B.S. Abdur Rahman
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2022
Curriculum and Syllabi
(As approved by the 19th Academic Council)
September - 2022

M.Tech.
(Structural Engineering)

B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2022

CURRICULUM AND SYLLABI
(As approved by the 19th Academic Council)

SEPTEMBER – 2022

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 School for Education, Training and Research in Civil Engineering for a better future and over-all Socio-Economic progress of the Country in a sustainable manner

MISSION

- To nurture Civil Engineers into ethically strong and responsible leaders to address Global challenges through Quality Education, Application oriented research, innovation, inspiration, motivation and sustainable growth.

- To enrich and enhance knowledge for the best practices in various disciplines of Civil Engineering through Collaborations with Global Institutions of Excellence, Industries and Research Organizations.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.TECH STRUCTURAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: To impart knowledge and develop analytical skills to design structural components and systems based on codal provisions and create an urge for lifelong learning.

PEO 2: To impart skills in the usage of state of the art software tools for modeling and evaluation of structural systems

PEO 3: To improve the analytical skills of the graduates through supportive teaching tools and methodologies as solution providers

PEO 4: To develop research skills with full exposure to appropriate real time projects in the field of structural engineering

PEO 5: To educate graduates in the use of sustainable, cost effective construction materials and practices

PEO 6: To inculcate in students the ethical attitude, team work and effective communication skills

PROGRAMME OUTCOMES

Structural Engineering Graduates will be able to

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated

conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO4: Use research – based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering including prediction and modelling to complex engineering activities with an understanding of the limitations

PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at

large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

On successful completion of the programme, the graduates will be able to

PSO1: Model, Analyse and design the concrete & steel structural components & systems by using various codal provisions.

PSO2: Apply engineering techniques and relevant software to offer solution to structural engineering problems.

PSO3: Undertake real-time projects and research in the field of structural engineering including rehabilitation and retrofitting domains.

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

REGULATIONS 2022

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 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 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

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.	

2.2 ADMISSION REQUIREMENTS

2.2.1 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.

2.2.2 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 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

3.1. 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

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

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

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	Aeronautical Engineering	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.	Civil Engineering	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
		M. Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. in Civil Engineering / Structural Engineering / B.Arch. or Equivalent degree in relevant field.
3.	Mechanical Engineering	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.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	Computer Science and Engineering	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.	Information Technology	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
8.	Computer Applications	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 + 2level or equivalent degree in relevant field.
9.	Mathematics	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	Physics	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	Chemistry	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	Life Sciences	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.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.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or)

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	Studies		Any under graduate degree with Part 1 Arabic (or)Any under graduate degree with Aalim Sanad / Diploma / Certificate in Arabic or Islamic Studies.

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 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

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

3.3.3 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.

3.3.4 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.	76 - 80
MCA	86
M.Sc.	77 - 85
M.Com.	88
M.A.	72

3.3.5 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.

3.3.6 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

3.3.7 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.

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

3.3.9 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, aliter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 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.

3.4.2 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.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 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.

4.2 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.

5.0 COURSE COMMITTEE

5.1 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.

6.0 CLASS COMMITTEE

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

6.2 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

6.3 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.

6.4 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.

6.5 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.

7.0 REGISTRATION AND ENROLLMENT

7.1 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.

7.2 Change of a Course

A student can change an enrolled 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.

7.3 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.

7.4 A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

8.0 BREAK OF STUDY FROM PROGRAMME

8.1 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:

8.1.1 Medical or other valid grounds

8.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

8.1.3 Debarred due to any act of indiscipline

8.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

8.3 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).

8.4 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.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT WORK

9.1 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

9.2 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.

10.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.

10.2 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.

10.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

10.4 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.

10.5 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.

10.6 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.

10.7 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.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the department concerned, based on the availability of faculty members, and subject to a specified minimum number of students registering for each of such courses.

11.2 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.

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 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. 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.

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

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report

submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. 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.

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 SUPPLEMENTARY EXAMINATION

14.1 Final Year 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.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall preferably meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. 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
I	0

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

15.2 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.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of School and it shall be declared by the Controller of Examinations.

15.4 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 fees tothe Controller of Examinations. Subsequently the Head of the Department/ Dean of 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 knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 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 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 GP_i is the Grade Point in the i^{th} course

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

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" grade is excluded for calculating GPA.

"U" and**"I"** grades are excluded for calculating CGPA.

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

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

15.6.1 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 PG programme within the minimum prescribed period of study (except clause 8.1.1)

15.6.2 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 8.1.1)

15.6.3 The students who do not satisfy clause 15.6.1 and clause 15.6.2 shall be classified as second class.

15.6.4 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.

16.0 DISCIPLINE

16.1 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.

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

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

17.1 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 stipulated time.
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.

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

18.0 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.

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

CURRICULUM & SYLLABI FOR

M. TECH. (STRUCTURAL ENGINEERING)

Regulations 2022

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MAE 6184	Probability and Matrix Theory	3	1	0	4
2.	CEE 6101	Advanced Design of Concrete Structures	3	1	0	4
3.	CEE 6102	Dynamics of Structures	3	1	0	4
4.	CEE 6103	Condition Assessment and Rehabilitation of Structures	3	0	0	3
5.	CEE 6104	Destructive and Non-Destructive Testing of Concrete	0	0	2	1
6.	ENE 6181	English for Career Development	1	1	0	2
7.		Professional Electives				**3**
		Credits				**21**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEE 6211	Finite Element Analysis in Structural Engineering	3	0	0	3
2.	CEE 6212	Earthquake Resistant Design of Structures	3	0	0	3
3.	GEE 6201	Research Methodology and IPR	2	0	0	2
4.	CEE 6213	Advanced Design of Steel Structures	3	1	0	4
5.	CEE 6214	Structural Modeling and Analysis Laboratory	0	0	2	1
6.		Professional Electives				**9**
		Credits				**22**

SEMESTER III

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

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEE 7101	Project Work - Phase II				18#
		Credits				**6+18 = 24**

Overall Total Credits - 78

* 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

Value-added course to be enrolled in the first or second semester.

PROFESSIONAL ELECTIVES

LIST OF ODD SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEEY 101	Advanced Concrete Technology	**3**	**0**	**0**	**3**
2.	CEEY 102	Design of Bridges	**3**	**0**	**0**	**3**
3.	CEEY 103	Design of Steel Concrete Composite Structures	**3**	**0**	**0**	**3**
4.	CEEY 104	Experimental Methods in Structural Engineering	**3**	**0**	**0**	**3**
5.	CEEY 105	Ground Improvement Techniques	**3**	**0**	**0**	**3**
6.	CEEY 106	Matrix Methods of Structural Analysis	**3**	**0**	**0**	**3**
7.	CEEY 107	Theory of Elasticity and Plasticity	**3**	**0**	**0**	**3**
8.	CEEY 108	Water Proofing of Concrete and Masonry Structures	**3**	**0**	**0**	**3**
9.	CEEY 109	Prefabricated Structures	**2**	**0**	**0**	**2**
10.	CEEY 110	Subsurface Exploration Techniques	**2**	**0**	**0**	**2**
11.	CEEY 111	3D Printing Concrete Technology	**1**	**0**	**0**	**1**

LIST OF EVEN SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEEY 201	Advanced Foundation Design	**3**	**0**	**0**	**3**
2.	CEEY 202	Corrosion Prevention and Control in RC Structures	**2**	**0**	**2**	**3**
3.	CEEY 203	Design of Industrial Structures	**3**	**0**	**0**	**3**
4.	CEEY 204	Optimization in Structural Design	**3**	**0**	**0**	**3**
5.	CEEY 205	Prestressed Concrete Structures	**3**	**0**	**0**	**3**
6.	CEEY 206	Stability of Structures	**3**	**0**	**0**	**3**
7.	CEEY 207	Structural Safety and Reliability	**3**	**0**	**0**	**3**
8.	CEEY 208	Tall Structures	**3**	**0**	**0**	**3**
9.	CEEY 209	Theory of Plates and Shells	**3**	**0**	**0**	**3**
10.	CEEY 210	Wind and Cyclone Effects on Structures	**2**	**0**	**0**	**2**
11.	CEEY 211	Fire Protection of Structures	**1**	**0**	**0**	**1**

MAE 6184	PROBABILITY AND MATRIX THEORY	L	T	P	C
SDG: 4		3	1	0	4

COURSE OBJECTIVES:

COB1 : To provide a comprehensive knowledge on the theory of probability and random variables.

COB2 : To familiarize with the various techniques to carry out the probability calculations and identify probability distributions.

COB3 : To impart knowledge on the multidimensional random variables.

COB4: To enable the students to understand the concepts in advanced matrix theory.

COB5: To provide sufficient knowledge on the importance of variational problems.

MODULE I PROBABILITY AND RANDOM VARIABLE 9+3

Axioms of probability – Addition and Multiplication theorem – conditional probability –Total Probability – Baye's theorem - Random variable – Probability mass function – Probability density functions – Properties – Expectation - Moments – Moments generating functions and their properties.

MODULE II STANDARD DISTRIBUTIONS 9+3

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions.

MODULE III MULTIDIMENSIONAL RANDOM VARIABLES 9+3

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

MODULE IV ADVANCED MATRIX THEORY 9+3

Matrix norms – singular value decomposition – QR algorithm – pseudo inverse – least square approximations.

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”, Fifth Edition, Elesvier 2016.
2. Richard A. Johnson, “Probability and Statistics for Engineers”, 8th Edition, Pearson Education, 2017.
3. T. Veerarajan, “Probability, Statistics and Random Processes”, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2008.
4. Lewis D W, “Matrix Theory”, Allied Publishers, Chennai 1995.
5. A. S. Gupta, “Calculus of variations with applications”, PHI Pvt. Ltd. New Delhi 2011.

REFERENCES:

1. Cramer.H., “Random Variables and Probability Distributions”, Cambridge University Press, (2004).
2. Elsgolts, “Differential Equations and Calculus of Variations”, University Press of the Pacific (2003).
3. Gupta S.C. and V. K. Kapoor, “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan Chand and Sons, 2014.
4. Roger A. Horn, Charles R Johnson , “Matrix Analysis”, Cambridge University Press, 2nd edition (2012).

COURSE OUTCOMES:

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

CO1: Solve fundamental problems on probability

CO2: Solve the probability problems using appropriate distributions.

CO3: Derive the probability mass / density function of a random variable and multiple correlations and regressions.

CO4: Find eigen values and eigenvectors of a higher-order matrix.

CO5: Solve problems of calculus of variations by direct method and using Euler’s formulae.

Board of Studies (BoS) :
14th BOS of Mathematics & AS held on 30.06.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L												H	
CO 2	M	L												H	
CO 3	M	L												H	
CO 4	M	M												H	
CO 5	M	M												H	

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

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

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

CEE 6101	ADVANCED DESIGN OF CONCRETE STRUCTURES	L	T	P	C
SDG: 9 ,11		3	1	0	4

COURSE OBJECTIVES:

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

COB2 : To provide exposure on 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 floor.

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

MODULE I TORSION IN BEAMS & LIMIT STATE OF SERVICEABILITY 9+3

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+3

Behaviour 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+3

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+3

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 BEAMS 9+3

Inelastic behaviour 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;T- 15;TOTAL HOURS –60

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) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	M	H										H	H	H
CO 2	M	M	H										H	H	H
CO 3	M	M	H										H	H	H
CO 4	M	M	H										H	H	H
CO 5	M	M	H										H	H	H

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

CEE 6102	DYNAMICS OF STRUCTURES	L	T	P	C
SDG: 9 &11		3	1	0	4

COURSE OBJECTIVES:

COB1 : To impart knowledge on the theory of vibrations and vibration parameters.

COB2 : To analys

e the dynamic forces caused by an earthquake.

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+3

Simple Harmonic motion-Longitudinal Vibrations Equation of motion- dynamic equation of motion- D'Alembert's principle- equivalent stiffness-Springs connected in series and parallel -frequency and period Amplitude of motion-Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems.

MODULE II SINGLE DEGREE OF FREEDOM SYSTEM 9+3

Free and Forced Vibration with and without Damping - Response to Harmonic Loading- - Underdamped, Overdamped and Critically damped- Logarithmic decrement.

MODULE III TWO DEGREE OF FREEDOM SYSTEM 9+3

Introduction- Concept of Shear Building- Free Vibration with and without damping - Forced Vibration with and without damping - Response to General Dynamic Loading using Duhamel's Integral.

MODULE IV MULTIPLE DEGREE OF FREEDOM SYSTEM 9+3

Multiple Degree of Freedom System - Orthogonality Principle - Equation of motion of multi degree of freedom with lumped and distributed mass-Stiffness, mass and damping matrices – Decoupling of Equations- Superposition method.

MODULE V DESIGN CONCEPTS AGAINST BLAST AND IMPACT 9+3

Characteristics of internal and external blast - Impact and impulse loads - pressure distribution on buildings above ground due to external blast - underground explosion -design principles of buildings for blast and impact as per BIS codes of practice.

L – 45;T- 15;TOTAL HOURS –60

REFERENCES:

1. Anil K. Chopra, “Dynamics of Structures: Theory and Applications to Earthquake Engineering”, Prentice Hall, Englewood Cliffs, New Jersy, 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. Hurty.W.C, Rubinstein. M.F, ”Dynamic of Structures”, Prentice Hall of India Pvt Ltd. New Delhi, 2002.
5. M. Y. H. Bangash, T. Bangash, “Explosion-Resistant Buildings: Design, Analysis, and Case Studies”, Springer –Verlag Berlin Heidelberg, Germany, 2006.
6. Donald O. Dusenberry, “Handbook For Blast-Resistant Design of Buildings”, John Wiley & Sons, Inc, 2010.

COURSE OUTCOMES:

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

CO1: Develop the mathematical modeling of dynamic systems using fundamental theory and equation of motion.

CO2 : Develop the equation of motion for single degree of freedom systems.

CO3 : Analyse the response of two degree freedom systems.

CO4 : Find the dynamic response of multi degree of freedom systems.

CO5 : Apply the design principles against blast and impact forces on buildings using BIS codes of practice.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	M	M										L	H	L
CO 2	H	M	M										L	M	L
CO 3	H	M	M										L	M	L
CO 4	M	M	M										L	M	L
CO 5	M	M	M										M	M	L

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

.

CEE 6103	CONDITION ASSESSMENT AND	L	T	P	C
SDG: 11	REHABILITATION OF STRUCTURES	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 concrete (RC) structures in the real time conditions.

COB2: condition assessment of distressed RC structures using NDT techniques

COB3: materials used in RC repair works

COB4: techniques used for rehabilitation of RC structures

COB5: seismic retrofitting cum rehabilitation of RC structures

MODULE I PHYSICAL AND CHEMICAL DETERIORATING MECHANISMS **9**

Durability of concrete – influencing parameters. Life cycle cost and sustainability. Physical deteriorating mechanisms: shrinkage & creep - abrasion – erosion – cavitation - freeze and thaw – thermal incompatibility – high temperature variations. Chemical deteriorating mechanisms: alkali silica reaction – leaching - acid attack – sulphate attack – corrosion of steel rebar in RC (chloride penetration and carbonation) – microbial induced corrosion – effluent gases from industries.

MODULE II CONDITION ASSESSMENT OF RC STRUCTURES USING NDT **9**

Condition assessment: significance and objectives – various stages – preliminary inspection – planning – visual inspection – laboratory and field testing. Non-Destructive techniques for condition assessment: overview – Rebound hammer test, ultrasonic pulse velocity test, concrete resistivity, covermeter, concrete core test, half-cell potential test, tests for carbonation, chemical analysis (chloride and sulphate content), tests for assessing fire damage in concrete structures. Condition assessment of distressed building: case study – report preparation.

MODULE III MATERIALS FOR REPAIR **9**

Repair materials – Factors influencing selection of repair materials – various stages of concrete repair – importance of surface preparation – bond coat – rust convertors – rust removers - protective coating to steel rebars - superplasticizers – corrosion inhibitor admixed concrete – micro concrete - polymer modified mortar / concrete – carbon fiber sheets – grouting agents - concrete coatings - sacrificial anodes.

MODULE IV TECHNIQUES FOR REHABILITATION OF RC ELEMENTS **9**

Rehabilitation techniques – overview, significance and selection methods – dry pack method – overlays – preplaced aggregate concrete - pressure grouting– RC jacketing technique – Plate bonding technique – FRP jacketing technique – prestressing technique - ferrocement – guniting and shotcrete – techniques for repairing cracks – sacrificial anode cathodic protection.

MODULE V CASE STUDIES ON RETROFITTING AND REHABILITATION OF RC STRUCTURES **9**

Seismic retrofitting of G+4 building: analysis for higher seismic level – revised member dimensions and steel requirement – retrofitting strategy. Case study on rehabilitation of : dampness in buildings, leaky sunken slab, distressed roof slab, overhead RC water tank, corrosion damaged RC bridge, fire damaged building, damaged industrial floors etc.

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.
9. FEMA 273; NEHRP Guidelines for the Seismic Rehabilitation of Buildings, 2005.
10. ATC – 40: Seismic Evaluation and Retrofit of Concrete Buildings, Vol. 1 & 2, 2005.

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

CO1: under the physical and chemical deteriorating mechanisms detrimental to the RC structures.

CO2: perform conditions assessment of distressed building using NDT

CO3: suggest materials for different repair works

CO4: identify the suitable repair techniques for rehabilitation of RC elements

CO5: suggest procedure for rehabilitation and retrofitting of RC structures.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1							M								H
CO2							M								H
CO3							M								M
CO4							M				M				M
CO5					H		M				M				H

Note: L- Low Correlation M -Medium Correlation H -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 during its life time.
2. Make the existing human settlements safe and resilient by performing condition assessment using NDT and by adopting suitable repair techniques for its rehabilitation including seismic retrofitting.

CEE 6104	DESTRUCTIVE AND NON-DESTRUCTIVE TESTING OF CONCRETE	L	T	P	C
SDG: 9 , 11		0	0	2	1

COURSE OBJECTIVES:

COB1 : To enable the students to understand the design of concrete mix by various codal provisions and conduct the tests on fresh concrete properties

COB2 : To gain knowledge on the strength and durability properties of concrete by conducting various tests.

COB3 : To expand the knowledge on the non-destructive tests on concrete.

COB4: To examine the behaviour of concrete beams under flexural loading.

MODULE I MIX DESIGN OF CONCRETE & FRESH CONCRETE PROPERTIES **5**

Mix design of concrete as per Codal Provisions - Fresh concrete properties

MODULE II STRENGTH & DURABILITY TESTS ON CONCRETE **10**

Correlation between cube strength, cylinder strength, splitting tensile strength and modulus of rupture - Study of stress - strain curve for concrete & steel - Determination of Young's modulus - Durability Tests on Concrete – RCPT, sorptivity test, permeability test.

MODULE III NON-DESTRUCTIVE TESTS ON CONCRETE **7**

Rebound Hammer method – Ultrasonic pulse velocity method

MODULE IV TESTING OF REINFORCED CONCRETE BEAMS **8**

Behavior of Reinforced Concrete Beams under flexure loading using Data logger, LVDT, Strain gauges and load cell

P – 30; TOTAL HOURS – 30

REFERENCES:

1. Lea, "Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017.
2. Mehta and Monteiro, "Concrete- Micro Structure, Properties and Materials", McGraw Hill Professional, 2017.

3. Neville A. M. and Brooks J. J., “Concrete Technology”, Pearson Education, 2019.
4. Neville A.M., "Properties of Concrete”, Trans-Atlantic Publications, Inc.; 5e, 2016
5. Santhakumar.R. “Concrete Technology”, Oxford Universities Press, 2018.
6. Shetty, M. S., “Concrete Technology”, S. Chand & Co., 2018.

COURSE OUTCOMES:

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

CO1: Perform the mix design of normal & high strength grade concrete and investigate the fresh concrete properties.

CO2: Assess the various properties of hardened concrete by conducting the strength and durability tests.

CO3: Evaluate the concrete structure by conducting the non-destructive tests.

CO4: Apply the engineering techniques to test & study the behaviour of concrete beams.

Board of Studies (BoS) : 17th BoS of Civil held on 10.08.2022

Academic Council: 19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1			H	H									H	L	H
CO 2			H	H									H	L	H
CO 3			H	H									H	L	H
CO 4			H	H									H	L	H

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 : Designing of durable concrete by properly understanding the properties of concrete constituent materials, expected strength, exposure conditions and application.

ENE 6181	ENGLISH FOR CAREER DEVELOPMENT	L	T	P	C
SDG: 4 , 8		1	1	0	2

COURSE OBJECTIVES:

COB1: To enable students to learn about the job search, application, and interview process

COB2: To give them an opportunity to explore their global career path, build vocabulary and improve language skills to achieve professional goals

COB3: To produce a professional-looking resume

COB4: To understand networking and interview skills

COB5: To understand the key skills and behaviors required to facilitate a group discussion

MODULE I ENTERING THE JOB MARKET 3+2

Introduction to the Career Development -Job Search Overview-Identifying Your Interests and Skills

Language Focus: Vocabulary and Word Forms Related to Jobs-Choosing the Job that's the Best Fit

Language Focus: Verb Tenses (Present vs. Present Progressive) Understanding Job Descriptions: Reading a Job Advertisement

Language Focus: Phrases to Compare Similarities

Online Learning Opportunities to Extend Your Skills

MODULE II RESUMES 3+2

What is a resume? Why do you need one?

Parts of a Resume-Writing a Resume, Part 1: Name and Contact Information

Listening: Connecting Employers with Job Seekers in Today's Economy

Language Focus: Key Words

Writing a Resume, Part 2: Headline and Summary

Writing a Resume, Part 3: Work Experience

Writing a Resume, Part 4: Education

Language Focus: Action Verbs

Writing a Resume, Part 5: Complete your Resume

MODULE III WRITING A COVER LETTER 3+2

What is a Cover Letter?

Professional Writing: Letter Format

Cover Letter: Paragraph 1- Introducing Yourself

Cover Letter: Paragraph 2- Highlighting Your Skills in the Cover letter

Cover Letter: Paragraph 3- Closing

Language Focus – Present Perfect vs. Past Tense
Professional Writing: Level of Formality
Language Focus: Using Modal Verbs to Write politely
Writing a Cover Letter for a Specific Job

MODULE IV INTERVIEWING FOR A JOB 3+5

Overview of the Job Interview: Answering Typical Interview Questions
Language Focus: Asking for Clarification in an Interview-
Sample Interview: Do's and Don'ts Part 1
Sample Interview: Do's and Don'ts Part 2
Sample Video: Responding to an Interview Question

MODULE V GROUP DISCUSSION 3+4

Introduction to Group Discussion - Participating in group discussions – understanding group dynamics - brainstorming the topic - questioning and clarifying - GD strategies- activities to improve GD skills

L - 15, T - 15; TOTAL HOURS - 30

REFERENCES:

1. R. Byrne, D. Teaching Oral Skill. London: Longman. 1975.
2. Byrne, D.Teaching Writing, London: Longman. 1975.
3. Rani Asoka, DeviVimala. English for Career development: ACourse in Functional English. Orient Longman Pvt. Ltd., India,2004.
4. Anderson, K., Maclean, J. & Lynch, T. Study speaking: A Course in Spoken
5. English for Academic Purposes. Cambridge University Press, UK, 2004.
6. Withrow, J., Brookes, G.& Cummings, M.C.Inspired to write. Reading and Tasks to Develop Writing Skills. Cambridge University Press, U.K., 2004.
7. Shinde, Maithry etal.Life Skills & Personality Development, Cambridge University Press India Pvt. Ltd, New Delhi
8. Fernandez, Agna Generic Skills for Employability, Cambridge University Press India Pvt. Ltd, New Delhi

COURSE OUTCOMES:

CO1: Identify the steps in the job search process

CO2: Describe themselves and their experiences in a résumé

CO3: Build their job-related vocabulary

CO4: Write a clear cover letter that tells employers why they are the right person for the job

CO5: Take part in Group discussion confidently.

Board of Studies (BoS) :
15thBoS of the Department of English held on 14.6.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1									H	H		H	L	L	L
CO2									H	H		H	L	L	L
CO3									H	H		H	L	L	L
CO4									H	H		H	L	L	L
CO5									H	H		H	L	L	L

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

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

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

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

SEMESTER – II

CEE 6211	FINITE ELEMENT ANALYSIS IN	L	T	P	C
SDG: 9 , 11	STRUCTURAL ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the fundamental concepts of finite element method.

COB2: To impart knowledge on the matrix techniques and concepts of one, two and higher order elements.

COB3: To understand the concepts of mesh generation and providing solutions to the critical problems.

MODULE I FUNDAMENTAL CONCEPTS **9**

Stresses and equilibrium – Boundary conditions – strain displacement relations – stress- strain relations – potential energy and equilibrium – weighted integral and weak formulation – variational approach – Rayleigh Ritz method – Galerkin method**.**

MODULE II ONE DIMENSIONAL ELEMENT FORMULATION **9**

Types of an element –Convergence Criteria- derivation of Elemental Equations – coordinates and shape functions – Assembly of global stiffness matrix and global load vector – treatment of boundary conditions.

MODULE III TWO DIMENSIONAL ELEMENT FORMULATION **9**

Types of triangular element -constant strain triangle – Linear strain triangle - Geometry Invariance- stress calculations.

MODULE IV HIGHER ORDER ELEMENT FORMULATION **9**

Rectangular Elements -Isoparametric elements - Lagrange and serendipity elements- Introduction to finite element software

MODULE V MESHING AND SOLUTION PROBLEMS **9**

Pre and post processor interpretations - p and h methods of refinement - ill conditioned elements - discretisation errors – patch test - auto and adaptive mesh generation techniques - Gaussian Formulation-Static Condensation.

L- 45; TOTAL HOURS – 45

REFERENCES:

1. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. “Concepts and Applications of Finite Element Analysis”, Wiley Students Edition, 2004.
2. David V. Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition, 2005.
3. Krishnamoorthy, C.S, “Finite Element Analysis Theory and Programming”, Tata McGraw Hill Publishing Co.Ltd. New Delhi 2004.
4. Reddy, J.N, “An Introduction to the Finite Element Method”, McGraw Hill International Edition, New York, 3rd edition, 2008.
5. Seshu, P., “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
6. Tirupathi R. Chandrupatla, Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India, New Delhi, 2007.

COURSE OUTCOMES:

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

CO1: Solve the boundary value problems using approximate methods**.**

CO2: Derive the elemental equations and shape function for one and two dimensional elements.

CO3: Derive the elemental equations and shape function for two dimensional elements.

CO4: Generate the isoparametric functions for various elements.

CO5: Describe the mesh refinement and Gaussian formulation.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	H											L	H	L
CO 2	H	H											L	H	L
CO 3	H	H											L	H	L
CO 4	H	H											L	H	L
CO 5	H	H											L	H	L

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

CEE 6212	EARTHQUAKE RESISTANT DESIGN	L	T	P	C
SDG: 9 ,11	OF STRUCTURES	3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the phenomena of earthquakes and its measurements and factors that affect the design of structures in seismic areas.

COB2: To impart knowledge on the fundamentals of load calculation for various structural systems, design and detailing aspects of structures subjected to earthquake loading.

COB3: To provide insight knowledge on the seismic retrofitting techniques and response control system of structures

MODULE I ENGINEERING SEISMOLOGY **9**

Introduction to engineering seismology – plate tectonics- faults- causes of earthquake-- Seismic waves - Liquefaction – Evaluations & its Mitigation- Seismic Bearing Capacity of Foundations - Magnitude of earthquake – Intensity-measurement – seismographs – Characteristics of strong ground motions - seismic zones of India.

MODULE II SEISMIC DESIGN CONCEPTS **9**

Earthquake load on simple buildings – load path – floor and roof diaphragms – seismic resistant building architecture – plan configuration – vertical configuration – pounding effects – mass and stiffness irregularities – Flexible Building and Rigid Building Systems- torsion in structural system

MODULE III SEISMIC METHODS OF ANALYSIS **9**

Philosophy and Principles of earthquake.-resistant design- Design earthquake loads-– Seismic Methods of Analysis – seismic co-efficient method – response spectrum analysis - factors in seismic analysis – Modal Analysis – Time History Method.

MODULE IV SEISMIC BEHAVIOUR & DESIGN OF STRUCTURES **9**

Behaviour of unreinforced and reinforced masonry walls – Behaviour of Infill walls – Improving seismic behaviour of masonry buildings – earthquake resistant design of RC members – beams – columns –joints of frames – slabs – staircases – behavior & design of shear walls – steel frames – steel panel zones – bracing members–connection design and joint behaviour.

MODULE V SEISMIC RESTORATION & RESPONSE CONTROL SYSTEMS **9**

Seismic restoration techniques - Damages in structures - repair materials for seismic strengthening - retrofitting techniques - response control systems - base isolation - Active, Passive, Semi- active & hybrid systems.

L- 45; TOTAL HOURS – 45

REFERENCES:

1. Anil K.Chopra, “Dynamics of Structures Theory and Applications to Earthquake Engineering”, Prentice Hall of India (P) Ltd., New Delhi, 2nd Edition, 2015.
2. Datta T.K., “Seismic Analysis of Structures”, John Wiley & Sons, 2010.
3. Duggal S.K., “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.
4. Paulay.T and Priestly. M.N.J., “Aseismic Design of Reinforced Concrete and Masonry Building”, John Wiley and Sons, 2007.

COURSE OUTCOMES:

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

CO 1 : identify the types of seismic waves, measure the magnitude of earthquake and describe the characteristics of ground motion.

CO2: Describe the conceptual design of the structural systems against the lateral load.

CO 3 : Perform seismic analysis of structures by using various methods.

CO 4 : Describe the seismic behaviour and design the masonry, RC and steel buildings.

CO 5 : Suggest suitable retrofitting and strengthening methods for structural members and describe the seismic base isolation & passive energy dissipation for seismic response control of civil engineering structures

Board of Studies (BoS) :	**Academic Council:**
17th BoS of Civil held on 10.08.2022	19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	H									H	L	L
CO 2	H	M	H	H									H	L	L
CO 3	H	M	H	H									H	L	L
CO 4	M	M	H	H									H	L	L
CO 5	M	M	H	H									H	L	L

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 : Earthquake Resistant Design of structures is more essential to ensure safe and sustainable building..

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

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To analyze the research design, information retrieval and problem formulation techniques.

COB3: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB4: To execute the effective communications of research findings and apply the ethics in research.

COB5: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

PREREQUISITES:

- Basics of core engineering, probability and statistics.
- Basics of flowchart and algorithm techniques.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN **6**

Research - objectives – types - Research process, solving engineering problems - Identification of research topic - Formulation of 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 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- Spreadsheet tool - Basic principles of Statistical Computation. Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES **8**

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 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.
6. Prabhuddha Ganguli. ”Intellectual Property Rights”. 1st Edition, TMH Publishers, 2012.

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:

CO1: Formulate the research problem

CO2: Design and Analyze the research methodology

CO3: Apply statistical techniques for hypothesis construction

CO4: Analyze and interpret the data to construct and optimize the research hypothesis

CO5: Report the research findings as publications, copyright, trademarks and IPR

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		H		H				H			H		M	M	M
CO2		H		H				H			H		M	M	M
CO3		H		H				H			H		M	M	M
CO4		H		H				H			H		M	M	M
CO5		H		H				H			H		M	M	M

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

CEE 6213	**ADVANCED DESIGN OF STEEL STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 9 &11		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To impart sufficient knowledge to students on various codal provisions for steel structural design.
COB2: To offer knowledge to analyse and design different types of bolted and welded connections; industrial structural members; cold formed structural elements; and special structures such as chimney etc.
CO3: To give exposure to students on plastic analysis of structures.

MODULE I DESIGN OF CONNECTIONS 9+3

Types of connection - importance - codal provisions as per IS: 800 - behaviour and design of bracket connection - unstiffened and stiffened seated connections – framed connections - connections for force and moment transmission – tee stub and end plate connections - stiffeners and other reinforcement.

MODULE II PLASTIC ANALYSIS OF STRUCTURES 9+3

Introduction - concepts of plastic design - shape factor - redistribution of moments plastic collapse load - conditions of plastic analysis - methods of plastic analysis plastic design of portal frames – problems. Connections - requirement - design of straight and haunched connections.

MODULE III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 9+3

Review of loads on structures - dead, live wind and seismic loads as per standards - requirements of industrial buildings - structural framing - braced frames & unbraced frames - analysis and design of Industrial building components such as roof truss, rafter bracing, purlin, eave girder, stanchions, gable column and bents - analysis and design of gable frames - design of moment resisting baseplates.

MODULE IV ANALYSIS AND DESIGN OF COLD–FORMED STEEL STRUCTURES 9+3

Types of cross sections – concepts of local buckling and effective width – codal provisions as per IS : 801 - analysis and design of unstiffened and stiffened compression elements - design of webs of beams - design of flexural members - economic design for beam strength - concept of lateral buckling of beams -

concept of lateral bucking and bracing requirement – concept of shear lag and flange curling - design of compression members - design of wall studs and connection details.

MODULE V DESIGN OF ALUMINUM & TUBULAR STRUCTURES 9+3

Design of Aluminum Structures: Introduction – Stress-strain relationship – Permissible stresses – Tension members – Compression members – Laced and battened columns – Beams – Local buckling of elements of compression –Riveted and bolted connections. Design of tubular structures – Design of tension and compression members, Connections, truss configurations, space structures.

L – 45 T- 15;TOTAL HOURS –60

REFERENCES:

1. W.F. Chen, E.M. Lui, Principles of Structural Design, CRC Press, 2005
2. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2010.
3. Wei-Wen Yu, Cold-Formed Steel Design, John Wiley & Sons, 2000.
4. Ramchandra, S., Design of Steel Structures, Vol.-II, Standard Publications, New Delhi, 2010.
5. Subramanian N, Steel Structures - Design and Practice, Oxford University Press, 2011.
6. Duggal S.K., Design Of Steel Structure, Tata McGraw-Hill Education, 2009.

COURSE OUTCOMES:

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

CO1:design connections for the expected shear force and bending moment

CO2:describe the concepts of plastic design, methods of plastic analysis and plastic collapse mechanism.

CO3:design components of industrial building such as roof truss, purlins, columns, bracing based on application requirement.

CO4:analyse and design cold formed flexural members, compression members and wall studs.

CO5: Design the tension and compression members of aluminum & tubular structures

Board of Studies (BoS) : 17th BoS of Civil held on 10.08.2022

Academic Council: 19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1													H		M

CO2													H		M
CO3													H		M
CO4													H		M
CO5													H		M

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

CEE 6214	STRUCTURAL MODELLING AND ANALYSIS LABORATORY	L	T	P	C
SDG: 9 &11		0	0	2	1

COURSE OBJECTIVES:

COB1: To gain knowledge on the analysis of concrete and steel structures using STAAD Pro software.

COB2: To impart knowledge on the modelling of a residential building using BIM and analyse through STAAD Pro software.

MODULE I ANALYSIS OF RC BUILDING USING STAAD PRO SOFTWARE **7**

Analysis of RC building - Design of foundation for the RC building

MODULE II ANALYSIS OF STEEL STRUCTURES USING STAAD PRO SOFTWARE **7**

Analysis of steel structure - Design of foundation for the structure

MODULE III INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM) **7**

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

MODULE IV DESIGN Of A RESIDENTIAL BUILDING **9**

Annotate the model with 2D drafting elements and access building information from the building model's database - Creating and editing architectural & structural floor - Creating new material - Developing ceiling plan, adding ceiling, hosted components, interior space planning, developing interior 3D image using camera & rendering.

P -30; TOTAL HOURS –30

REFERENCES:

1. T.S.Sarma, Staad Pro v8i for beginners, Notion Press, 2014

2. Hardin, B., & McCool, D., BIM and construction management: proven tools, methods, and workflows.John Wiley & Sons, 2015

3. Issa, R. R., & Olbina, S. (Eds.)., Building Information Modeling: Applications and Practices, American Society of Civil Engineers,2015

4. Krygiel, E., & Nies, B., Green BIM: successful sustainable design with building information modeling, John Wiley & Sons, 2008.

COURSE OUTCOMES:

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

CO1: analyse the reinforced concrete buildings using STAAD Pro software.

CO2 : analyse the steel buildings using STAAD Pro software.

CO3 :understand concepts of Building Information Modeling.

CO4 :design a building structure using software

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1			H	H									H	H	L
CO 2			H	H									H	H	L
CO 3			H	H									H	H	L
CO 4			H	H									H	H	L

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

CEE 7102	**INTERNSHIP**	L	T	P	C
SDG: 9 &11					**2**

GENERAL GUIDELINES :

- It is one credit for one month of internship.
- Internship shall be of not less than 30 days duration
- Students should choose preferably, government agencies/ IIT's/ NIT's /major industries in their specialization to do their internship
- At the end of industrial internship, the student shall submit a certificate and feedback from the organization. Students should also submit a brief report.
- The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

Board of Studies (BoS) :	**Academic Council:**
17th BoS of Civil held on 10.08.2022	19th AC held on 29.09.2022

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 the need for sustainable and resilient infrastructure, in the real time context, without compromising innovation and safety aspects.

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PROFESSIONAL ELECTIVES - ODD SEMESTER

CEEY 101	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: usage of mineral and chemical admixtures in concrete

COB2: mechanism of corrosion of steel rebar in concrete and protection methods

COB3: ready-mix concrete and self-compacting concrete

COB4:polymer modified concrete, fiber reinforced concrete and pervious concrete

MODULE I MINERAL ADMIXTURES IN CONCRETE 9

Supplementary cementitious materials : source, significance and overview. Flyash (different classes), silica fume, metakaoline, blast furnace slag, rice husk, titanium-di-oxide : 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 CORROSION OF STEEL REBARS IN REINFORCED CONCRETE 9

Mechanism of corrosion of steel in concrete – causes and influencing parameters –Carbonation, chloride attack, microbial induced corrosion and acid attack: deteriorating mechanism - consequences of corrosion in reinforced concrete and pre-stressed concrete structures - Corrosion protection methods: overview - Protective coating to steel rebars: fusion bonded epoxy coating, galvanization and cement polymer anticorrosive coating – sacrificial anode cathodic protection – concrete coatings : types and materials – corrosion inhibitors – types – working mechanism.

MODULE IV READY MIX CONCRETE AND SELF COMPACTING CONCRETE **9**

Ready mix concrete: ingredients, mix proportion, mix design, manufacturing process and good construction practices. Self compacting concrete: ingredients, mix design as per EFNARC guidelines, workability requirements of SCC : Abrams cone, J-ring, V-funnel, L-box and U-box, good construction practices and application areas.

MODULE V SPECIAL CONCRETES : POLYMER MODIFIED CONCRETE, FIBER-REINFORCED CONCRETE AND PERVIOUS CONCRETE **9**

Polymer modified mortar / concrete: Types of polymers – working mechanism in cementitious systems - influence on fresh mortar / concrete, hardened mortar / concrete, microstructure, transport mechanism and durability properties – applications areas. Fiber-reinforced concrete : types of fibers – working mechanism – influence on fresh, hardened and durability properties – application areas. Pervious concrete: significance, manufacturing, properties and 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.

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, students will be able to

CO1: understand the significance of addition of mineral admixtures in concrete for varied applications.

CO2: suggest the chemical admixtures for real time applications

CO3: describe the manufacturing of ready-mix concrete

CO4: perform mix design of self-compacting concrete as per EFRAC standards

CO5: describe mechanism of corrosion in concrete and suggest protection measures

CO6: describe procedure for manufacture of polymer modified concrete, fiber-reinforced concrete and pervious concrete including its application areas.

Board of Studies (BoS) : 17th BoS of Civil held on 10.08.2022

Academic Council: 19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1							M								H
CO2							M								H
CO3							M								M
CO4							M				M				M
CO5					H		M				M				H
CO6					H					M	M				H

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

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

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

CEEY 102	DESIGN OF BRIDGES	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on types of bridges, need for investigation, load distribution theories, IRC specification for road bridges and design of short span bridge.

COB2: To develop an understanding of the behavior and design of long span bridges, prestressed concrete bridges.

COB3: To give exposure to design principles of plate girder bridges, steel truss bridges, types of bearings and design of sub structures.

MODULE I INTRODUCTION AND SHORT SPAN BRIDGES 9

Components of bridge - Need for investigation- types of bridges and loading standards - Materials of construction- investigation and planning - choice of type - I.R.C. specifications for road bridges - general design considerations - load distribution theories - Design of RCC solid slab bridges- analysis and design of slab culverts, T-beam, deck slab and cantilever slab.

MODULE II LONG SPAN BRIDGES 9

Design principles of continuous bridges - box girder bridges - balanced cantilever bridges - Cable stayed bridge.

MODULE III PRESTRESSED CONCRETE BRIDGES 9

General aspects-types of prestressed concrete bridges - typical cross section detailing - over view of design principles of prestressed concrete - pre-tensioned prestressed concrete bridge - post-tensioned prestressed concrete bridge - design of post-tensioned prestressed concrete slab bridge deck and T-beam.

MODULE IV STEEL BRIDGES 9

Types of plate girder bridges - 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 FOUNDATION FOR BRIDGES 9

Bridge bearings – types - design principles – design of steel rocker bearing. – Design of piers and abutments of different types – bridge foundation– Types of bridge foundations – design of well foundation – design of pile foundation.

L-45; TOTAL HOURS – 45

REFERENCES:

1. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., New Delhi,2010.
2. Petros P. Xanthakos, " Theory and Design of Bridges", .John Wiley & Sons, 2007.
3. Hambly, E.C., Bridge Deck Behaviour, Chapman and Hall. (1991).
4. T.R. Jagadeesh and M.A. Jayaram, “Design of Bridge Structures,” Prentice-Hall of India, New Delhi, 2006.
5. Ponnuswamy, Bridge Engineering, Tata McGraw-Hill Education, 2008.
6. Johnson Victor D., "Essentials of Bridge Engineering", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, 2008.
7. Raina. V. K “Concrete Bridge Practice Analysis, Design and Economics”, 4th Edition, Shroff Publishers and Distributors Pvt. Ltd., 2014)

COURSE OUTCOMES:

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

CO1: Design slab culverts and T-beam bridge superstructure for the IRC loading conditions.

CO2: Describe the design principles of continuous bridges, box girder, balanced cantilever bridges and arch bridge for its use in real time conditions

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 IRS loading conditions. design bearing and substructure for pile foundation and well foundation as per IRC.

Board of Studies (BoS) : 17th BoS of Civil held on 10.08.2022

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1													H		M
CO2													H		M
CO3													H		M
CO4													H		M

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

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

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.

CEEY 103	**DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 9 & 11		**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 - introduction to steel-concrete - steel sandwich construction.

MODULE II DESIGN OF COMPOSITE MEMBERS **9**

Behaviour of composite beams - columns - design of composite beams - steel - concrete composite columns - design of composite trusses.

MODULE III DESIGN OF CONNECTIONS **9**

Types of connections - design of connections in the composite structures - shear connections - design of connections in composite trusses.

MODULE IV COMPOSITE BOX GIRDER BRIDGES **9**

Introduction - behaviour of box girder bridges - design 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

REFERENCES:

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.

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 beams and columns

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) :
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Academic Council:
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1			H	H									H	L	L
CO 2			H	H									H	L	L
CO 3			H	H									H	L	L
CO 4			H	H									H	L	L
CO 5			H	H									H	L	L

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: The holistic understanding of design concepts of steel and concrete composite structures is more essential to ensure safe and sustainable buildings.

		L	T	P	C
CEEY 104	**EXPERIMENTAL METHODS IN STRUCTURAL ENGINEERING**				
SDG: 9 ,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

The objectives of the course are :

COB1: To impart knowledge on the similitude principles and model analysis that governs the design, testing and interpretation of models.

COB2: To provide sufficient knowledge on the various aspects of elastic and inelastic models of various materials.

COB3: To impart sound knowledge on the various model fabrication techniques and emphasis on instrumentation techniques.

CO4: To impart sound knowledge on the various types of loads acting on the structures.

MODULE I THEORY OF STRUCTURAL MODELS 7

Dimensions and Dimension Homogeneity - Dimensional Analysis - Structural Models- Similitude requirements-Physical Modeling and choice of geometric scale-Modeling process-Advantages and limitation of Model Analysis-Accuracy of Structural Models.

MODULE II MATERIALS FOR ELASTIC AND INELASTIC MODELS 9

Materials for elastic models-Plastics-Time effects in Plastics-effect of loading rate, temperature and environment-Inelastic models – Prototype and model concretes-design mixes for model concrete-structural steel models-reinforcement for small scale concrete models – Model prestressing reinforcement and techniques - Bond characteristics of model steel - bond similitude.

MODULE III MODEL FABRICATION TECHNIQUES 9

Basic cutting, shaping and machining operation-basic fastening and gluing techniques- Construction of structural steel models-Construction of concrete models-Fabrication of concrete masonry models-Construction of Plastic Models - size effects, accuracy, and reliability in materials systems.

MODULE IV INSTRUMENTATION- PRINCIPLES AND APPLICATIONS 9

Quantitiestobemeasured-strainmeasurements-mechanicalstraingauges,electrical strain gauges-Displacement measurements-mechanical dial gauges, Linear Variable differential transformer, linear resistance potentiometers - Full field strain measurement and crack detection methods-brittle coating-photo elastic coating,

other crack detection methods-Stress and Force Measurements- load cells, embedded stress meters and plugs-Data Acquisition and reduction-types of data recording, various data acquisition systems-Introduction on fibre optic sensors for smart structures.

MODULE V STRUCTURAL MODEL TESTING 11

Types of loads - discrete vs distributed loads- flexural and axial test on structural members - Application of NDT for quality assessment and damage detection of structures and materials- Statistical quality control - Materials for dynamic models - properties of steel and concrete- Loading systems for dynamic modeling- vibration and resonant testing, wind tunnel testing, shock tubes and blast chambers, shaking tables, drop hammers and impact pendulums – Case studies - shaking table tests on buildings.

TOTAL HOURS –45

REFERENCES:

1. Bungey, J.H., S.G. Millard, S.G and Grantham, M.G., “Testing of Concrete in Structures”, CRC Press, 4th Edition, 2014.
2. Harry, G. Harris and Gajanan M. Sabnis, “Structural Modeling and Experimental Techniques” Second Edition, CRC Press, 2010.
3. Malhotra and Carino, “Handbook of Nondestructive Testing of Concrete”, CRC Press, 2004.

COURSE OUTCOMES:

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

CO1: Describe the similitude principles and model analysis that governs the design, testing and interpretation of models.

CO2: Prepare the elastic and inelastic model for various types of materials, which facilitate to the study their behaviour

CO3: Develop the techniques for fabricating small-scale structural models.

CO4: Identify the correct type of instrument and sensor design for a particular experimental measurement application and match this instrument with a signal conditioning and data acquisition system to obtain an integrated measurement.

CO5: Conduct flexural and axial test on structural members

Board of Studies (BoS) :	**Academic Council:**
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			M	H									H	L	L
CO2			M	H									H	L	L
CO3			M	H									H	L	L
CO4			M	H									H	L	L
CO5			M	H									H	L	L

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 : The holistic understanding of structural model testing through experimental methods is more essential to ensure safe and sustainable buildings

CEEY 105	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
SDG: 9 ,11		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the various ground improvement methods based on soil type.

COB2: To impart knowledge on the selection, design, and Construction aspects of ground improvement techniques in problematic soils.

COB3: To understand the methods and properties of reinforced soil

COB4: To provide sufficient knowledge on the basic concepts of geosynthetics.

MODULE I INTRODUCTION 9

Role of ground improvement in foundation engineering – methods of ground improvement – Ground Improvement – Potential – Hazardous ground conditions, poor ground conditions, favorable ground conditions, Alternative Approaches, Geotechnical Processes – Selection of suitable ground improvement techniques based on soil condition.

MODULE II HYDRAULIC MODIFICATION 9

Drainage techniques – well points – Vaccum and electro osmotic methods – seepage analysis for two dimensional flow – fully and partially penetrating slots in homogenous deposits (Simple cases only).

MODULE III MECHANICAL MODIFICATION 9

Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro- floatation, Blasting, Dynamic consolidation, pre- compression and compaction piles, Field compaction control and geo material replacement concept.

MODULE IV EARTH REINFORCEMENT 9

Reinforce earth- principles – components of reinforced earth – design principles of reinforced earth walls – stability checks – soil nailing.

MODULE V GEOSYNTHETICS 9

Geo – synthetics – Geo – textiles – types – functions, properties and applications – Geogrids, Geo- membranes and gabions – properties and applications. Grouting – objectives of grouting – grouts and their applications – methods of grouting – stage of grouting – hydraulic fracturing in soils and rocks – post grout tests.

L - 45; TOTAL HOURS – 45

REFERENCES:

1. Das, B.M, “Principles of Foundation Engineering”, Thomson Brooks Cole, USA. 2003.
2. R.M. Korner, “Design with Geosynthetics”, Prentice Hall, New Jersy, 3rd Edition 2002.

COURSE OUTCOMES:

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

CO1: Assess the properties of problematic soil and necessity of different ground improvement.

CO2: Explain the process of dewatering and assess the soil strength.

CO3: Analysis the various available mechanical methods to strengthen soil.

CO4: Effectively utilize different earth reinforcement materials and understand various available methods.

CO5 : Describe the concept of geosynthetics of ground improvement

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1							L				M	L	L	L	L
CO 2	L		M			M			M	L			L	L	L
CO 3	L		M			M	M		M	M		M	L	L	L
CO 4			M						M	M	L	L	L	L	L
CO 5			M			M			M	M	L		L	L	L

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 : The holistic understanding of various techniques for ground improvement is more essential to ensure safe and sustainable buildings.

CEEY 106	**MATRIX METHODS OF STRUCTURAL ANALYSIS**	**L**	**T**	**P**	**C**
SDG: 9 ,11		**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 an in-depth analytical knowledge on the physical interpretation of stiffness matrices to assemble stiffness matrices.

MODULE I FUNDAMENTAL CONCEPTS AND TRANSFORMATION **9**

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**

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**

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**

Static condensation technique – substructure technique - transfer matrix method – symmetry & anti symmetry of structures – reanalysis technique.

MODULE V DIRECT STIFFNESS METHOD **9**

Discrete system – direct stiffness approach – application to two and three dimensional pin-jointed trusses - plane frames grids–three dimensional space frames.

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: Extend the direct stiffness method for three dimensional framed structure

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M											M	H	L
CO2	H	M											M	H	L
CO3	H	M											M	H	L
CO4	H	M											M	H	L
CO5	H	M											M	H	L

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

CEEY 107	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
SDG: 9 &11		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the general features of elastic systems and analyse two-dimensional state of stresses and strains

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

COB3: To understand the fundamental concepts to solve problems in structural members by various energy methods.

CO4: To provide sufficient background on the theory of plasticity

MODULE I ANALYSIS OF STRESS & STRAIN 9

Basic 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 - Lame'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 free end - bending of a beam by uniform load - Equation of Equilibrium in polar coordinates - Two dimensional problems in polar coordinates for curved beam, thick cylinders and plate with holes.

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- Griffith’s theory of rupture - Castigliano’s theorem - Principle of least work.

MODULE IV TORSION OF VARIOUS SHAPED BARS 9

Torsion of straight bars–elliptic cross section- Saint Venant’s theory–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) - Prandle Reuss equation - Levy Mises equation – Lower bound, upper bound and uniqueness Theorems - Application to simple problems in tension – compression - Solution of elasto-plastic 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: Analyse the structural members by various energy methods.

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

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M										L	H	L
CO2	H	M	M										L	H	L
CO3	M	M	M										L	H	L
CO4	M	M	M										L	H	L
CO5	M	M	M										L	H	L

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 : The holistic understanding of theory of elasticity and plasticity is more essential to ensure safe and sustainable buildings..

CEEY 109	PREFABRICATED STRUCTURES	L	T	P	C
SDG: 11		2	0	0	2

COURSE OBJECTIVES:

The course will impart knowledge on

COB1:design orinciples of prefabricated structures

COB 2: behavior of prefabricated RC structures

COB 3: the concepts in the construction of prefabricated structural components

COB 4:design of elements for industrial buildings

MODULE I DESIGN PRINCIPLES 07

General civil engineering requirements, specific requirements for planning and layout of prefabrication plant. IS code specifications- modular co-ordination, standardization, disuniting of prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, deflection control, lateral load resistance, location and types of shear walls - long wall and cross-wall large panel buildings.

MODULE II REINFORCED CONCRETE 08

one way and two way prefabricated slabs, framed buildings with partial and curtain walls - connections – beam to column and column to column. Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, description of joints, their behaviour and reinforcement requirements, deflection control for short term and long term loads, ultimate strength calculations in shear and flexure.

MODULE IV WALLS 07

Types of wall panels, blocks and large panels, curtain, partition and load bearing walls, load transfer from floor to wall panels, vertical loads, eccentricity and stability of wall panels, design curves, types of wall joints, their behaviour and design, leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

MODULE V INDUSTRIAL BUILDINGS AND SHELL ROOFS 08

Components of single-storey industrial sheds with crane gantry systems, R.C.roof trusses, roof panels, corbels and columns, wind bracing design - cylindrical, folded plate and hyper-prefabricated shells, erection and jointing, joint design, hand book based design.

L-30; TOTAL HOURS - 30

REFERENCES:

1. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III & IV
   Bauverlag, GMBH, 1971.
2. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures,AkademiaiKiado, Budapest, 2007.
3. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company,Amsterdam/ London/New York, 1998.
4. Structural Design Manual, Precast Concrete Connection Details, Society for theStudies in the use of Precast Concrete, Netherland BetorVerlag, 2009.
5. Warszawski, A., Industrialization and Robotics in Building - A managerialapproach, Harper and Row, 1990.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: apply the design principles used to construct prefabricated structures.

CO2: create a panel and framed buildings with their connections of prefabricated RC structures.

CO3: Classify the types of floors, stairs and roofs and describe their behaviour of structures.

CO4: Critically describe the various types of wall panels for prefabricated structures.

CO5: Construct a prefabricated structural component for industrial buildings.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			H	H									H	L	L
CO2			H	H									H	L	L
CO3			H	H									H	L	L
CO4			H	H									H	L	L
CO5			H	H									H		

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 : The holistic understanding of prefabricated structures is more essential to ensure safe and sustainable buildings.

CEEY 110	SUBSURFACE EXPLORATION TECHNIQUES	L	T	P	C
SDG: 9 &11		2	0	0	2

COURSE OBJECTIVES:

COB1: To understand the importance and methods of subsurface exploration.

COB2: To impart knowledge on the various techniques on soil sampling.

COB3: To provide insight knowledge on the various laboratory tests and its interpretation

COB4: To impart knowledge on the testing of soil in field.

MODULE I INTRODUCTION 7

Introduction – Scope and objectives, planning of exploration program - methods of exploration - exploration for preliminary and detailed design, spacing and depth of bore holes, data Interpretation - Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions.

MODULE II SOIL SAMPLING 6

Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling, advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

MODULE III LAB TESTING OF SOIL 7

Introduction – determination of index and engineering properties of soil – Grain size Analysis, Atterberg limits, Permeability of soil, Shear test – direct shear, vane shear, tri axial tests - consolidation measurements- lab procedure – calculations and interpretation.

MODULE IV INSITU EXPLORATION TECHNIQUES 10

Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressure meter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test - Procedure, limitations, correction and data interpretation of all methods - Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results.

L -30; TOTAL HOURS – 30

REFERENCES:

1. Alam Singh and Chowdhary G. R., “Soil Engineering in Theory and Practice, Volume - 2, Geotechnical Testing And Instrumentation”, CBS Publishers and Distributors, New Delhi, 2006.

2. Muni Budhu, "Soil Mechanics and Foundations", John Wiley and Sons, Inc., New York, 2000.
3. Thomson.D and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012
4. Venkataramiah.C, “Geotechnical Engineering”, New Age International Pvt. Ltd, 2002.

COURSE OUTCOMES:

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

CO1: Implement the concepts of soil tests and boring methods.

CO2: Apply various techniques for soil sampling.

CO3: Determine the soil properties by conducting laboratory tests.

CO4: Demonstrate the various methods of field test.

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Academic Council:
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L	L				L		L	L	L		H	H	M
CO 2	L	M	M	L			L		L	M			H	H	M
CO 3	M	L	M				M		L	M	L	M	H	H	M
CO 4	M	L	L				L		L	M		L	H	H	M

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 subsurface exploration is more essential to ensure safe and sustainable building.

CEEY 111	**3D PRINTING IN CONCRETE TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 9 ,11		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To introduce the 3D printing for building and construction, including the technologies, materials and applications.

MODULE I General Considerations and Technologies 7

Introduction - General considerations for 3D printing and additive fabrication - 3D printing of cement-based materials - digital and additive fabrication of cement materials - Printed methods using extrusion and deposition - Methods of printing by injection into a particle bed -Alternative printing methods - A classification of 3D printing methods for concrete.

MODULE II Techniques for Extrusion/Casting 8

Introduction Breakdown of the process into stages - Behavior during the fresh state and the printing stage - Rheology of cement-based materials - Pumping - Extrusion -Stability of an elemental layer during deposition -Elastic deformation and accuracy of the deposition - Shrinkage and cracking during drying - Bonding between layers – weakness at the interface between layers .

L – 15; TOTAL HOURS –15

REFERENCES:

1. Jay Sanjayan, Ali Nazari, Behzad Nematollahi, “3D Concrete Printing Technology Construction and Building Applications”, 2019.
2. Arnaud Perrot, “3D Printing of Concrete State of the Art and Challenges of the Digital Construction Revolution”, Wiley, New York, 2019.

COURSE OUTCOMES:

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

CO1: Describe the history and classification of 3D printing methods for concrete

CO2: Elucidate techniques for Extrusion/Casting of 3D printable concrete.

Board of Studies (BoS) :	**Academic Council:**
17th BoS of Civil held on 10.08.2022	19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			H	H									H	H	H
CO2			H	H									H	H	H

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

PROFESSIONAL ELECTIVES - EVEN SEMESTER

CEEY 201	**ADVANCED FOUNDATION DESIGN**	**L**	**T**	**P**	**C**
SDG: 9 ,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart knowledge on the analysis and design of shallow foundation.

COB2: To design the pile foundations under vertical and lateral loads.

COB3: To understand the components and methods of well and other types of foundations.

COB4 : To provide in-depth knowledge on the basic concepts of soil dynamics and design the machine foundation

MODULE I SHALLOW FOUNDATIONS 10

Requirements for Satisfactory Performance of Foundations, Methods of Estimating, Bearing Capacity, Factors affecting bearing capacity Factors influencing selection of depth of foundation, types of shallow foundations, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure – Settlement Computation.

MODULE II LATERAL AND UPLIFT LOAD EVALUATION OF PILES 10

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 III WELL FOUNDATION 10

Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection

MODULE IV MISCELLANEOUS FOUNDATION 8

Sheet Pile Structure- Types, Cantilever, Anchored sheet pilling, Design by Fixed Earth Method - Anchor Braced sheeting cofferdam- Single well cofferdams- Cellular cofferdam, Stability of cellular cofferdam.

MODULE V SOIL DYNAMICS & MACHINE FOUNDATIONS 7

Introduction to soil dynamics – Soil behaviour under dynamic loads – Difference between static and dynamic load behaviour of soil – Dynamic soil properties – Free vibrations and forced vibrations – Types of machines – Types of machine foundations – Vibration analysis of a machine foundation – General design criteria for machine foundations.

L -45 ; TOTAL HOURS – 45

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. Whitmen, “Soil Mechanics - Ⅱ”, Wiley Eastern Ltd., 2000.
4. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007.
5. Swami saran, “Soil Dynamics and Machine Foundations”, Galgotias, 2012.
6. 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: Design the shallow foundations based on the bearing capacity of soil.

CO2: Perform lateral and uplift load analysis and suitably design a pile foundation.

CO3: Analyse and design the well foundation for structure.

CO4: Design the sheet pile and coffer dams

CO5: Describe the dynamic behaviour of soil and foundations for machines.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	M			L		L		M		H	H	H
CO2	H	M	H	M			M		L		M		H	H	H
CO3	H	M	L	M			M		L		M		H	H	H
CO4	H	M	L				L		L		L		H	H	H
CO5	H	M	L	L			L				L		H	H	H

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.

CEEY 203	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

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

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 ANALSYSIS & DESIGN OF INDUSTRIAL BUILDINGS 9

Industrial building frames - analysis of industrial bents – design of gable frames - industrial roofs - crane girders - machine foundations

MODULE IV DESIGN OF SPECIAL STRUCTURES 9

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

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 McGraw Hill, 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.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			H	H									H	H	H
CO2			H	H									H	H	H
CO3			H	H									H	H	H
CO4			H	H									H	H	H
CO5			H	H									H	H	H

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

CEEY 204	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 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 analysis of structures.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M										L	H	L
CO2	H	M	M										L	M	L
CO3	H	M	M										L	M	L
CO4	M	M	M										L	M	L
CO5	M	M	M										M	M	L

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

CEEY 205	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
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 – 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 4. Inc, 2000.
3. RamaswamyG.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.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	H										H	M	L
CO2	M	M	H										H	M	L
CO3	M	M	H										H	M	L
CO4	M	M	H										H	M	L
CO5	M	M	H										H	M	L

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

CEEY 206	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

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 METHODS OF ANALYSIS AND INELASTIC BUCKLING 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 9

Isotropic rectangular plates - governing differential equations - simply supported on all edges – use of energy methods – plates with stiffeners – numerical techniques.

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:

A**t** 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

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	M											L	M	L
CO 2	M	M											L	H	L
CO 3	M	M											L	H	L
CO 4	M	M											L	M	L
CO 5	M	M											L	M	L

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

CEEY 207	**STRUCTURAL SAFETY AND RELIABILITY**	**L**	**T**	**P**	**C**
SDG: 9 .11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart adequate knowledge on safety aspects involved in 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 Factors, 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, Standardised 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: Explain the 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: Explain the reasons leading to different values of partial safety factors for load and resistance variables in design and assessment standards.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M											H	M	L
CO2	M	M											H	H	L
CO3	M	M											H	H	L
CO4	M	M											H	M	L
CO5	M	M											H	M	L

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

CEEY 208	TALL STRUCTURES	L	T	P	C
SDG: 9 ,11		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the problems associated with large heights of structures with respect to different loads

COB2: To impart knowledge on the behaviour, analysis and design of various structural systems.

COB3: To impart knowledge on stability of tall buildings and also on dynamic analysis of wind and earthquake loadings.

MODULE I DESIGN CRITERIA & 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 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 BUILDINGS 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 minimise 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

REFERENCES:

1. Bryan Stafford Smith and AlexCoull, "Tall Building Structures, Analysis Design", John Wiley and Sons, Inc.1991
2. Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw Hill Book Co., 2016.
3. Emil Simiu and Dong Hun Yeo, "Wind Effects on Structures - Modern Structural Design for Wind", John Wiley and Sons, Inc. 2019.

COURSE OUTCOMES:

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

CO1: Describe the different types of loads acting on tall structures and identify the different factors affecting the tall structures.

CO2 : Classify and use appropriate types of structural systems in tall structures.

CO3: Construct the modelling using various analysis techniques and describe its behaviour for various structural systems.

CO4 : Manipulate the second order effects of gravity loading, translational and torsional instability in the analysis of tall structures.

CO5 : Analyse the response of wind and seismic motions on tall structures.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			H	H									H	L	L
CO2			H	H									H	L	L
CO3			H	H									H	L	L
CO4			H	H									H	L	L
CO5			H	H									H	L	L

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 : The holistic understanding of behaviour, analysis and design of Tall buildings leads to development of sustainable buildings.

CEEY 209	THEORY OF PLATES AND SHELLS	L	T	P	C
SDG: 9 ,11		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the behavior of thin and thick plates in cartesian and polar coordinates

COB2: To understand the behaviour of reinforced concrete plate and shell elements at 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, northlight 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 on different types of shells and develop equilibrium equations and force displacement relations.

CO4 : Analyse the various types of shells under different loading conditions

CO5 : Design the various types of shell structures.

Board of Studies (BoS) :
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	M											L	M	M
CO 2	M	M											L	M	M
CO 3	M	M											L	M	M
CO 4	M	M											L	M	M
CO 5	M	M											L	M	M

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

CEEY 210	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
SDG: 9 ,11		2	0	0	2

COURSE OBJECTIVES:

COB1: To impart sufficient knowledge on the concepts of wind effects on structures

COB2: To familiarise on the modeling and designing the structures for wind and cyclone effects as per the codal recommendations**.**

MODULE I INTRODUCTION 7

Types of wind – characteristics of wind – wind velocity, method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - dynamic nature of wind – pressure and suctions - spectral studies, gust factor.

MODULE II WIND TUNNEL STUDIES 8

Wind tunnel studies- types of tunnels, prediction of acceleration – load combination factors – wind tunnel data analysis – calculation of period and damping value for wind design - modeling requirements – interpretation of results-aero dynamic and aero-elastic models

MODULE III WIND EFFECTS ON STRUCTURES 7

Classification of structures - rigid structures, flexible structures - static and dynamic effects on tall buildings - chimneys.

MODULE IV CYCLONE EFFECTS ON STRUCTURES 8

Cyclone effect on low rise structures – sloped roof structures - tall buildings - effect of cyclone on claddings and design of cladding as per codal provisions in cladding design –procedure and modeling of cladding.

L -30; TOTAL HOURS –30

REFERENCES:

1. John D. Holmes, “Wind Loading on Structures”, Taylor & Francis, 2007.
2. Emil Simiu and Dong Hun Yeo, “Wind Effects on Structures - Modern Structural Design for Wind”, John Wiley and Sons, Inc. 2019.

COURSE OUTCOMES:

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

CO1 : Describe the concepts on the wind effects on structures.

CO2 : Perform the wind tunnel studies, analyse and compute the various parameters for wind design.

CO3 : Critically describe the behavior of various types of structures due to wind loading.

CO4 : Describe and perform the design of structures against cyclone.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	M											M	M	M
CO 2	M	M											M	M	M
CO 3	M	M											M	M	M
CO 4	M	M											M	M	M

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 wind and cyclone effects on structures is more essential to ensure safe and sustainable building.

CEEY 211	FIRE PROTECTION OF STRUCTURES	L	T	P	C
SDG: 9 &11		1	0	0	1

COURSE OBJECTIVES:

COB1: To introduce the fundamental concepts of fire protection in a building.

MODULE I BASIC CONCEPTS OF FIRE PROTECTION 7

Types of construction and classification of buildings - Main building elements - Requirements of buildings - Combustibility and fire resistance - Fire hazard category of production processes- Process of combustion in fire-Effect of fire load & ventilation condition on enclosure fire- growth and decay of fire in enclosure.

MODULE II FIRE RESISTANCE IN BUILDINGS 8

Initial condition for calculating fire resistance of structures- Duration of fire- Temperature of fire- Method of investigating temperature regimes of fires- -, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings-Determination of duration of fire in industrial buildings and warehouses-Standardization of fire resistance of structures.

L - 15 ; TOTAL HOURS –15

REFERENCES:

1. John A. Purkiss “Fire Safety Engineering Design of Structures”-, Butterworth Heinemann, 2009.
2. Brannigan, F. L. and Corbett, G. P. Brannigan, “Building Construction for the Fire Service”, Sudbury, MA: Jones & Bartlett Publishers, 2008
3. U.S Bendev, “Fire Resistance of Buildings”, Amerind Publishing Co. Pvt. Ltd, 2006.
4. Andrew H. Buchman “Structural Design for Fire Safety, Comprehensive Overview of the Fire Resistance of Building Structures”, John Wiley and Sons, 2001.

COURSE OUTCOMES:

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

CO1 : Describe the fundamental concepts of fire protection in buildings.

CO2: Determine the fire load and duration in various types of buildings.

Board of Studies (BoS) : 17th BoS of Civil held on 10.08.2022

Academic Council: 19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1			M										M	L	L
CO2			M										M	L	L

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 Fire Protection of structures is more essential to ensure safe and sustainable building..