of students on desired metrics.
- Detailed experimental investigation and in-depth analytical study shall be performed in line with the objectives of the investigation.
- The students are expected to analyze the obtained results and discuss the same in an elaborate manner by preparing necessary charts/tables/curves to get an inference.
- The important conclusions need to be drawn and the scope for further research also to be highlighted.
- The outcome of project work shall preferably be published in journals/conference of National or International importance.
- At the end of project phase II, students shall submit a detailed report and it shall include Experimental investigation and analytical study, Results & Discussion of experimental/analytical work, Conclusions, References etc., in addition to work completed in Phase –I viz. Introduction, Literature and methodology.
- The project co-ordinator in consultation with Dean/ Head of the department and Controller of Examination shall arrange for a semester end oral examination by following SOP of the Institution to ascertain the overall performance of the students in Project work.
- The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: Able to interpret analytical / experimental data by applying critical thinking, scientific principles/ context etc.

CO2: Able to provide conclusions and recommendations to a problem with emphasis on professional ethics, care for safety and society and environment and sustainability.

CO3: Exhibit good communication and report writing skills.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	-	3	3
CO2	2	-	2	2
CO3	-	3	-	-

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Holistic Understanding of materials and behavior of structural elements supported by analytical study is more essential to ensure safe and sustainable building.

PROFESSIONAL ELECTIVES COURSES

CEFY 01	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
SDG : 11		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to impart adequate knowledge on

- COB1:** Identify the influence and compatibility of mineral admixtures in concrete
- COB2:** Identify the influence and compatibility of chemical admixtures in concrete
- COB3:** durability properties of concrete
- COB4:** Assess the performance of concrete structure through microstructure Analysis
- COB5:** Design and develop special concrete.

MODULE I MINERAL ADMIXTURES IN CONCRETE 9

Supplementary cementitious materials: source, significance and overview - Fly ash (different classes), silica fume, metakaolin, blast furnace slag, rice husk, titanium- dioxide: properties – Influence on fresh concrete, hardened concrete, microstructure and durability properties of concrete.

MODULE II CHEMICAL ADMIXTURES IN CONCRETE 9

Chemical admixtures for concrete: overview and significance - Water reducers/plasticizers: types, working mechanism, optimum dosage, influence on workability and application areas - Viscosity modifying agents, retarders, set accelerators, air entraining agents, damp-proofers, water repelling admixtures - Shrinkage reducing admixtures: types, brief working mechanism and application areas - Influence of chemical admixtures on fresh concrete, hardened concrete, microstructure and durability properties of concrete.

MODULE III DURABILITY PROPERTIES OF CONCRETE 9

Sustainable construction – life cycle cost benefits –Significance of proper selection of construction materials, mix design and good construction practices – Durable

concrete - factors influencing - Tests to assess durability of concrete: rapid chloride permeability test, water absorption, water permeability, water sorptivity test - accelerated corrosion test – test procedures and estimation methods.

MODULE IV MICROSTRUCTURAL PROPERTIES OF CONCRETE 9

Micro structural Characterization - Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD) to examine cement, mortar and concrete - Advanced Techniques of SEM and X-ray Diffraction XRD microanalysis- Simple imaging of fracture surfaces - digital image analysis on polished sections. Identify deleterious process in concrete, Interpretation of example images and X-ray spectra of the principal causes of damage to concrete. Energy Dispersive X-ray Spectroscopy (EDS), Thermogravimetric Analysis (TGA).

MODULE V SPECIAL CONCRETES 9

Fibre reinforced concrete, Sulphur impregnated concrete, Polymer modified concrete – High Strength and High performance concrete - High density concrete – Self Compacting Concrete, mix design as per EFNARC guidelines, workability requirements - Geo Polymer Concrete – Ready mixed concrete – Pervious concrete - Cold and Hot weather concreting - Vacuum concrete – Lightweight concrete - significance – composite manufacturing - Application areas.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Brooks, J.J. and Neville, A.M., “Concrete Technology”, Pearson, 2019.
2. Santhakumar, A.R., “Concrete Technology” Oxford University Press, New Delhi, 2007.
3. Johnnewman and Ban Seng Choo, Advanced concrete Technology, (Vol.I to VI) Elsevier, London, 2003.

REFERENCES:

1. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete: Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. Shetty.M.S., and A.K. Jain “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2010.
3. Gambhir.M.L., “Concrete Technology”, 5th Edition, Tata McGraw Hill Education,

2017.

4. Nayak, N.V, and Jain, A.K, Handbook on Advanced Concrete Technology, Narosa Publishing House Pvt. Ltd., New Delhi, 2012.

5. Zongjin Li, "Advanced Concrete Technology", John Wiley & Sons, 2011.

6. EFNARC (2002), "Specification and Guidelines for Self-Compacting Concrete", Surrey, UK.

7. John Broomfield, "Corrosion of Steel in Concrete – Understanding, Investigation and Repair", CRC Press, London, 2003.

8. Yoshihiko Ohama, "Hand Book of Polymer Modified Concrete and Mortars", Noyes Publications, U.K., 3rd Edition, 2013.

COURSE OUTCOMES:

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

- CO1:** understand the significance of the addition of mineral admixtures in concrete for various applications.
- CO2:** understand the significance of the addition of chemical admixtures in concrete for various applications.
- CO3:** describe the durability properties of concrete including its test method as per Indian Standard / ASTM
- CO4:** understand the concepts of SEM analysis and X-ray micro analysis and the behaviour of microstructure of concrete.
- CO5:** understand the principles of special concreting techniques including its application areas.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	2	3
CO2	2	2	2	3
CO3	1	3	2	2
CO4	2	2	2	2
CO5	2	2	1	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement : Designing of durable, high performance and sustainable reinforced concrete (i) by using mineral admixtures, chemical admixtures in concrete, (ii) by adopting specialized procedures and methods and (iii) by adopting corrosion protection methods during construction; and make the human settlements safe, resilient and sustainable.

CEFY 02	DESIGN OF BRIDGES	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to impart adequate knowledge on

COB1: the components of bridges, its types, relevant specifications and design requirements

COB2: the design of culverts and reinforced concrete bridges, including deck slabs, cantilever slabs, longitudinal and cross girder as per IRC

COB3: prestressed concrete bridge design: types, cross-section, focussing on the design of post-tensioned prestressed concrete slab bridge deck and T-beam

COB4: the design of plate girder and truss bridges, emphasizing codal provisions, loading standards and stiffener design

COB5: type and design of bearings, abutment and foundation

MODULE I FUNDAMENTALS OF BRIDGE DESIGN 6

Historical overview of bridge engineering - Components of bridge – Classifications of bridges - Need for investigation – Site selection, planning, data collection, choice of bridge type and most economical span - I.R.C. specifications for road bridges - General design considerations, load distribution theories - Design discharge, linear water way and scour depth – Problems - Case study.

MODULE II CULVERTS AND REINFORCED CONCRETE BRIDGES 12

Types of culverts – Basic features - Methods of design of slabs and girders - Effective width method, Pigeaud's method, Courbon's method and approximate method – Impact factor calculation - Design of slab culverts - Design of reinforced concrete T-beam bridges – Design of deck slab, cantilever slab, longitudinal and cross girders.

MODULE III PRESTRESSED CONCRETE BRIDGES 6

General aspects of prestressed concrete bridges – Types – Pre-tensioned verses post-tensioned systems - Typical configuration - Design principles of post-tensioned prestressed concrete bridges – Significance of end block - design of post-tensioned prestressed concrete slab bridge deck and T-beam.

MODULE IV PLATE GIRDER BRIDGES**9**

Plate girder bridges, general features, types, advantages and disadvantages - Design principles - codal provisions and loading standards - Design of plate girder bridges - intermediate stiffeners - end bearing stiffeners - Truss bridges, types, design of truss bridge.

MODULE V BEARINGS AND FOUNDATIONS**12**

Bridge bearings, general features, types of bearings - Design of steel rocker roller bearing – Design of piers and abutments – Bridge foundation – Types - Design of well foundation and pile foundation - Introduction to Structural health Monitoring (SHM) of bridges.

L – 45 ; TOTAL HOURS – 45**TEXT BOOKS:**

Johnson Victor D., Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2008.

REFERENCES:

1. Edwin H. Gaylord Jr., Charles N. Gaylord, James, E., Stallmeyer Design of Steel Structures, McGraw Hill Education, 1991.
2. Krishnaraju, N., Design of Bridges, Oxford and IBH Publishing Co., New Delhi, 2019.
3. Petros P. Xanthakos, Theory and Design of Bridges, John Wiley & Sons, 1994.
4. Ponnuswamy, S., Bridge Engineering, Tata McGraw Hill Publishing Company, New Delhi, 2017.
5. Raina V.K. Concrete Bridge Practice: Analysis, design and Economics, Shroff Publishers, 2014.

DATA BOOKS/ CODES/ STANDARDS (Latest versions):

1. IRC 6: 2000, "Section: II Loads and load combinations," Bureau of Indian Standards, New Delhi, India
2. IRC 24: 2001, "Section V: Steel road bridges (Limit state method)," Bureau of Indian Standards, New Delhi, India
3. IRC – 78: 2000, "Standard code of practice for limit state design for foundations," Bureau of Indian Standards, New Delhi, India
4. IRC – 83 - (Part – I): 1982, "Section: IX Bearing's Part 1 - Roller and rocker

bearings,” Bureau of Indian Standards, New Delhi, India

5. IRC 112: 2011, “Code of practice for concrete road bridges,” Bureau of Indian Standards, New Delhi, India
6. IS: 456: 2000, “Indian standard Plain and reinforced concrete: Code of practice,” Bureau of Indian Standards, New Delhi, India
7. IS: 800: 2007, “Indian standard code of practice for general construction in steel,” Bureau of Indian Standards, New Delhi, India
8. Pigeauds Chart

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: identify the components and types of bridges, assess the materials requirements and apply IRC specifications to bridge design

CO2: design of culverts and reinforced concrete bridges incorporating deck slab, cantilever slab, longitudinal and cross girder as per IRC specifications

CO3: design post tensioned prestressed concrete slab bridge and T-beam bridge superstructure for the IRC loading

CO4: design steel plate girder bridge and truss bridge based on IRC loading conditions

CO5: design of bearing, abutment and foundation for bridges.

Board of Studies (BoS) :

20th BoS of Civil held on
08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	2	3	2
CO2	3	2	3	2
CO3	3	2	3	2
CO4	3	2	3	2
CO5	3	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG – 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The knowledge on design of bridges shall lead to construction of smart and resilient infrastructure in line with the needs of industrialization and innovation.

CEFY 03	DESIGN OF STEEL CONCRETE	L	T	P	C
SDG: 9 &11	COMPOSITE STRUCTURES	3	0	0	3

COURSE OBJECTIVES:

- COB1:** To impart knowledge on the behaviour of composite beams, columns and connections.
- COB2:** To understand the behaviour and design concepts of composite box girder bridges and composite trusses.

MODULE I CONCEPTS OF STEEL CONCRETE COMPOSITE CONSTRUCTION 9

Introduction to steel - concrete composite construction – theory of composite structures – Codes - Composite action – Serviceability and Construction issues in design

MODULE II DESIGN OF COMPOSITE MEMBERS 9

Design of composite beams, slabs, columns, beam – columns - Design of composite trusses.

MODULE III DESIGN OF CONNECTIONS 9

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

MODULE IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction - behaviour of box girder bridges and its types - Design procedure & concepts.

MODULE V CASE STUDIES ON STEEL CONCRETE COMPOSITE CONSTRUCTION 9

Case studies on steel - concrete composite construction in buildings – Seismic behaviour of composite structures.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Johnson R.P., “Composite Structures of Steel and Concrete”, Blackwell Scientific Publications (Second Edition), UK, 2005.
2. Owens, G.W. and Knowels. P., “Steel Designers Manual”, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 5th Edition, 2002.

REFERENCES:

- 1 Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.
2. David A.Nethrcot "Composite Construction" Spon Press, UK, 2003.

COURSE OUTCOMES:

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

- CO1:** describe the composite structures using various theories.
CO2: design the composite members.
CO3: analyse and design the connections in composite structures
CO4: design composite box girder bridges.
CO5: describe the steel concrete composite construction in buildings through case studies

Board of Studies (BoS) :

20th BoS of Civil held on
08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: A holistic understanding of design concepts of steel and concrete composite structures are more essential to ensure safe and sustainable buildings.

CEFY 04	MATRIX METHODS OF STRUCTURAL	L	T	P	C
SDG: 9 & 11	ANALYSIS	3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the computation of deflections and forces in statically determinate and indeterminate structures using matrix methods.

COB2: To provide in-depth analytical knowledge on the physical interpretation of stiffness matrices to assemble stiffness matrices.

MODULE I	FUNDAMENTAL	CONCEPTS	AND	9
	TRANSFORMATION			

Introduction — Forces and displacement measurements — Principle of superposition — Methods of structural analysis — Betti's Law — Stiffness and flexibility matrices of the elements - Indeterminate structures — Transformation of system force to element forces — Element flexibility to system flexibility — System displacement to element displacement — Transformation of forces and displacement in general — Normal and orthogonal transformation.

MODULE II	FLEXIBILITY METHOD	9
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Choice of redundant — Ill and well-conditioned equations — Automatic choice of redundant — Rank technique — Transformation of one set of redundant to another set — Thermal expansion — Lack of fit — Application to pin jointed plane truss - Continuous beams - Frames and grids.

MODULE III	STIFFNESS METHOD	9
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Development of stiffness method — Analogy between flexibility and stiffness — Analysis due to thermal expansion, lack of fit — Application to pin-jointed plane and space trusses — Continuous beams — Frames and grids — Problem solving.

MODULE IV	MATRIX DISPLACEMENT METHODS - SPECIAL TOPICS	9
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Static condensation technique — Substructure technique - Transfer matrix method — Symmetry & anti symmetry of structures — Reanalysis technique.

MODULE V DIRECT STIFFNESS METHOD**9**

Local and global coordinates systems, principle of contragradience, global stiffness matrices of beam and truss elements, analysis of continuous beams and trusses.

L - 45; TOTAL HOURS – 45**REFERENCES:**

1. Godbole P.N., Sonparote, R.S., Dhote, S.U., "Matrix Methods Of Structural Analysis", PHI Learning Pvt. Ltd., 2014
2. Mcguire and Gallagher, R.H, "Matrix Structural Analysis", John Wiley, 2001
3. Meek J. L., "Computer Methods in Structural Analysis", Taylor and Francis, 2017.
4. Nelsm J.K., Nelson K James and Mc Cormac J C., "Structural analysis using Classical and Matrix Methods", John Wiley &sons, 2002
5. Rajasekaran, S and Sankara Subramanian. G, "Computational Structural Mechanics", Prentice Hall of India, 2001.

COURSE OUTCOMES:

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

CO1: transform the system force to element forces and system displacement to element displacement.

CO2: apply the matrix flexibility method for planar trusses, beams, and frames.

CO3: compute reactions, internal forces and deflections for planar trusses, beams, and frames using matrix stiffness method.

CO4: analyse the matrix displacement method for symmetry and anti-symmetry of structures using various techniques.

CO5: analyse the continuous beams and trusses by direct stiffness method.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: Matrix methods of Structural analysis is more essential to ensure safe and sustainable buildings.

CEFY 05	MAINTENANCE AND REHABILITATION OF	L	T	P	C
	CONSTRUCTED FACILITIES				
SDG: 11		3	0	0	3

COURSE OBJECTIVES: The objective of the course is to impart adequate knowledge on

COB1: physical and chemical deterioration mechanisms acting on reinforced structures and condition assessment of distressed RC structures using NDT techniques

COB2: Materials for repair and rehabilitation

COB3: Surface and near surface repair methods

COB4: Methods for strengthening and rehabilitation of structural elements

COB4: Maintenance of steel structures, pavements and masonry structures

MODULE I DETERIORATING MECHANISMS AND CONDITION ASSESSMENT 9

Deterioration mechanism for steel and cementitious materials - Physical mechanisms: shrinkage & creep - abrasion – erosion – cavitation - freeze and thaw - Chemical mechanisms: alkali silica reaction – sulphate attack – corrosion of steel rebar in RC (chloride penetration and carbonation) – microbial induced corrosion – Condition assessment of structures – Principles of various measurement techniques (Ultrasonic pulse velocity, half-cell potential, resistivity, core test, characterization techniques)

MODULE II MATERIALS FOR REPAIR AND REHABILITATION 9

Repair materials – Factors influencing selection of repair materials – rust convertors – rust removers - protective coating to steel rebars - superplasticizers – bonding materials -corrosion inhibitor admixed mortar / concrete – micro concrete - polymer modified mortar / concrete – grouting agents – FRP sheets - coatings for concrete and steel – galvanic anodes.

MODULE III SURFACE AND NEAR SURFACE REPAIR METHODS 9

Surface and near surface repairs – significance of surface preparation – nuances of surface preparation – repair methods for patch repair: conventional method, galvanic anodes to prevent halo effect and design criteria - methods for repairing surface cracks in concrete and masonry – surface deterioration in masonry / concrete due to dampness, efflorescence, leaching and peeling of paint film: remedial measures – method to repair carbonated cover region.

MODULE IV STRENGTHENING FOR REHABILITATION OF 9
STRUCTURAL ELEMENTS

Rehabilitation techniques for beams, columns, slab, floor, beam-column joint, and structural cracks – overview, significance and selection methods – overlays – pressure grouting – RC jacketing technique – Plate bonding technique – FRP jacketing technique - ferrocement – galvanic anode cathodic protection – Case studies.

MODULE V MAINTENANCE OF STEEL STRUCTURES, PAVEMENTS 9
AND MASONRY STRUCTURES

Significance of maintenance of residential buildings and infrastructure facilities - Maintenance of steel structures: critical observation of joints for bimetallic corrosion - method for rust removal - application of protective coating. Patch repair of flexible and rigid pavements, and bridge decks - rehabilitation of delaminated deck slabs and piers using galvanic anodes - Maintenance of masonry structures from surface deterioration, cracks, etc. Retrofitting of RC structures for design deficiency, seismic upgradation etc. - case studies.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Perkins, P.H., "Repair, Protection and Waterproofing of Concrete Structures", Third edition, E & FN Spon, 1997.
2. Emmons, P.H., "Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques", RSMeans Publishers, 2002.

REFERENCES:

1. Santha Kumar, A.R., "Concrete Technology", Oxford University Press, New Delhi, 2007.
2. Shetty.M.S., and A.K. Jain "Concrete Technology (Theory and Practice)", S. Chand and Company Ltd., 2010.
3. Brooks, J.J. and Neville, A.M., "Concrete Technology", Pearson, 2019.
4. Kumar Mehta. P. and Paulo J.M. Monteiro., "Concrete: Microstructure, Properties, and Materials" 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
5. Hand Book on "Repair and Rehabilitation of RCC Buildings", Central Public Works Department, Government of India, 2002.
6. Malhotra, V.M. and Carino, N.J., "Handbook on Non-destructive Testing of

Concrete", CRC Press, 2004.

7. John Broomfield, "Corrosion of Steel in Concrete – Understanding, Investigation and Repair", CRC Press, London, 2003.
8. Yoshihiko Ohama, "Hand Book of Polymer Modified Concrete and Mortars", Noyes Publications, U.K., 3rd Edition, 2013.

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: perform condition assessment of building by considering the physical and chemical mechanisms acted / acting on the buildings.

CO2: suggest materials for different repair works.

CO3: identify the suitable repair method for surface and near surface distress in structures

CO4: identify the suitable repair methods for strengthening and rehabilitation of structural elements.

CO5: suggest procedure for maintenance of steel structures, pavements, and masonry structures.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	2	2	2
CO2	2	1	3	1
CO3	2	1	3	1
CO4	2	1	3	1
CO5	1	1	2	2

Note: 1- Low Correlation 2 -Medium Correlation 3 -High Correlation

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

1. Development of sustainable infrastructure by understanding the physical and chemical deteriorating mechanisms responsible for repair during its life time.
2. Make the existing human settlements safe and resilient by performing condition assessment of RC structures using NDT and, by adopting suitable repair materials and techniques for its maintenance and rehabilitation.

CEFY 06	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

The objective of the course is to impart adequate knowledge on

COB1: The general features of elastic systems and analyze two-dimensional state of stresses and strains.

COB2: To solve the torsion of non-circular cross-sections by various approaches.

COB3: The fundamental concepts to solve problems in structural members by various energy methods.

COB4: Sufficient background on the theory of plasticity.

MODULE I ANALYSIS OF STRESS & STRAIN 9

Introduction to the concepts of deformation of deformable bodies, notations for stress and strain in two and three dimensions - Stress transformation laws - Differential equations of equilibrium in two and three dimensions in cartesian coordinates - Generalized Hooke's law - Lamé's constants.

MODULE II TWO DIMENSIONAL PROBLEMS 9

Plane stress and plane strain problems, examples - Airy's stress function — Polynomials - Direct method of determining Airy's stress function - Two-dimensional problems in rectangular coordinates - Bending of a cantilever loaded at the free end - Bending of a beam by uniform load - Equation of Equilibrium in polar coordinates -

MODULE III STRAIN ENERGY METHODS 9

Total strain energy - Complementary energy - Principle of virtual work and total potential energy - Theorem of minimum potential energy - Betti's reciprocal theorem - Principle of linear superposition - Uniqueness of elasticity solution - Theorem of minimum complementary energy - Castigliano's theorem - Principle of least work.

MODULE IV TORSION OF VARIOUS SHAPED BARS 9

Introduction to general solution for torsion - Torsion of prismatic bars - Torsion of straight bars – Elliptic cross-section - Introduction to St. Venant's Principal – Membrane analogy – Narrow rectangular cross-section - Torsion of thin-walled open sections - Torsional stress concentration.

MODULE V PLASTICITY**9**

Introduction - Physical assumptions, yield criteria of metals, graphical representation of yield criteria - Flow rule (plastic stress-strain relation) – Prandtl-Reuss equation - Levy Mises equation — Lower bound, upper bound and uniqueness theorems - Application to simple problems in tension-compression - Solution of elastoplastic problems.

L - 45; TOTAL HOURS – 45**REFERENCES:**

1. Arthur P Boresi, Ken P.Chong, "Elasticity in Engineering Mechanics", John Wiley & Sons, 2000.
2. Kachanov L M, "Fundamentals of the Theory of Plasticity", Dover Publications, 2013.
3. Stuart Antman, "Nonlinear Problems of Elasticity", Springer Publication, 2nd Edition, 2005.
4. Sadhusingh, "Theory of Elasticity", Khanna Publishers, New Delhi 2012.
5. Timoshenko and Goodier, "Theory of Elasticity", 3rd Edition, McGraw Hill, 2010.

COURSE OUTCOMES:

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

CO1: Critically describe the mathematical and physical foundations of the continuum mechanics of solids, including deformation, stress measures and constitutive relations.

CO2: Solve the two-dimensional problems in cartesian and polar coordinates.

CO3: Apply the principles to evaluate the problems related to torsion of non-circular cross-sections.

CO4: Analyze the structural members by various energy methods.

CO5: Describe the basic concepts of the theory of plasticity.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: A holistic understanding of the theory of elasticity and plasticity is essential to ensure safe and sustainable buildings.

CEEY 07	CORROSION CONTROL IN REINFORCED	L	T	P	C
SDG: 9 &11	CONCRETE STRUCTURES	2	0	2	3

COURSE OBJECTIVES: The objective of the course is to impart adequate knowledge on

COB1: mechanism of corrosion of steel in concrete, major causes, influencing parameters, and consequences in reinforced and prestressed concrete structures.

COB2: condition assessment of corrosion damaged structures, corrosion prevention, and corrosion protection in reinforced concrete (RC) structures.

COB2: types of corrosion and its mechanism, non-destructive and destructive testing techniques for corrosion assessment in distressed concrete elements through hands on training.

MODULE I MECHANISM OF CORROSION OF STEEL IN CONCRETE STRUCTURES 8

Causes of corrosion of steel in concrete – carbonation - chloride attack – microbial induced corrosion – influencing parameters. Corrosion mechanism of steel in concrete exposed to carbonation and chlorides – black rust - pits - stray current effects - stress corrosion cracking - hydrogen embrittlement. Consequences of corrosion steel in reinforced concrete and prestressed concrete structures : Techo-commercial aspects - Cost of corrosion in Infrastructure sector: worldwide scenario.

MODULE II CORROSION PREVENTION IN CONCRETE STRUCTURES 8

Significance of concrete constituent materials, steel rebar, and construction practice - high performance concrete – Preventive measures against carbonation and chloride attack: Corrosion inhibitors (anodic, cathodic, mixed, bipolar, and vapour phase Inhibitors), Protective coatings to steel rebars (fusion bonded epoxy coating, galvanization, cement polymer composite coating, anticorrosive polymer cementitious coatings), concrete coatings (sealers and membranes), galvanic anode cathodic protection (type of anodes, and design criteria).

MODULE III CONDITION EVALUATION AND CORROSION RATE MEASUREMENT 7

Preliminary survey - visual Inspection and detailed survey – delamination survey - cover – half-cell potential measurements - carbonation depth measurement - chloride

determination - resistivity measurement. Corrosion rate measurement – linear polarization resistance techniques - impedance studies - macrocell techniques - potential-time behaviour studies and accelerated corrosion studies.

MODULE IV CORROSION PROTECTION IN CONCRETE STRUCTURES 7

Physical and chemical rehabilitation techniques – Patch repair (conventional, with anodes) - RC jacketing technique – Surface preparation and repair Materials - Electrochemical repair techniques : principles of chloride removal and realkalization technique - cathodic protection: design criteria.

LIST OF EXPERIMENTS / CASE STUDIES:

1. Cover meter survey, location of rebar and its spacing and resistivity of concrete
2. Determination of Depth of Carbonation and Chloride Penetration
3. Quantitative estimation of chloride in concrete / mortar samples
4. Half-cell potential measurements on corroding RC elements
5. Rapid chloride penetration test on chemical admixture modified concrete / mortar
6. Corrosion rate measurement - Electrochemical Impedance Spectroscopy (EIS) technique
7. Macrocell corrosion studies on RC prisms
8. Accelerated corrosion studies on RC specimens
9. Bimetallic corrosion of steel rebars in existing buildings - Case study
10. Performance evaluation of coated steel rebars – Case study

L – 30, P - 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. John P. Broomfield, Corrosion of Steel in Concrete : Understanding, Investigation and Repair, second edition, CRC Press, 2006.

REFERENCES:

1. ACI (American Concrete Institute) 222R-01: Protection of metals in concrete against corrosion. American Concrete Institute, Farmington Hills, MI, USA, 2010.
2. ASTM A 775/A775 M-19, "Standard specification for epoxy-coated steel reinforcing bars", American Society for Testing and Materials, 2019.
3. ASTM C 876, Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete, American Society for Testing and Materials, 2015.
4. ASTM G109-07: Standard test method for determining effects of chemical

- admixtures on corrosion of embedded steel reinforcement in concrete exposed to chlorides. ASTM International, West Conshohocken, PA, USA, 2013.
5. Baeckmann, W. von, W. Schwenk, and W. Prinz, Handbook of cathodic corrosion protection : Theory and practice of electrochemical protection processes, 3rd ed. Gulf Publishing Company, 1997.
 6. Central Public Works Department (CPWD). "Handbook on repair and rehabilitation of RCC buildings." 2002.
 7. Chess, P. M. and J. P. Broomfield, Cathodic Protection of Steel in Concrete and Masonry, 2nd Edition. London: CRC Press, 2014.
 8. EN ISO 12696:2022; Cathodic Protection of Steel in Concrete, 8th Edn. 2022.
 9. Haji Sheik Mohammed MS, "Performance evaluation of protective coatings on steel rebars", Ph.D. Thesis submitted to Anna University, India, 2008.
 10. IS 12594, Hot-Dip Zinc Coating on Structural Steel Bars for Concrete Reinforcement - Specification, Bureau of Indian Standards, 1988.
 11. IS 13620, "Fusion bonded epoxy-coated reinforcing bars-Specification", Bureau of Indian Standards, New Delhi, 2020.
 12. Jacobson, Gretchen A. "NACE International's IMPACT Study Breaks New Ground in Corrosion Management Research and Practice." The Bridge 46, no. 2, 2016.
 13. Javaherdashti, R., Microbiologically Influenced Corrosion (An Engineering Insight), 2nd ed. Springer, Cham, 2017.
 14. Luca Bertolini, Bernhard Elsener, Pietro Pedferri, Elena Redaelli and Rob B. Polder, Corrosion of Steel in Concrete : Prevention, Diagnosis, Repair, 2nd Edition, Wiley, 2013.
 15. Mattsson, Einar. "Basic Corrosion Technology for Scientists and Engineers." 1996.
 16. Popov, B. N., Corrosion Engineering: Principles and Solved Problems. Elsevier, 2015.

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: understand corrosion mechanism under different contexts, its causes and consequences.

CO2: Suggest techniques and methods for corrosion prevention in RC structures.

CO3: conduct corrosion audit in distressed RC elements by understanding the scientific principles, and submit a professional report

CO4: recommend techniques / methods for corrosion protection of distressed RC structures

Board of Studies (BoS) :
20th BoS of Civil held on 08.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	1	2	2
CO2	3	1	2	1
CO3	3	3	2	1
CO4	3	1	2	1

Note: 1- Low Correlation 2 -Medium Correlation 3 -High Correlation

SDG - 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The knowledge on corrosion prevention and protection, and corrosion auditing in RC structures shall lead to construction of safe and resilient infrastructure by giving emphasize to sustainability and innovation.

CEFY 08	DESIGN OF PRESRESSED CONCRETE	L	T	P	C
	STRUCTURES				
SDG: 9 & 11		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the fundamental concepts and analysis of stresses of prestressed concrete members.

COB2: To impart knowledge on the analysis and design of various prestressed concrete members.

COB3: To understand the concepts and design the composite structures.

MODULE I BASIC CONCEPTS & ANALYSIS OF STRESSES 9

Basic concepts – Advantages of PSC – Materials required – Systems and methods of prestressing — Analysis of sections — Stress concept — Strength concept — Load balancing concept - Stresses in tendons - Losses of prestress — Deflections of prestressed concrete members - Factors influencing deflections – Effect on tendon profile on deflections - Short term and long term deflections as per codal provisions.

MODULE II DESIGN OF PSC MEMBERS 9

Flexural strength — Simplified procedures as per codes — Shear and principal stresses — Ultimate shear resistance of PSC members - Design of shear reinforcement — Behaviour under torsion — Modes of failure - Design for torsion, shear and bending - Design of PSC sections for flexure - Transmission of prestress in pre-tensioned members — Bond and transmission length — End zone reinforcement — Anchorage zone stresses - Stress distribution - Design of anchorage zone reinforcement - Prestressed concrete slabs: types of prestressed concrete floor slabs - Design of prestressed concrete one way and two way slabs — Design of prestressed concrete simple flat slabs and continuous flat slab floors.

MODULE III STATICALLY INDETERMINATE STRUCTURES 9

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations.

MODULE IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members - Design of prestressed concrete pipes and cylindrical water tanks - Design of compression members with and without flexure - Design of prestressed concrete piles.

MODULE V DESIGN OF COMPOSITE MEMBERS**9**

Analysis and design of composite members – Deflection of composite members - Flexure and shear of composite members - Partial prestressing - Advantages and applications.

L - 45; TOTAL HOURS – 45**REFERENCES:**

1. Krishna Raju, N., "Prestressed Concrete", Tata McGraw Hill Company, New Delhi, 2012.
2. Lin.T.Y., "Design of Prestressed Concrete Structures", John Wiley and Sons, Inc, 2000.
3. Ramaswamy G.S., "Modern Prestressed Concrete Design", Arnold Heinimen, New Delhi, 1990.
4. Rajagopal, N, "Prestressed Concrete", 2nd Edition, Narosa Publications, New Delhi, 2007.
5. Sinha, N.C, & S.K.Roy, "Fundamentals of Prestressed Concrete", S.Chand & Co, New Delhi, 2000.

COURSE OUTCOMES:

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

CO1 : Apply the principles for analysing the prestressed concrete structures; and evaluate the short and long term losses & deflection for PSC members

CO2 : Establish appropriate approaches to calculate the design strength for flexure, shear & torsion and design the PSC members.

CO3 : Analyse the indeterminate PSC structures

CO4: Apply the principles and techniques for the design of Tension and Compression members

CO5: Analyse and design the composite structural members.

Board of Studies (BoS) :20th BoS of Civil held on 08.07.2025**Academic Council:**24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of analysis and design of prestressed concrete members leads to development of resilient infrastructure.

Case studies.

MODULE V EXPANSION JOINTS AND SEALANTS

9

Basics of expansion joint detailing and design principles - Choosing a Joint System - Sealants - T-Joint Systems - Expanding Foam Sealant - Hydrophobic Expansion Systems - Sheet Systems - Bellows Systems - Preformed Rubber Systems - Vertical Expansion Joints - Heavy-Duty Metal Systems.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Michael T. Kubal, "Construction Waterproofing: Handbook", Second edition, McGraw Hill Education, 2008.

REFERENCES:

1. Brooks, J.J. and Neville, A.M., "Concrete Technology", Pearson, 2019.
2. Emmons, P.H., "Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques", RSMeans Publishers, 2002.
3. Handbook on "Waterproofing of Concrete Structures", Indian Concrete Institute, 2020.
4. Hand Book on "Repair and Rehabilitation of RCC Buildings", Central Public Works Department, Government of India, 2002.
5. Kumar Mehta. P. and Paulo J.M. Monteiro., "Concrete: Microstructure, Properties, and Materials" 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
6. Mahel Al-Jabari, "Integral Waterproofing of Concrete Structures: Advanced Protection Technologies of Concrete by Pore Blocking and Lining", Elsevier Ltd., 2022.
7. Malhotra, V.M. and Carino, N.J., "Handbook on Non-destructive Testing of Concrete", CRC Press, 2004.
8. Perkins, P.H., "Repair, Protection and Waterproofing of Concrete Structures", Third edition, E & FN Spon, 1997.
9. Santha Kumar, A.R., "Concrete Technology", Oxford University Press, New Delhi, 2007.
10. Yoshihiko Ohama, "Hand Book of Polymer Modified Concrete and Mortars", Noyes Publications, U.K., 3rd Edition, 2013.

COURSE OUTCOMES: After completing this course, the students will be able to:

- CO1:** Explain the scientific principles and components of waterproofing systems
CO2: Select and design below-grade waterproofing systems for various conditions
CO3: Choose appropriate materials and methods for above-grade waterproofing
CO4: Address waterproofing issues specific to residential buildings
CO5: Apply inspection and repair techniques in remedial waterproofing projects

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	1	1	3
CO2	2	2	2	3
CO3	2	2	2	3
CO4	2	2	3	2
CO5	1	3	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement:

1. Development of sustainable infrastructure by understanding the principles of waterproofing in buildings.
2. Make the existing human settlements safe and resilient by identifying suitable waterproofing materials, and adopting feasible techniques based on application areas.

MODULE IV JOINTS AND CONNECTIONS IN PRECAST BUILDINGS 9

Introduction to joints systems – Typical joint system, emulative joints, Mechanical joints systems – Details of connections – column to foundation – wall panel to foundations – beams to column - column to column connections – floor to beam connections – wall panel to panel connections -connection materials and properties.

MODULE V PRODUCTION, HANDLING AND ERECTION OF PRECAST BUILDINGS 9

Planning and set up of production factory – types of precast concrete products – Moulds and formworks – concreting and vibration - Demoulding techniques – storage and curing – Transportation of precast elements –Handling equipments & techniques – lifting devices – erection schemes and supports – other accessories – installation of precast elements – safety conditions.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Hubert Bachman and Alfred steinle , “Precast Concrete Structures “ , Ernst and Sohn Publishing House , UK.
2. Kim S. Elliot , “ Precast Concrete Structures” , 2nd Edition , CRC Press.
3. Hussam Ali Mohammed, “Analysis and Design of precast concrete buildings”, Dar Al-Dhakira for Publishing and Distribution, 2021.

REFERENCES:

1. Handbook on Precast Concrete Buildings, First Edition, Indian Concrete Institute. ICI Bulletin 02.
2. Structural Precast Concrete Handbook – 2nd edition, Technology development division, Building construction authority.

COURSE OUTCOMES: At the end of the course, the students will be able to

- CO1:** Explain the principles, evolution, and components of precast concrete systems used in modern construction.
- CO2:** Design various precast structural elements considering load combinations, tolerances, and progressive collapse resistance.
- CO3:** Evaluate the suitability of different materials and products used in precast concrete construction for durability and performance.

- CO4:** Illustrate joint detailing and select appropriate connection systems for different precast elements.
- CO5:** Demonstrate the planning, production, handling, and erection methods used in precast concrete buildings with emphasis on safety and efficiency.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	1	1	3	3
CO2	2	2	2	3
CO3	2	1	3	2
CO4	2	2	2	2
CO5	2	2	2	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement:

Structural design, material performance, and advanced construction techniques, learners are equipped to drive technological innovation in the construction industry, improving quality, safety, and productivity in modern infrastructure development.

This course promotes the development of safe, affordable, and sustainable urban structures through the use of precast technology. By focusing on durability, efficient production, and construction safety, students are prepared to contribute to sustainable city planning.

CEFY 11	ADVANCED FOUNDATION DESIGN	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES: The objective of the course is to impart knowledge on

- COB1:** the scope and methods of site investigation and soil exploration.
- COB2:** the selection of type and design of shallow foundation.
- COB3:** the load carrying capacity and settlement of the pile foundations under vertical and lateral loads
- COB4:** the components and methods of well and other types of foundations
- COB5:** the basic concepts of soil dynamics and design the machine foundation

MODULE I SITE INVESTIGATION AND SOIL EXPLORATION 9

Scope and objectives - planning an exploration program - methods of exploration - spacing and depth of bores - data presentation - Geophysical exploration and interpretation - seismic and electrical methods -. Methods of boring and drilling - stabilization of boreholes - bore logs. Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, Field tests - penetration tests - Field vane shear - Insitu shear and bore hole shear test - pressure meter test - dilatometer test - plate load test – block vibration test – Procedure – limitations - correction and data interpretation of all methods.

MODULE II SHALLOW FOUNDATIONS 9

Types of foundations – Types of shallow foundation – Design concept - General requirements - Additional consideration - selection of type of foundation. Bearing capacity of shallow foundations - Homogeneous - Layered soils - Soft and Hard Rocks - Evaluation of bearing capacity from insitu tests - partial safety factor approach – Codal recommendations.

MODULE III PILE FOUNDATIONS 9

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles

MODULE IV MISCELLANEOUS FOUNDATION 9

Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection. Sheet Pile Structure- Types, Cantilever, Anchored sheet piling, Design by Fixed Earth Method - Anchor Braced sheeting cofferdam- Single well cofferdams-Cellular cofferdam, Stability of cellular cofferdam.

MODULE V MACHINE FOUNDATIONS 9

Criteria for a satisfactory machine foundation - methods of analysis of machine foundations - springs - Degrees of freedom of a block foundation - methods of determination of soil constants in laboratory and field based on IS code provisions -. Foundation of reciprocating machines - design criteria Foundations subjected to impact loads - design criteria - vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method). Vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations.

L – 45; Total Hours:45

TEXT BOOKS:

1. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007.
2. Gopal Ranjan and Rao, A.S.R, Basic and Applied Soil Mechanics, Wiley Eastern Ltd.,2002.
3. Das, B.M., Principles of Geotechnical Engg, PWS Publishing Comp, Boston, 2021
4. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2002
5. Swami Saran, "Soil Dynamics and Machine Foundation", Galgotia publications Pvt. Ltd., New Delhi 2016.

REFERENCES:

1. Bowles J E, "Foundation Analysis & Design - II", McGraw Hill Education; 5th edition, 2017.
2. Kurian. N.P, "Design of foundation systems: Principles and Practices - II", Narosa Publishing House, 2014.
3. Lambe T. W. & R. V. Whitman, "Soil Mechanics - II", Wiley Eastern Ltd.,2000.
4. Swami saran, "Soil Dynamics and Machine Foundations", Galgotias,2012.
5. Varghese P.C., "Design of Reinforced Concrete Foundations - II", PHI Learning Private Limited, New Delhi, 2009.

COURSE OUTCOMES: At the end of the course, the students will be able to

- CO1:** explain the significance of understanding the soil properties at a site, conduct a sequential soil exploration according to the site and report writing based on the results obtained from field and laboratory tests.
- CO2:** design the shallow foundations based on the bearing capacity of soil.
- CO3:** perform lateral and uplift load analysis and suitably design a pile foundation.
- CO4:** analyse and design the well foundation sheet piles and coffer dams
- CO5:** describe the dynamic behaviour of soil and foundations for machines.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	3	3	2
CO2	3	3	3	2
CO3	3	3	3	2
CO4	3	3	3	2
CO5	3	3	3	2

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and Sustainable.

Statement: Knowledge on Advanced Foundation Design is more essential to ensure safe and sustainable building.

CEFY 12	DESIGN OF INDUSTRIAL STRUCTURES	L	T	P	C
SDG: 9 & 11		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide knowledge on functional requirements of industrial buildings and to design various industrial building components.

COB2: To impart knowledge on the design of various special structures and transmission line towers.

MODULE I	GENERAL REQUIREMENTS OF INDUSTRIAL STRUCTURES	9
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Classification of industries and industrial structures — General requirements of various industries – Engineering, textiles, chemicals etc, - Planning and layout of buildings and components.

MODULE II	FUNCTIONAL REQUIREMENTS OF INDUSTRIAL STRUCTURES	9
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Lighting, illumination levels, characteristics of good lighting – Principles of day lighting design – Artificial lighting – Ventilation – Natural and mechanical ventilation – Evaporate cooling design – Measurement – Contaminant control – Installation and operation - Acoustics – Fire safety – Guidelines from factories act.

MODULE III	ANALYSIS & DESIGN OF INDUSTRIAL BUILDINGS	9
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Industrial building frames - Analysis of industrial bents — Design of gable frames - Industrial roofs - Crane girders - Machine foundations.

MODULE IV	DESIGN OF SPECIAL STRUCTURES	9
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Design of corbels and nibs - Analysis and design of bunkers and silos — Design of chimneys - Design of cooling towers.

MODULE V	ANALYSIS & DESIGN OF POWER TRANSMISSION STRUCTURES	9
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Tower configuration and bracings – Loads acting on towers – Analysis and design of lattice towers — Transmission line towers — Tower foundations.

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Dayaratnam P., "Design of Steel Structures", Wheeler and Co., New Delhi, 1999.
2. Krishna Raju, "Advanced Concrete Structures", McGraw Hill, New Delhi, 2000.
3. Manohar S.N., Tall Chimneys; "Design and Construction", Tata McGrawHill, 1985.
4. Ramchandra. V, "Design of Steel Structures", Standard Book House, New Delhi, 2007.
5. SP 32: 1986, Handbook on Functional Requirements of Industrial buildings.
6. Santhakumar A.R. and Murthy S.S, "Transmission Line Structures", McGraw-Hill, 1990.

COURSE OUTCOMES:

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

CO1: Plan for general requirements in an industry and prepare a layout on buildings and structural components for various industries.

CO2: Make an appropriate lighting & ventilation and identify suitable measures to control fire as per factories act.

CO3: Analyze & Design an industrial building with bents along with crane girder; describe suitable foundations for the various types of machines/equipment in an industry.

CO4: Analyse and design the special structures such as corbels, bunkers, silos, chimneys and cooling towers for an industry.

CO5: Identify suitable tower configurations and structurally design the tower for power transmission.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of design of industrial buildings leads to development of sustainable buildings.

CEFY 13	TALL STRUCTURES	L	T	P	C
SDG : 9 & 11		3	0	0	3

COURSE OBJECTIVES:

- COB1:** To identify the problems tied to the large heights of structures with respect to different loading conditions.
- COB2:** To disseminate knowledge on the behavior, analysis, and design of various structural systems.
- COB3:** To educate on the stability of tall buildings and the dynamic analysis of wind and earthquake loadings.

MODULE I DESIGN PRINCIPLES & LOADING 9

General - Factors affecting growth, height and structural form - Design philosophy – loading, gravity loading, wind loading, earthquake loading - Combinations of loading - Strength and stability - Stiffness and drift limitations - Human comfort criteria - Creep effects - Shrinkage effects - Temperature effects - Fire - Foundation settlement - Soil-structure interaction.

MODULE II STRUCTURAL FORMS & FLOORING SYSTEMS 9

Structural forms – Braced frame, rigid frame, infilled frame, shear wall structures, wall - Frame structures, framed tube structures, outrigger braced structures, space structures, hybrid structures, R.C. floor systems - One-way slab on beams and girders - Two-way flat slab - Two-way flat plate - Waffle flat slabs - Two-way slab and beam - Steel framing floor systems - One-way beam system - Two-way beam system - Three-way beam system - Composite steel - Concrete floor systems.

MODULE III MODELLING, BEHAVIOUR & ANALYSIS OF STRUCTURAL SYSTEMS 9

Assumptions - Modelling for approximate analyses - Modelling for accurate analysis - Reduction technique. types, behaviour and analysis methods of braced frames - Behaviour and analysis of rigid frame structures - Behaviour, analysis & design of infilled frame structures - Behaviour and analysis of shear wall, coupled shear wall and wall-frame structures - Behaviour of tubular structures, core structures and outrigger - Braced structures.

MODULE IV STABILITY OF TALL STRUCTURES 9

Overall buckling analysis of frames (approximate methods) - Overall buckling analysis of wall frames - Second order effects of gravity loading - Translational - Torsional instability - Out-of-plumb effects - Effects of foundation rotation - Creep and shrinkage effects - Temperature effects.

MODULE V DYNAMIC ANALYSIS 9

Response to wind loading - Along-wind response - Across-wind response - Estimation of natural frequencies & damping - Types of excitation - Design to minimize dynamic response - Response to earthquake motions - Response to ground accelerations - Response spectrum analysis - Estimation of natural frequencies and damping - Human response to building motions.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw Hill Book Co., 2016.
2. Feng Fu, Design and analysis of Tall and Complex Structures, Butterworth Heinemann, 2018.

REFERENCES:

1. Bryan Stafford Smith and Alex Coull, "Tall Building Structures, Analysis Design", John Wiley and Sons, Inc. 1991
2. Emil Simiu and Dong Hun Yeo, "Wind Effects on Structures - Modern Structural Design for Wind", John Wiley and Sons, Inc. 2019.
3. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.
4. Gupta.Y.P.(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi, 1995.
5. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.
4. IS: 1893:2016 (Part 1), Criteria for earthquake resistant design of structures.
5. IS:4326: 2013, Earthquake Resistant Design and Construction of Buildings

6. IS:13920: 2016, Ductile Design and Detailing of reinforced concrete structures subjected to seismic forces.

7. IS 875 Code of practice for Design Loads BIS, India.

COURSE OUTCOMES:

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

- CO1:** Identify the different types of loads acting on tall structures and recognize the factors that influence them.
- CO2:** Classify and utilize the appropriate structural systems in tall buildings.
- CO3:** Develop modelling using various analysis techniques and describe their behaviour for different structural systems.
- CO4:** Manipulate the second order effects of gravity loading, translational and torsional instability in the analysis of tall structures.
- CO5:** Analyse the impact of wind and seismic motions on tall structures.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	1	1	3	2
CO3	2	2	3	1
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement : The holistic understanding of behavior, analysis and design of tall buildings leads to development of sustainable buildings.

CEFY 14	THEORY OF PLATES AND SHELLS	L	T	P	C
SDG: 9 & 11		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the behaviour of thin and thick plates in Cartesian and polar coordinates.

COB2: To understand the behaviour of reinforced concrete plate and shell elements at the material level, element level and system level.

MODULE I THIN AND THICK PLATES 9

Plate equation and behaviour of thin plates in Cartesian - Polar coordinates - Isotropic and orthotropic plates - Bending and twisting of plates.

MODULE II ANALYSIS & DESIGN OF PLATES 9

Navier's solution and energy method, rectangular, circular plates with various end conditions - Design steps - Minimum thickness and reinforcements as per I.S. specifications for R.C. folded plates.

MODULE III BEHAVIOUR OF SHELLS 9

Shell behaviour - Shell surfaces and characteristics - Classifications of shells - Equilibrium equations in curvilinear coordinates - Force displacement relations.

MODULE IV ANALYSIS OF SHELLS 9

Membrane analysis and bending theory of shells of revolution - Cylindrical shells under different loads - Shallow shells - Solutions for typical problems.

MODULE V DESIGN OF SHELLS 9

Design of spherical, conical, paraboloid, ellipsoid, Cylindrical hyperbolic paraboloid, and north light shells – Detailing of shell structures.

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Philip L Gould, "Analysis of Shells and Plates", Prentice Hall, 2012.
2. Ramaswamy. G.S, "Design and Construction of Concrete Shell Roofs", CBS Publishers, 2005.
3. Reddy, J.N., "Mechanics of Laminated Composites Plates and Shells", CRC Publishers, 2nd Edition, 2003.
4. Timoshenko. S and S.W. Krieger, "Theory of Plates & Shells", McGraw Hill &

Co., New York, 2003.

COURSE OUTCOMES:

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

CO1: describe the behaviour of thin and thick plates.

CO2: solve and establish classical solutions for various types of plates.

CO3: illustrate the characteristics of different types of shells and develop equilibrium equations and force-displacement relations.

CO4: analysis and design of the various types of shells under different loading conditions.

CO5: design the various types of shell structures.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG-9: Build resilient Infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

SDG-11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of the theory of plates and shells leads to the development of an analytical tool to analyse sustainable buildings.

CEFY 15	STABILITY OF STRUCTURES	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

- COB1:** To introduce the basic concepts of elastic structural stability, analytical approaches to stability and analysis of inelastic buckling of columns.
- COB2:** To impart knowledge on the stability analysis of beam columns and frames using FEM and other methods and analysis of buckling of beams, thin plates & shells.

MODULE I STABILITY OF COLUMNS 9

Concepts of elastic structural stability- analytical approaches to stability - characteristics of stability analysis- elastic buckling of columns- equilibrium; energy and imperfection approaches – non-prismatic columns- built up columns- orthogonality of buckling modes- effect of shear on buckling load - large deflection theory.

MODULE II INELASTIC BUCKLING OF COLUMNS 9

Approximate methods – Rayleigh and Galerkin methods – Numerical methods – Finite difference and finite element - Analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of column design formula - Effective length of columns - Inelastic behaviour - Tangent modulus and double modulus theory.

MODULE III BEAM- COLUMNS AND FRAMES 9

Beam column behaviour - Standard cases - Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of wood's charts.

MODULE IV BUCKLING OF BEAMS 9

Lateral buckling of beams – Energy method - Application to symmetric and simply symmetric I beams – Simply supported and cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non-uniform torsion on open cross section - Flexural torsional buckling – Equilibrium and energy

approach.

**MODULE V BUCKLING OF THIN PLATES AND
STABILITY ANALYSIS OF THIN SHELLS**

9

Isotropic rectangular plates - Governing differential equations - Simply supported on all edges – Use of energy methods – Plates with stiffeners – Numerical techniques – Buckling in various types of shells – Stability analysis for thin shells – Problems on thin shells.

L – 45; Total Hours: 45

REFERENCES:

1. Ashwini Kumar, "Stability of Structures", Allied Publishers Ltd, 2003.
2. Stephen P. Timoshenko and Gere, "Theory of Elastic Stability", McGraw- Hill Company, 2000.
3. Iyengar, N.G.R, "Structural Stability of Columns and Plates", Affiliated East- West Press Pvt. Ltd, 2007.
4. Chai H Yoo, Sung Lee, "Stability of Structures - Principles and Applications", Elsevier, 2011.
5. Gambhir, M.L, "Stability Analysis and Design of Structures", Springer, 2004.

COURSE OUTCOMES:

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

- CO1:** Describe the basic concepts of elastic structural stability and identify suitable analytical approaches for the stability of structures.
- CO2:** Analyse the inelastic buckling of structures by various approximate methods
- CO3:** Illustrate the buckling behaviour of various structural components and evaluate under critical loading conditions.
- CO4:** Perform stability analysis by different approaches for various types of beams.
- CO5:** Establish differential equations for thin plates under different edge conditions and stability analysis of thin shells.

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CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of stability analysis of beam columns and frames leads to development of sustainable buildings.

CEFY 58	CIRCULAR ECONOMY IN	L	T	P	C
SDG: 9	CONSTRUCTION INDUSTRY	3	0	0	3

COURSE OBJECTIVES: The course will impart knowledge on

COB1: Principles of circular economy

COB2: Impact of materials and energy level on circular economy

COB3: Life cycle assessment of buildings

COB4: Criteria and indicators for circularity

COB5: Role of stakeholders

MODULE I CIRCULAR ECONOMY 9

Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs Circular Economy. Circular economy – Butterfly Diagram – Principles – 10 R Strategy – Circular economy in built environment – Existing structures – New buildings – Selection of materials – Modularity and prefabrication – Reversible and transformable buildings – case studies.

MODULE II CIRCULAR ECONOMY- MATERIAL LEVEL AND ENERGY LEVEL 9

Challenges in implementation – Building Level – Component level – Reusing components – Refurbishment (Repair-Repaint-Retrofit) and Upgrading – Material Level – Circular Materials – Concrete – Steel – timber – Masonry – Additive Manufacturing – Energy Level – Energy Efficiency and sources – Building Services – Material Use – and Reuse – Net Zero Energy Buildings – Photo voltaic – Wind Energy – Thermal solar collectors – Geothermal energy

MODULE III LIFE CYCLE ASSESSMENT 9

Life Cycle Assessment – ISO Standard (ISO 14040 – 14043)– LCA of Building - EN 15, 978 - Stages – Life Cycle phases of buildings – Design Framework – ReSOLVE - Frameworks of design strategies to achieve established circular principles - Frameworks of design strategies to be implemented throughout phases of the building life cycle.

MODULE IV CRITERIA AND INDICATORS**9**

Circularity Criteria for Construction Materials – Classification of building materials – CE Criteria – Traditional building Materials – Novel Sustainable construction materials - Strategic Indicators Based on Material flow analysis – Resource Potential Indicator - Material Circularity Indicator – Longevity Indicator– a multicriteria decision analysis - Construction and Demolition Waste Management Indicators - Water Consumption Indicators - Environmental and Economic Impact of Construction Materials - Carbon Footprint Impact of Construction Materials - Circularity Criteria and Indicators at the Building Component and System Level - Circularity Criteria and Indicators at the Whole Building Design Level

MODULE V STAKEHOLDERS' ROLE AND CASE STUDIES**9**

Stakeholders' Role, Inter-Relationships, and Obstacles in the Implementation of Circular Economy - Circular Value Chain Management—Barriers and Opportunities - Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG. Business models, Solid Waste Management / Wastewater, Plastics: A case study, Extender Polluter Responsibility : polluters pay principle, Industrial symbiosis/ Eco-parks.

L – 45; Total Hours: 45**TEXT BOOKS:**

1. Sheng-Hong Chen, Marco di Prisco, Ioannis Vayas, Sanjay Kumar Shukla, "Circular Economy Design and Management in the Built Environment", Springer Tracts in Civil Engineering, 1st Edition 2025
 2. Walter R Stahel, "The Circular Economy A User's Guide", Routledge; 1st Edition, 2019
 3. Shalini Goyal Bhalla, "Circular Economy: (Re) Emerging Movement", Invincible Publisher, 2021
-
1. Towards Zero Waste: Circular Economy Boost, Waste to Resources María-Laura Franco-García, Jorge Carlos Carpio-Aguilar, Hans Bressers. Springer International Publishing 2019.
 2. Strategic Management and the Circular Economy Marcello Tonelli, Nicolo Cristoni, Routledge 2018.

3. Circular Economy: Global Perspective Sadhan Kumar Ghosh, Springer, 2020.
4. The Circular Economy: A User's Guide Stahel, Walter R. Routledge 2019.
5. An Introduction to Circular Economy Lerwen Liu, Seeram Ramakrishna, Springer Singapore 2021.

COURSE OUTCOMES: The student will be able to

- CO1:** Differentiate between linear and circular economic models and describe circular economy in built environment
- CO2:** Select the material and energy for the building using the circular economy principle.
- CO3:** Perform the life cycle assessment of a given building
- CO4:** Identify the criteria and indicators for material or a whole building
- CO5:** Perform a case study analysis of a given building

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	PO1	PO2	PO3	PO4
CO1	1	-	3	3
CO2	1	-	3	3
CO3	1	2	3	3
CO4	1	-	3	3
CO5	1	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The holistic understanding of circular economy fosters sustainable industrialization by promoting innovation in product design, resource efficiency, and waste minimization.

CEFY 16	OPTIMIZATION IN STRUCTURAL DESIGN	L	T	P	C
SDG: 9 & 11		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart sufficient knowledge on basic concepts of optimization and classical methods.

COB2: To impart knowledge on the queuing theory, exposure to various optimization techniques for the design of structural elements, and linear programming methods for plastic design.

MODULE I BASIC CONCEPTS IN OPTIMIZATION 9

Basic concepts of minimum weight - Minimum cost design - Objective function – Constraints - Classical methods.

MODULE II QUEUING THEORY 9

Queuing model - Poisson and exponential distributions - Queues with combined arrivals and departures - Random and series queues.

MODULE III OPTIMIZATION TECHNIQUES AND ALGORITHMS 9

Linear programming - Integer programming - Quadratic programming - Dynamic programming and geometric programming methods for optimal design of structural elements.

MODULE IV SEARCH METHODS IN OPTIMIZATION 9

Linear programming methods for plastic design of frames - Computer search methods for univariate and multivariate minimization.

MODULE V OPTIMIZATION THEOREMS 9

Optimization by structural theorems – Maxwell - Mitchell, and Heyman's Theorems for trusses and frames - Fully stresses - Design with deflection constraints - Optimality criterion methods.

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Iyengar. N.G.R. and Gupta. S.K., "Structural Design Optimisation", Affiliated East West Press Ltd, New Delhi, 2002
2. Quang Liang, Q., "Performance-based Optimization of Structures: Theory and Applications", Taylor & Francis, 2005.
3. Ratan Prakash Agarwal, Ravi P. Agarwal, "Recent Trends in Optimization Theory and Applications", World Scientific, 2010

COURSE OUTCOMES:

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

CO1: describe the various basic concepts in optimization.

CO2: perform the queuing theory in structural analysis.

CO3: execute different optimization techniques for the design of structural elements.

CO4: appropriately use the computer search methods for analysis of structures.

CO5: Describe the various optimization theorems for the analysis of structures.

Board of Studies (BoS) :

20th BoS of Civil held on 08.07.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	2	3	2
CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG-9: Build resilient Infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

SDG-11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

Statement: Optimization in Structural Engineering is more essential to ensure safe and sustainable building.

CEFY 17	3D PRINTING OF CONCRETE STRUCTURES	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

- COB1:** To compare 3D printing technologies with traditional construction methods, highlighting their benefits and limitations
- COB2:** To explore various 3D printing technologies, materials, and equipment used in construction, including cement-based materials and advanced systems.
- COB3:** To understand the material properties, mix design, and rheological requirements for 3D printing in construction.
- COB4:** To analyze the hardened properties, microstructure, and challenges such as shrinkage, cracking, and interlayer bonding in 3D printed concrete.
- COB5:** To study real-world applications and case studies of 3D printing in housing, infrastructure, and architectural projects globally and in India.

MODULE I INTRODUCTION TO 3D PRINTING IN CONSTRUCTION 9

Introduction - Evolution of additive manufacturing - Benefits and limitations in the construction sector - Comparison with traditional construction methods - General considerations for 3D printing and additive fabrication – Characteristics of 3D printing of cement-based materials.

MODULE II PRINTING TECHNOLOGIES, MATERIALS AND EQUIPMENT 9

3D printing methods for concrete – Technology, Material and Equipment - Extrusion-Based Printing - Particle-Binding (Binder Jetting) - Shotcrete 3D Printing (SC3DP)- Material Based – Mortar, Concrete and Geopolymer concrete - Equipment types - Gantry system - Robotic arm systems.

MODULE III MIX DESIGN AND RHEOLOGY 9

Fresh properties – Open time, Pumpability, Extrudability and Buildability- Rheology of cement-based materials – Significance of rheology in 3D concrete printing.

MODULE IV HARDENED PROPERTIES AND 9 **MICROSTRUCTURE OF 3D PRINTED** **CONCRETE**

Testing methods - Elastic deformation and accuracy of the deposition - Shrinkage and cracking during drying - Bonding between layers – Weakness at the interface between layers - Interaction between printing parameters and material composition - Characterisation methods.

MODULE V APPLICATIONS AND CASE STUDIES 9

Housing, infrastructure, and architectural elements - Indian and global projects.

L – 45; Total Hours: 45

TEXT BOOKS:

1. 3D Printing of Concrete: State of the Art and Challenges of the Digital Construction Revolution (Civil Engineering and Goemechanics) , Wiley-ISTE; 1st edition (12 April 2019)
2. Sanjayan, J.G., Nazari, A. and Nematollahi, B., 2019. *3D concrete printing technology: construction and building applications*. Butterworth-Heinemann.

REFERENCES:

1. Perrot, A. ed., 2019. 3D printing of concrete: state of the art and challenges of the digital construction revolution.
2. Wang, X., Li, W., Guo, Y., Kashani, A., Wang, K., Ferrara, L. and Agudelo, I., 2024. Concrete 3D printing technology in sustainable construction: A review on raw materials, concrete types and performances. *Developments in the Built Environment*, p.100378.

COURSE OUTCOMES:

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

CO1: Describe the evolution and principles of 3D technology.

CO2: Identify and select appropriate technologies, materials, and equipment.

CO3: Design and optimize material mixes.

CO4: Analyze the hardened properties and microstructure.

CO5: Apply knowledge of 3D printing in practical applications.

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	PO1	PO2	PO3	PO4
CO1	1	1	3	1
CO2	1	1	3	1
CO3	3	3	3	1
CO4	3	3	3	3
CO5	2	2	3	1

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding of 3D printing for building and Construction, leads to development of sustainable buildings.

CEFV 18	STRUCTURAL SAFETY AND	L	T	P	C
SDG: 9 & 11	RELIABILITY	3	0	0	3

COURSE OBJECTIVES:

COB1: To impart adequate knowledge on safety aspects involved in the construction industry.

COB2: To impart knowledge on the quantitative estimates of the reliability of structures under different limit state conditions.

MODULE I INTRODUCTION TO STRUCTURAL SAFETY 9

Structural safety - Role of safety officers, responsibilities of general employees, safety committee, safety monitoring - Concepts of safety factor - Safety, reliability, and risk analysis.

MODULE II PROBABILITY CONCEPTS 9

Fundamentals of set theory and probability - Probability distribution - Regression analysis - Hypothesis testing - Stochastic process and its moments - Probability distributions - Probability of failure - Fatal accident rate - Societal risk - Anatomy of failure - Management of safety.

MODULE III STRUCTURAL RELIABILITY THEORY AND METHODS 9

R-S problem in structural design and assessment - Probability of failure and the reliability index - Convolution Integral - Standardized method for normal variables - First order reliability method - Monte Carlo simulation - Second order reliability method.

MODULE IV RELIABILITY ANALYSIS 9

Measures of reliability - Factor of safety, safety margin, reliability index, performance function, and limiting state - Reliability Methods - First Order Second Moment Method (FOSM) - Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method)

MODULE V RELIABILITY BASED DESIGN 9

Specification of characteristic load/resistance values - Design values - Partial Factors - Target reliability - Methods of code calibration - Use of ISO 2394 method

and its significance.

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Tim Howarth, Paul Watson, "Construction Safety Management" Wiley- Blackwell, 2008.
2. Choi S K, Grandhi R V, and Canfield R A., "Reliability Based Structural Design", Springer Verlag, London, UK, 2007.
3. Haldar, A., and Mahadevan, S., "Probability, Reliability and Statistical Methods in Engineering Design", John Wiley and Sons, New York, 2000.
4. Ranganathan,R., "Structural Reliability Analysis and Design", Jaico Publishing House, Mumbai, 2006.

COURSE OUTCOMES:

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

CO1: describe the safety practices to be followed during various construction operations.

CO2: quantifying uncertainties using theories of probability.

CO3: illustrate the theory of methods of structural reliability based on the concept of reliability indices.

CO4: perform the reliability-based limit state design for simple structural elements and recognize the sensitivity of the outcome to the uncertainty in different variables.

CO5: reasons leading to different values of partial safety factors for load and resistance variables in design and assessment standards.

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CO2	2	2	3	2
CO3	2	2	3	2
CO4	2	2	3	2
CO5	2	2	3	2

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG-9: Build resilient Infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

SDG-11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

Statement: The holistic understanding of structural safety and reliability of structures leads to the development of sustainable buildings.

CEFY 19	APPLICATIONS OF AI AND ML IN	L	T	P	C
SDG: 9 &11	STRUCTURAL ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to impart adequate knowledge on

COB1: The fundamental concepts of Artificial Intelligence (AI) and Machine Learning (ML) with relevance to structural engineering applications

COB2: The integration of AI techniques into structural analysis and design

COB3: AI tools to assess, model, and enhance the resilience of structures under extreme events and uncertainties

COB4: ML models for structural health monitoring (SHM) using real-time data, sensors, and anomaly detection techniques

COB5: Learn data-driven models to predict material behavior, degradation, and optimize structural performance across the life cycle

MODULE I FUNDAMENTALS OF AI and ML 9

Introduction to Data Science (DS), AI, ML and DL – Python and MATLAB for structural engineering - Data Collection and Validation - Types of AI: Narrow AI vs. General AI – Examples in structural contexts – Overview of Supervised, Unsupervised, and Reinforcement Learning - Role of ML in Engineering Decision-Making – Common ML Algorithms - Basics of artificial neural networks (ANN) and DL – Ethics in AI and Civil Engineering – Data Bias, Transparency.

MODULE II AI FOR STRUCTURAL ANALYSIS AND DESIGN 9

Introduction to Computational Design with AI – AI Driven Design Optimization Techniques - AI applications in structural analysis and design – AI based finite element analysis – AI based performance-based design - AI in structural design optimization – Integration of AI in structural design software.

MODULE III AI FOR ENHANCING STRUCTURAL RESILIENCE 9

Concept and framework of structural resilience - Role of AI in pre-event planning, real-time monitoring, and post-event Assessment – Decision support systems for resilience - Predictive Models for hazard response: Wind, Earthquake, Fire - AI for emergency response planning in structural failures - AI in Retrofitting and

rehabilitation planning - Evaluation and interpretation of results.

MODULE IV ML FOR STRUCTURAL HEALTH MONITORING 9

Introduction to SHM: Importance of SHM in structural engineering, Types of sensors and data collection techniques - Applications of SHM in crack detection - ML Algorithms for SHM: Supervised and unsupervised learning for SHM - Vibration-based damage detection: ML models for vibration pattern classification - Predictive maintenance using ML.

MODULE V ML FOR STRUCTURAL PERFORMANCE 9 **OPTIMISATION**

Overview of Smart Materials and Material Behavior - Data Collection and Preparation - ML models for compressive/tensile strength prediction - Life-cycle prediction of materials, structural elements using ML - Accelerated aging data modelling - ML for optimising load distribution in structures - Case Studies

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Dr. John Martin, Dr. V SelvaKumar, Rashmi Rani Patro, Rojalini Patro, "Data Mining for Machine Learning and Statistics", Xoffencer International Publications, Madhya Pradesh, 2023.
2. Trevor Hastie Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning Data Mining, Inference, and Prediction", Springer, Second Edition, 2008.
3. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
4. Kothari Dwarkadas Pralhaddas, Samui Pijush, "Artificial Intelligence in Civil Engineering", LAP Lambert Academic Publishing, India, 2012.

COURSE OUTCOMES:

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

CO1: Learn the fundamentals of AI and ML in structural engineering

CO2: Explore AI-assisted models for structural design and optimization

CO3: Apply AI-based decision support systems for improving structural resilience

CO4: Explore ML techniques for real-time structural health monitoring, damage detection, and condition assessment

CO5: Apply predictive models to evaluate material properties and forecast deterioration using experimental and field data

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CO1	2	2	3	3
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CO5	2	2	3	3

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

SDG - 9: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: AI and ML in design, monitoring, and resilience enhances long-term infrastructure sustainability