CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

ACADEMIC REGULATIONS & SYLLABUS

Chandubhai S Patel Institute of Technology

Faculty of Technology & Engineering (FTE)
Chandubhai S. Patel Institute of Technology (CSPIT)
Department of Civil Engineering

Master of Technology Programme
(Civil-Structural Engineering)
Choice Based Credit System

Effective from 2024-25

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CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

Vision

"To provide state of the art education in Civil Engineering guided by innovative research leading to centre of excellence in Civil Engineering education having recognition at national and international levels"

Mission

"Being a pioneering branch of Engineering, the department of Civil Engineering under the shelter of CHARUSAT is intended as a facilitator for creating a liaison between the brilliant student community and the next generation industrial needs"

Programme Educational Objectives (PEO's):

PEO 1: The graduate will possess foundation of engineering knowledge and exhibiting critical thinking and problem solving skills

PEO 2: The graduates will have trait of lifelong learning and be able to inculcate the capabilities to meet the diversified needs of industry, academia and research.

PEO 3: The graduate will exhibit the professional ethics and be supportive to the social needs **PEO 4:** The graduates will possess comprehending, analyzing and designing capabilities to generate sustainable solutions

Programme Outcomes (PO's)

Engineering Graduates will be able to:

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

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

PO3: Students would be able to work individually and in the team for betterment of the society.

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Programme Specific Outcomes (PSO's):

By the completion of Master's in Civil-Structural Engineering program, the student will attain: **PSO1:** Employability skills with the cognizance of social and environmental necessity along with ethical responsibility to have a successful career and to become an entrepreneur.

CHARUSAT welcomes you for a Bright Future

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CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
Accredited with Grade A by NAAC,
Accredited with Grade A by KCG

Faculty of Technology and Engineering

ACADEMIC REGULATIONS

Master of Technology (Civil-Structural Engineering) Programme

Charotar University of Science and Technology (CHARUSAT)
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Academic Year 2024-2025

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CHARUSAT

FACULTY OF TECHNOLOGY AND ENGINEERING
ACADEMIC REGULATIONS
Master of Technology Programmes Choice
Based Credit System

Academic regulations recommendations are provided to ensure uniform system of education, programmes duration, eligibility criteria for admission, course credits distribution, teaching and examination pedagogy, detailed syllabus with reference material.

1) System of Education

The Charotar University of Science and Technology (CHARUSAT) shall follow Choice based Credit System (CBCS) with Semester pattern at Undergraduate and Master levels. Each semester will be at least of 90 working days. Apart from the programme core courses, provision for choosing University level electives and Programme electives are available under the CBCS.

2) Duration of Programme

(i)	Postgraduate programme	(M.Tech)
	Minimum	4 semesters (2 academic years)
	Maximum	6 semesters (3 academic years)

3) Eligibility for admissions
As enacted by Government of Gujarat/AICTE/UGC from time to time.

4) Mode of admissions
As enacted by Government of Gujarat from time to time.

5) Programme Structure and Credits
As per annexure – 1 attached

6) Attendance

6.1. Students are expected to maintain 100% attendance in all courses. However, students may involuntarily have to miss classes due to illness or some family emergency; students are permitted to maintain a minimum attendance of 75% with producing proof or reason for the absence. In case of medical exigencies, the student/parent should inform the principal immediately through call or by email. Within a week,

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starting from the day of absence, the proof of medical exigency must be submitted to the Principal's office.

6.2. Unauthorized absence will be considered as part of the discretionary 25% for fulfilling the minimum 75% attendance requirement for appearing in the examination.

6.3. Students nominated/sponsored by the University to represent in various forums like seminars/conferences/workshops/competitions or taking part in co-curricular/extra-curricular events will be given attendance credit provided the student applies in writing for such a leave in advance and obtains sanction from the Principal of his/her Institute for academic related requests.

7) Course Evaluation

7.1. The performance of every student in each course will be evaluated as follows:

7.1.1 Internal evaluation by the course faculty member(s) based on continuous assessment. The respective department /institute will conduct the continuous assessment. The course faculty members shall share the pedagogy related to the continuous evaluation with the students.

7.1.2 Final end-semester examination shall be conducted by the University through written paper, practical test, oral test, presentation by the student or a combination of these.

7.1.3 The weightages of continuous assessment and end-semester university examination in overall assessment shall depend on individual course as approved by Academic Council through Faculty Board and Board of Studies.

7.1.4 The performance of candidate in continuous assessment and in end-semester examination together (if applicable) shall be considered for deciding the final grade in a course.

7.1.5 In order to earn the credit in a course a student has to obtain grade other than FF.

7.2. Performance in continuous assessment and end-semester University Examination

7.2.1 Minimum performance with respect to continuous assessment as well as end-semester university examination will be an important consideration for passing a course.

7.2.2 If a candidate fails to obtain minimum required overall percentage of marks (36%), student has to repeat the examination till the minimum required overall percentage obtained.

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8) Grade Point System

1. The total of the internal evaluation marks and end semester examination marks in each course will be converted to a letter grade on a ten-point scale as per the following scheme:
2. Proposed Grading Scheme to awarding letter grade and grade point as per NEP 2020

Letter Grade	Grade Point	Grading Scheme for Mark (In %)
O (Outstanding)	10	96.0-100
A+ (Excellent)	9	86.0-95.9
A (Very Good)	8	76.0-85.9
B+ (Good)	7	66.0-75.9
B (Above Average)	6	56.0- 65.9
C (Average)	5	46.0 – 55.9
P (Pass)	4	36.0 – 45.9
F (Fail)	0	Below 36.0
Ab (Absent)	0	Absent

- The minimum passing marks for each pattern of evaluation are 36%

3. The student's performance in any semester will be assessed by the Semester Grade Point Average (SGPA). Similarly, his/her performance at the end of two or more consecutive semesters will be denoted by the Cumulative Grade Point Average (CGPA). The SGPA and CGPA are calculated as follows:

(i) SGPA = Σ Ci Gi / Σ Ci where Ci is the number of credits of course i
Gi is the Grade Point for the course i
and i = 1 to n, n = number of courses in the semester

(ii) CGPA = Σ Ci Gi / Σ Ci where Ci is the number of credits of course i
Gi is the Grade Point for the course i
and i = 1 to n, n = number of courses of all semesters up to which CGPA is computed.

9) Award of Class

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- The class awarded to a student in the programme is decided by the final CGPA as per the following scheme:

Award of Class	CGPA Range
First Class with Distinction	CGPA ≥ 7.0 & ≤ 10.0
First class	CGPA ≥ 6.0 & < 7.0
Second Class	CGPA ≥ 5.0 & < 6.0
Pass Class	CGPA < 5.0

10) Detention Criteria

- A student will be promoted to next year only if he/she has cleared all the courses of the year he/she is studying in.
  Link: https://charusat.ac.in/ => Student's Corner => Detention Rules

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CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY (CHARUSAT)

FACULTY OF TECHNOLOGY & ENGINEERING (FTE)

CHOICE BASED CREDIT SYSTEM

FOR

MASTER OF TECHNOLOGY

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Choice Based Credit System

With the aim of incorporating the various guidelines initiated by the University Grants Commission (UGC) to bring equality, efficiency and excellence in the Higher Education System, Choice Based Credit System (CBCS) has been adopted. CBCS offers wide range of choices to students in all semesters to choose the courses based on their aptitude and career objectives. It accelerates the teaching-learning process and provides flexibility to students to opt for the courses of their choice and / or undergo additional courses to strengthen their Knowledge, Skills and Attitude.

1. CBCS – Conceptual Definitions / Key Terms (Terminologies)

Types of Courses: The Programme Structure consist Foundation courses, Core courses, Elective courses, Non-credit (audit) courses and SWAYAM MOOCs.

1.1 Foundation Course

These courses are offered by the institute in order to prepare students for studying courses to be offered at higher levels.

1.2 Core Courses

A Course which shall compulsorily be studied by a candidate to complete the requirements of a degree / diploma in a said programme of study is defined as a core course. Following core courses are incorporated in CBCS structure:

A. University Core courses(UC):

University core courses are compulsory courses which are offered across university and must be completed in order to meet the requirements of programme. Environmental science will be a compulsory University core for all Undergraduate Programmes.

B. Programme Core courses(PC):

Programme core courses are compulsory courses offered by respective programme owners, which must be completed in order to meet the requirements of programme.

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1.3 Elective Courses

Generally, a course which can be chosen from a pool of courses and which may be very specific or specialised or advanced or supportive to the discipline of study or which provides an extended scope or which enables an exposure to some other discipline / domain or nurtures the candidates proficiency / skill is called an elective course. Following elective courses are incorporated in CBCS structure:

A. University Elective Courses(UE):

The pool of elective courses offered across all faculties / programmes. As a general guideline, Programme should incorporate 2 University Electives of 2 credits each (total 4 credits).

B. Programme Elective Courses(PE):

The programme specific pool of elective courses offered by respective programme.

1.4 Non Credit Course (NC) - AUDIT Course

A 'Non Credit Course' is a course where students will receive Participation or Course Completion certificate. This will be reflected in Student's Grade Sheet but the grade of the course will not be considered to calculate SGPA and CGPA. Attendance and Course Assessment is compulsory for Non Credit Courses.

1.5 Credit Transfer through SWAYAM MOOCs

CHARUSAT provides credit transfer as per UGC guidelines to all the students from SWAYAM against elective courses. The credit transfer is offered in two modes: (a) Partial credit transfer (b) Full credit transfer.

1.6 Medium of Instruction

The Medium of Instruction will be English.

In consonance with the National Education Policy (NEP) 2020 and the guidelines of the University Grants Commission (UGC), Charotar University of Science and Technology (CHARUSAT) implements the Multiple Exit scheme in their Master of Technology programme.

1.7 Table 1 shows the exit Elective Courses

Generally, a course which can be chosen from a pool of courses and which may be very specific or specialised or advanced or supportive to the discipline of study or which provides an extended scope or which enables an exposure to some other discipline / domain or nurtures the candidates proficiency / skill is called an elective course. Following elective courses are incorporated in CBCS structure:

C. University Elective Courses(UE):

The pool of elective courses offered across all faculties / programmes. As a general guideline, Programme should incorporate 2 University Electives of 2 credits each (total 4 credits).

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D. Programme Elective Courses(PE):

The programme specific pool of elective courses offered by respective programme.
t qualifications along with credit requirements.

Table 1 Exit Qualifications along with Credit Requirements

ACADEMIC LEVEL	EXIT QUALIFICATION AND CREDITS REQUIRED	NATIONAL CREDIT LEVEL (NCrF)
1st year of PG Degree	Post Graduate Diploma will be awarded after completion of 1st year of 2-year PG program *Minimum of 40 credits for individuals who have completed a bachelor's programme*	6.5

Exit after First Year:

Award: PG Diploma in XXXX

The student shall be awarded with "PG Diploma in XXXX", with redemption of credits from ABC. Total credits redemption shall be 1st year credits.

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CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
TEACHING AND EXAMINATION SCHEME FOR M TECH (CIVIL – STRUCTURAL ENGG.) CHOICE BASED CREDIT SYSTEM SCHEME

Semester	Course Code	Course Title	Teaching Scheme				Examination Scheme				
			Theory	Practical /Tutorial	Total	Credit	Theory		Practical		Total
							Internal	External	Internal	External	
Sem 1	**HSUS502**	Foreign Languages (French)	0	2	2	2	-	-	25	25	50
	OR						OR				
	HSUS501	Academic Speaking And Presentation Skills	0	2	2	2	-	-	25	25	
	MSUC529	Numerical And Statistical Techniques (Programme Core-I)	3	2	5	4	50	50	25	25	150
	CLUC501	Advanced Structural Analysis (Programme Core-II)	4	2	6	5	50	50	25	25	150
	CLUS501	Design Practices-I (Programme Core-III)	0	6	6	4	0	0	100	100	200
	CLXXXXX	Programme Elective-I	3	2	5	4	50	50	25	25	150
	CLXXXXX	Programme Elective-II	3	2	5	4	50	50	25	25	150
					29	**23**					**850**
Sem 2	**HS106.03A**	Academic Writing	0	2	2	2	0	0	25	25	50
	CLUC502	Finite Element Analysis (Programme Core-IV)	3	2	5	4	50	50	25	25	150
	CLUC503	Structural Dynamics & Earthquake Engineering (Programme Core-V)	4	2	6	5	50	50	25	25	150
	CLUS502	Design Practices-II (Programme Core-VI)	0	6	6	4	0	0	100	100	200
	CLXXXXX	Programme Elective-III	3	2	5	4	50	50	25	25	150
	CLXXXXX	Programme Elective-IV	3	2	5	4	50	50	25	25	150
	XXXXX	University Elective	0	2	2	2	0	0	50	50	100
					31	**25**					**950**

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							Internal		External			
							Report	Seminar	Report	Seminar	Viva	Total
Sem 3	CLUP601	Project Preliminaries				4	50	50	--	50	50	200
	CLUP602	Project Phase – I				16	100	150	50	100	100	500
						20						**700**
Sem 4	CLUP603	Project Phase - II				20	200	300	100	200	200	1000
						20						**1000**
		GRAND TOTAL				**88**						**3500**

Programme Electives

Semester 1 (Programme Elective-I)		**Semester 1 (Programme Elective-II)**	
CLUE501	Design of Foundation Systems	CLUE504	Advanced Concrete Technology
CLUE502	Prestressed Concrete Structures	CLUE505	Theory and Application of Plate and Shells
CLUE503	Stability Analysis	CLUE506	Design of Tall Structures
CLME503	Vibration of Continuous Systems	CLME504	Optimization Methods For Civil Engineering

Semester 2 (Programme Elective-III)		**Semester 2 (Programme Elective-IV)**	
CLUE507	Design of Offshore Structures	CLUE5010	Structural Optimization and Reliability
CLUE508	Design of Composite Structures	CLUE5011	Bridge Engineering
CLUE509	Design of Cold Formed Steel Structures	CLUE5012	Behavior of Structures under Extreme Loading
CLME501	Maintenance and Repair of Concrete Structures	CLME502	Reliability-Based Structural Design

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University Electives

FTUD501	Project Management	MBUD557	Software Based Statistical Analysis
FTUD551	Occupational Health and Safety	NROD555	First Aid and Life Support
CAUD516	Internet and Web Designing	CHUD558	Introduction to Polymer Science
CAUD517	Mobile Application Development	PH893	Clinical Data and Interpretation
PTOD501	Fitness and Nutrition	PH892.01	Intellectual Property Rights

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M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – I)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

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HSUS502: FOREIGN LANGUAGES (French)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	02	--	30	02
Marks	--	50	--	50	

Pre-requisite courses:

- French Language Studies- Introduction (Coursera)

Objectives of the Course:

- To hone and sharpen French Language Skills of students
- To prepare globally and multi-culturally competent communicators and professionally compatible cadre of future professionals
- To develop basic vocabulary required to speak French Language

Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Introduction to French Language	08
2.	Grammar: Articles, Tense, Forms, Numbers, Verbs, Days, Months, Family	08
3.	Grammar : Adjectives, Adverbs, Interrogative Forms, Directions, Countries, Nationalities, Seasons, Weather, Professions, Verbs	08
4.	Grammar: Prepositions, Conjunctions, Tenses, Colours, Vegetables, Fruits, Shapes, Verbs	06
	Total hours (Theory) :	--
	Total hours (Practical) :	30
	Total hours :	30

Detailed Syllabus:

1.	Introduction to French Language	08 Hours	28%
	Facts and figures about French Language; Basic French Linguistics-* Alphabets * Accents * Liaison * Nasalization French Culture, Differ between French and English; **Grammar**-Subject Pronoun, Verbs: (être, avoir, habiter, regarder, manger ... "er" verb), Form of address, Numbers		

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	(1 to 20), Nouns and plurals of nouns, The expression: C'est, Il y a; **Presentation:** -1) Self-Introduction-2) Question and answering; **Dialogue**		
2.	Grammar: Articles, Tense, Forms, Numbers, Verbs, Days, Months, Family	08 Hours	28%
	Grammar-Definite articles, Indefinite articles, Present tense (Positive Forms, Negative Forms), Numbers (21 to 100, 100- 1000), Days, Months, Family, Verbs: (aller, venir, finir, pouvoir, vouloir ... "ir" verb); **Social Links**-1), My family & relations 2) Appointments 3) Gathering information from someone; **Dialogue**		
3.	Grammar : Adjectives, Adverbs, Interrogative Forms, Directions, Countries, Nationalities, Seasons, Weather, Professions, Verbs	08 Hours	28%
	Grammar- Common Adjectives, Comparative Adjectives, Common Adverbs, Interrogative Forms, The expression: "On", Directions, Countries, Nationalities, Seasons, Weather, Professions, Verbs: (Prendre, Apprendre, Comprendre, faire ... "re " verb); **Work , Study and Travel**-1) Job/ Profession 2) Ticket Reservation (At Bus/At Railway/At Airport); **Dialogue**		
4.	Grammar: Prepositions, Conjunctions, Tenses, Colours, Vegetables, Fruits, Shapes, Verbs	06 Hours	26%
	Grammar-1) Common Prepositions 2) Common Conjunctions 3)Past Tense 4) Future Tense 5) Colors ,Shapes, Animals ,Vegetables, Fruits 6) Verbs: ("er", "ir","re" etc...); **Food & Shopping**-1) Buy a vegetables and fruits 2) Any Conversation between Customer and Vendor (At Mall/At Restaurant / At Market); **Dialogue**		

Course Outcome (COs):

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

CO1	Gain basic communication skills in French language with preliminary understanding of grammar
CO2	Develop vocabulary required to speak about him/herself and his/her immediate environment.
CO3	Become capable of interacting in simple ways, to ask simple questions to get necessary information, to reply simple questions.
CO4	Become capable of understanding and using simple instructions in their personal, academic and professional environments.
CO5	Develop skills and intelligences to function in multi-disciplinary and cross-cultural work environment.

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CO6	Practice new global trends in communication in multiple perspectives at personal, professional, and social level.

Evaluation Scheme

The evaluation scheme for the course will comprise the following components:

- Formative: Internal / Continuous and Comprehensive Evaluation (CCE) – 25 Marks
- Summative: External / Semester End Evaluation (SEE) – 25 Marks

Internal / Continuous and Comprehensive Evaluation (CCE) – 25 Marks	
Exam Pattern	**Marks**
Lab Work Assessment (Best 3 out of 4)	45
Viva voce/ Lab Quiz (Best 3 out of 4) (Note: Quiz Number 1 and 3 will be administered as lab quizzes, while Quiz Number 2 and/or 4 shall serve as part of the mid-term evaluation.)	45
Attendance	10
Total	**100*** **(scaled to 25 marks)**

*Note: The total Internal / CCE score out of 100 marks will be converted to 25 marks.

External / Semester End Evaluation (SEE) – 25 Marks	
Exam Pattern	**Marks**
Quiz	40
Viva-voce	30
Presentation/Task/GD/Case Analysis etc. (The Course Convenor / Faculty will brief the students about the examination components and weightage)	30
Total	**100*** **(scaled to 25 marks)**

*Note: The total External / SEE score out of 100 marks will be converted to 25 marks.

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Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	-	-	1	-
CO2	-	-	-	-
CO3	-	-	1	-
CO4	-	-	-	-
CO5	-	-	1	3
CO6	-	-	1	2

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Recommended Study Material:

- Text book:
  1. Complete French: All-In-One, McGraw-Hill, Amazon
  2. Best for Grammar: Easy French Step-by-Step, McGraw-Hill, Amazon
- Reference book:
  1. Basic French: McGraw-Hill, Amazon
  2. French Grammar for Beginners, Amazon
- Web material:
  1. https://alison.com/course/french-language-studies-introduction
  2. https://alison.com/course/basic-french-language-skills-for-everyday-life- revised-2017
  3. http://www.bbc.co.uk/languages/french/
  4. https://www.loecsen.com/en/learn-french
  5. https://www.youtube.com/watch?v=ujDtm0hZyII

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HSUS501: ACADEMIC SPEAKING AND PRESENTATION SKILLS

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	02	--	30	02
Marks	--	50	--	50	

Pre-requisite courses:

- Beginner/Intermediate level language proficiency

Objectives of the Course:

To facilitate the learners:

- to explore the concepts of advance communication
- to understand the concept of academic language
- to understand the concept and application of academic speaking
- to learn the nuances of formal/academic speaking
- to explore and implement accurate pronunciation, stress and intonation patterns in English
- to understand oral interactions, including impromptu speaking, job interviews, research presentations, and group discussion

Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Foundations of Advance Communication	04
2.	Art of Conversation	06
3.	Science of Power Speaking	06
4.	Academic Speaking Application – Part I	08
5.	Academic Speaking Application – Part II	06
	Total hours (Theory) :	--
	Total hours (Practical) :	30
	Total hours :	30

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Detailed Syllabus:

1.	Foundations of Advance Communication	04 Hours	14%
	Meaning and Definition of Advance Communication; Advance Communication in Digital, Social, Mobile World; Strategies for Advance Communication; Meaning and Concept of Academic Language; High Frequency Academic Vocabulary		
2.	Art of Conversation	06 Hours	20%
	Describing people, places and things; Expressing opinions; Making suggestions; Persuading someone; Interpreting and Summarizing		
3.	Science of Power Speaking	06 Hours	20%
	Phonemes, Word Stress, Pronunciation, Intonation, Pause, Register, Fluency, Prosody, Lexical Range		
4.	Academic Speaking Application – Part I	08 Hours	26%
	Art of Oratory, Formal Presentation, Speech Analysis – Decoding Best Speeches		
5.	Academic Speaking Application – Part II	06 Hours	20%
	Job Interview, Group Discussion, Meeting		

Course Outcome (COs):

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

CO1	understand and demonstrate advance communication and academic speaking skills
CO2	demonstrate ability to communicate in diverse situations
CO3	activate and extend their linguistic and communicative competence
CO4	demonstrate the formal presentation skills
CO5	demonstrate performing ability at group discussion and personal interview

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Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	-	-	3
CO2	-	-	2	3
CO3	-	2	-	3
CO4	-	2	-	3
CO5	2	-	3	3

Recommended Study Material:

1. *Business Communication Today* (Thirteenth Edition) by Courtland L. Bovee, John V. Thill and Roshan Lal Raina
2. *Effective Speaking Skills* by Terry O' Brien
3. *Speak Better Write Better* by Norman Lewis
4. *Well Spoken: Teaching Speaking to All Students* by Erik Palmer
5. *Let Us Hear Them Speak : Developing Speaking – Listening Skills in English* by Jayshree Mohanraj (Publisher – Sage Publication)
6. *The craft of scientific presentations: Critical steps to succeed and critical errors to avoid*. New York: Springer by Michael Alley
7. *Presentation Skills in English* by Bob Dignen (Publisher: Orient Black Swan)

- **Web material:**

1. TED Talk : How to speak so that people want to listen
   https://www.ted.com/talks/julian_treasure_how_to_speak_so_that_people_want_to_listen?language=en
2. TED Talk: The 110 techniques of communication and public speaking
   https://www.ted.com/talks/david_jp_phillips_the_110_techniques_of_communication_and_public_speaking

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MSUC529: NUMERICAL AND STATISTICAL TECHNIQUES

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Approximate solutions of various types of equations and eigenvalue problem	14
2	Interpolation and Curve Fitting	08
3	Probability and Statistical Inference	15
4	Correlation and Regression	08
	Total Theory Hours	**45**
	Total Laboratory Hours	**30**
	Total Hours	**75**

B. Detailed Syllabus:

1. Approximate solutions of various types of equations and eigenvalue problem: **14 Hours 31%**

1.1 Solution of system of simultaneous linear equations: LU decomposition, Choleski decomposition method, Gauss Seidel Method.

1.2 Solution of system of **simultaneous** non-linear equations: Newton-Raphson method and Method of Iterations.

1.3 Numerical solutions of ordinary differential equations by Euler's, Runge Kutta (4^{th} order) methods, Runge-Kutta-Fehlberg Method (RKF45).

1.4 Introduction to eigenvalue and eigenvector, numerical solution of eigenvalue problems using Power Method and Jacobi Method.

2 Interpolation and Curve Fitting: **08 Hours 18%**

2.1 Newton's divided difference and Newton's interpolation polynomial, Newton's forward and backward interpolation formulas, Lagrange's interpolation formula.

2.2 Least squares curve fitting, linear and nonlinear curve fitting.

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3	**Probability and Statistical Inference:**	**15 Hours 33%**
3.1	Introduction to probability distributions (Binomial, Poisson, Normal, Exponential).	
3.2	Population and sample, function of random variables associated with normal distribution, central limit theorem.	
3.3	Sampling distributions: Chi-square, t and F distributions.	
3.4	Point estimation and interval estimation: Estimation of population mean, population variance, population proportion, one population and two populations.	
3.5	Introduction to hypothesis Testing, z- test, t-test, chi-square test and F-test, one sample and two samples tests.	
4	**Correlation and Regression:**	**08 Hours 18%**
4.1	Measure of association between two variables. Types of Correlation, Karl Pearson's Coefficient of correlation and its mathematical properties.	
4.2	Spearman's Rank correlation and its interpretations.	
4.3	Regression Analysis: Concept and difference between correlation and regression, linear regression equations, properties of regression coefficients. Application to structural engineering problems.	

Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject must be discussed.
- Lectures may be conducted with the aid of multi-media projector, writing board, OHP etc.
- Attendance is compulsory in lectures and laboratory which carries weightage of 5 Marks.
- Two internal tests/unit tests will be conducted and its average will be converted to equivalent of 15 Marks as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated on regular basis. These carry a weightage of 5 Marks as a part of internal theory evaluation.
- Surprise Tests/Quizzes/Seminars will be conducted. These carry 5 Marks as a part of internal theory evaluation.
- The course includes a laboratory work, the students have to write MATLAB or SCILAB programs for the methods taught in lectures

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Course Outcomes (Cos):

After learning the course, students will able to

CO1	Determine approximate solution of non-linear equations and system of linear equations and ordinary differential equation.
CO2	Interpolate or extrapolate approximate value of dependent variable for any value of independent variable, employing only finitely many tabulated values.
CO3	Determine the relationship between two variables using curve fitting, Regression and Correlation.
CO4	Compute Probabilities using Probability distributions.
CO5	Apply the techniques of Hypothesis testing.
CO6	Construct the algorithm and perform the various commands in programming language.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO01
CO1	3	2	1	1
CO2	3	2	1	1
CO3	3	2	1	1
CO4	3	2	1	1
CO5	3	2	1	1
CO6	3	2	2	1

- Correlation levels 1, 2 or 3 as defined below:
- 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Recommended Study Material:

♦ **Books:**

1. Alfredo H-S. Ang and W. H. Tang; Probability Concepts in Engineering Planning and Design, on: volume II, Decision, Risk and Reliability. Wiley, 2006
2. Jack R. Benjamin and C. Allin Cornell; .Probability, Statistics and Decision for Civil Engineers. Courier Corporation, 2014.
3. Steffen Börm and Christian Mehl; Numerical Methods for Eigenvalue Problems. Walter de Gruyter, 2012.
4. Steven C. Chapra, Berger and Raymond P. Canale; Numerical Methods for Engineers. McGraw-Hill Education, 2015.
5. Robert V. Hogg, Elliot A. Tanis and Dale L. Zimmerman; Probability and Statistical Inference. Pearson/Prentice Hall, 2010.
6. Mario G. Salvadori and M. L. Baron; Numerical Methods in Engineering. Prentice Hall 1961.
7. S. S. Sastry; Introductory Methods of Numerical Analysis; PHI Learning Private Limited 2012.

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Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	4	2	6	5
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	10
2	Concepts of Flexibility	14
3	Stiffness Methods	24
4	Analysis of Elastic Instability and Second Order Response	12

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

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B. Detailed Syllabus:

1.	**Introduction**	**10 Hours**	**17%**
1.1	Concepts of structural analysis		
1.2	Introduction to matrix structural analysis		
1.3	Basis for principal of virtual work		
1.4	Principal of virtual force-standard and matrix formulation		
1.5	Principal of virtual displacement-standard and matrix formulation		
1.6	Extension of displacement method to the generalized stiffness method		
2	**Concepts of Flexibility**	**14 Hours**	**23%**
2.1	Analysis of beam and plane truss by member approach		
2.2	Analysis of plane frame and grid by member approach.		
3	**Stiffness Method**	**24Hours**	**40%**
3.1	Analysis of beam, plane truss, plane frames, grids, space truss, space frame and composite structures by member approach		
3.2	Special problems such as member discontinuities, non prismatic members, curved members and beams on elastic supports		
3.3	Secondary effects due to temperature changes, pre-strains and support displacement		
3.4	Symmetry / Anti-symmetry		
4	**Analysis of Elastic Instability and Second Order Response**	**12 Hours**	**20%**
4.1	Introduction		
4.2	Effects of Axial Force on Flexural Stiffness		
4.3	Matrix method of analysis		

C. Course Outcomes (COs):

On the successful completion of this course

CO1	Students will be able to evaluate and analyse results provided by the commercial software for the purpose of analysis & design.

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CO2	Students will be able to use variety of Structural Engineering software for their projects and research work.
CO3	The course will give in-depth knowledge of mathematical modeling and computational methods in the areas of non-linear, static and dynamic analysis of structures.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	2	1	2	2
CO2	2	1	2	2
CO3	1	-	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Gere & Weaver, Matrix Analysis of Framed Structures, Cbs publisher, 2004.
2. Dawe, D.J., Matrix and Finite Element Displacement Analysis of Structures, Clarendon Press.
3. MenonDevdas, Advanced Structural Analysis, Narosa Publishing House.
4. Ghali&Nevelle, Structural Analysis, Palgrave Macmillan.

- **Reference Books:**

1. Wang & Chu-Kia, Matrix Methods of Structural Analysis, International Textbook Company, Limited.
2. Fleming & John, F., Computer Analysis of Structural System, Prentice Hall; First Edition edition (November 1996).

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Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	-	6	6	4
Marks	-	200	200	

A. Outline of the Course

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Review of RCC Element Design	10
2	Multistoried Building	20
3	Flat Slab	10
4	Shear Wall	10
5	Water Tanks	15
6	Chimney	10
7	Bridges	15

Total Hours (Theory): 00

Total Hours (Lab): 90

Total Hours: 90

B. Detailed Syllabus:

1	**Review of RCC Element Design**	**10 Hours**	**11%**
1.1	Slab: One Way, Two Way, Continuous		
1.2	Beam: Singly, Doubly, Continuous		
1.3	Column: Short & Long Columns subjected to various Loadings		
1.4	Footing: Isolated, Combined		
1.5	Staircase		
2	**Multi-Storied Buildings**	**20Hours**	**22%**

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2.1	Determination of dead load, live load, wind load and earthquake load on various components of the buildings and appropriate design		
2.2	Detailing of reinforcement and bar bending schedule		
2.3	Different lateral load resisting system		
3	**Flat Slabs**	**10 Hours**	**11%**
3.1	Proportioning, analysis by direct design method and equivalent frame method		
3.2	Slab design and detailing		
4	**Shear Wall**	**10 Hours**	**11%**
4.1	Forces on Shear Wall, Shear Wall Design		
5	**Water Tanks**	**15 Hours**	**17%**
5.1	Classification, Codal Provisions		
5.2	Intze/Conical Water Tank Design		
6	**Chimney**		
6.1	Basic Design Philosophy & Design Considerations	**10 Hours**	**11%**
6.2	Loads acting and codal provisions		
6.3	Analysis & Design		
7	**Bridges**	**15 Hours**	**17%**
7.1	Design Philosophy & Considerations		
7.2	IRC Loads and codal provisions		
7.3	Analysis & Design		

C. Course Outcomes (COs):

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

CO1	Students will gain the knowledge of necessary tools to analyze the structures as competing points of view using empirical techniques and statistical inference.
CO2	Students will be able to apply the knowledge gained and skills to analyze and design various types of structures.
CO3	Students will develop the understanding of qualitative design services at competitive costs.

Course Articulation Matrix:

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	PO1	PO2	PO3	PSO1
CO1	1	-	1	1
CO2	-	1	1	2
CO3	2	-	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Pillai, S., &Menon, D., Reinforced Concrete Design, TATA McGraw-Hill.
2. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers, New Delhi.
3. Variyani and Radhaji, Manual of Limit State Design, CBS Publishers, New Delhi.

- **Reference Books:**

1. Shah &Karve, Illustrated Design of G + 3 Building, Standard Book House.

- **Other Material:**

1. IS: 456, Plain and Reinforced Concrete
2. IS: 875,Code of Practice for Design Loads
3. IS: 1893 (Part-I), Criteria for Earthquake Resistant Design
4. IS: 4326 , Earthquake Resisting Design & Construction Building
5. IS: 13920 , Ductile Detailing of RC Structures

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CLUE501: DESIGN OF FOUNDATION SYSTEMS (PROGRAMME ELECTIVE-1)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Foundation System	04
2	Bearing Capacity	11
3	Shallow Foundations	08
4	Pile Foundations	08
5	Well Foundation	08
6	Foundations on Difficult Soils	06

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Introduction to Foundation System**	**04 Hours**	**08%**
1.1	Soil exploration, Classification of foundations (Flexible, rigid, shallow and deep foundations).		
1.2	Terminology: Gross bearing capacity, ultimate bearing capacity, net- ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure.		
1.3	Factors for Selection of Type of Foundation: Function of the structure and the loads it must carry, sub-surface condition of the soil, cost of super-structure.		
2.	**Bearing Capacity**	**11 Hours**	**25%**
2.1	Bearing capacity based on the classical earth pressure theory of Rankine		
2.2	Semi-empirical solutions based on theory of plasticity (a). Prandtl's theory (b). Terzaghi's theory (c). Meyerhof's theory		
2.3	Bearing capacity of shallow footings in clays. Effect of water table on Ultimate Bearing Capacity.		
2.4	Allowable Bearing Capacity, Safe Bearing Capacity in clays		
2.5	IS code Design practice		
2.6	Penetration Tests (insitu-tests): SPT- Standard penetration test, SCPT- Static cone penetration test DCPT- Dynamic cone penetration test PMT- pressure meter test. VST- vane shear test. PLT- plate load test (Insitu- test).		
3.	**Shallow Foundations**	**08 Hours**	**18%**
3.1	Types of foundations		

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3.2	Spread footing		
3.3	Safe Bearing Pressure		
3.4	Settlement of Footing		
3.5	Combined Footing & Strap Footing		
3.6	Mat or Raft Footing		
3.7	IS code of Practice for Design of Raft Foundations		
4.	**Pile Foundations**	**08 Hours**	**18%**
4.1	Introduction, Types		
4.2	Estimation of Pile Length		
4.3	Installation of Piles		
4.4	Load Transfer Mechanism		
4.5	Static Formula		
4.6	Pile Load Test		
4.7	Group Actions in Piles		
4.8	Various types of Piles		
5.	**Well Foundation**	**08 Hours**	**18%**
5.1	Introduction: Cassions		
5.2	Shapes of Well Foundation, Components		
5.3	Forces Acting & Analysis of Well Foundations		
5.4	Simplified analysis of heavy wells		
5.5	IRC method, Illustrative examples		
6.	**Foundations on Difficult Soils**	**06 Hours**	**13%**
6.1	Foundations of Collapsible Soil		
6.2	Foundations of Expansive Soil		
6.3	Sanitary Landfills		

C. Course Outcomes (COs):

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

CO1	Select appropriate foundation system for the different structure.
CO2	Analyse and design of shallow foundation
CO3	Analyse and design of raft, pile and well foundations

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Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	3	1	2	2
CO2	2	1	2	2
CO3	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Kasmalkar, J. B., Foundation Engineering, Pune VidyarthiGraha Prakashan-1786,Pune-411030.
2. Bowels, Joseph E., Practical Foundation Engineering Handbook. 5th edition, McGraw- Hill, New York.
3. Das, Braja M., Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.
4. Peck, Ralph B., Hansen, Walter E., &Thornburn, Thomas H., Foundation Engineering. John Wiley & Sons, New York.
5. Punamia B C, Soil Mechanics & Foundation Engineering, Laxmi Publications
6. Arors K R, Soil Mechanics & Foundation Engineering, Standard Publishers

- **Reference Books:**

1. Praksh, Shamsher, & Sharma, Hari D., Pile foundation in Engineering Practice, John Wiley & Sons, New York.
2. Som, N. N., & Das, S. C., Foundation Engineering: Principles and Practice. Prentice –Hall of India Pvt. Ltd. New Delhi-001.
3. Varghese, P. C., Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi-001.

   Tomlonson, Michael J., Foundation Design and Construction. 6th edition. John Wiley & Sons, New York.

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CLUE502: PRESTRESSED CONCRETE STRUCTURES (PROGRAMME ELECTIVE-1)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	06
2	Deflection of prestressed concrete member	06
3	Flexural strength of prestressed concrete sections	06
4	Design of Flexure Members	08
5	Ultimate strength and Design in Shear and Torsion	10
6	Composite construction	09

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Introduction**	**06 Hours**	**13 %**
1.1	Development of prestressed concrete		
1.2	Classification of types of prestressing		
1.3	Concepts of prestressing		
1.4	Losses of prestress		
2.	**Deflection of prestressed concrete member**	**06 Hours**	**13 %**
2.1	Factors influencing deflection		
2.2	Short-Term deflection of uncracked members		
2.3	Prediction of Long time deflection		
3.	**Flexural strength of prestressed concrete sections**	**06 Hours**	**13 %**
3.1	Behavior under flexure, Types of flexure failure		
3.2	Strain compatibility method		
3.3	Indian code procedure		
4	**Design of Flexure Members**	**08 Hours**	**19 %**
4.1	Introduction		
4.2	Flexural design using allowable stresses at service load		
4.3	Stress range approach		
4.4	Magnel's approach		
5.	**Ultimate strength and Design in Shear and Torsion**	**10 Hours**	**22 %**
5.1	Concept of shear		
5.2	Mechanism of shear resistance in concrete in concrete beams		
5.3	Ultimate shear resistance of PSC members		
5.4	Design of Prestressed sections for shear		
5.5	Behaviour of PSC member under torsion		
6.	**Composite construction**	**09 Hours**	**20 %**
6.1	Introduction, Need for composite construction		
6.2	Types of composite construction		
6.3	Behaviour of composite construction		
6.4	Flexural strength of composite section		
6.5	Shear strength of composite section		
6.6	Design of composite section		

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C. Course Outcomes (COs):

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

CO1	Calculate and develop solutions based on learned structural methods.
CO2	Theories and practical aspects of prestressing along with the design and management applications.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	1	2	2
CO2	1	1	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**
  1. Krishna Raju, N., Design of Prestressed Concrete Structures, Tata Mcgraw-hill, Fourth Edition
  2. Lin, T.Y., & Burns, N.H., Design of Pre-stressed Concrete Structures, Wiley India Pvt Ltd.
  3. Ragagopalan, Prestressed Concrete, Narosa Publishing House.
- **Reference Books:**
  1. Mallick, D.K., & Gupta, A.P., Limit State Design of Prestressed Concrete Structures, Oxford and IBH Publishing Company.

     IS 1343:1980, Code of practice for Prestressed Concrete, (First Revision)

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CLUE503: STABILITY ANALYSIS (PROGRAMME ELECTIVE-1)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Fundamental concepts	06
2	Elastic Buckling of Columns and Frames	10
3	Torsional Bucking	10
4	Lateral Buckling of Beams	10
5	Dynamic stability	09

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Fundamental concepts**	**06 Hours**	**14%**
1.1	Definitions of stability		
1.2	Structural instability		
1.3	Analytical approaches to structural instability		
1.4	Continuous deformable elastic bodies		
2.	**Elastic Buckling of Columns and Frames**	**10 Hours**	**22%**
2.1	Special Functions, bending theory		
2.2	Critical load of perfect columns with various end restraints		
2.3	Bucking of columns		
2.4	Critical load for various boundary conditions		
2.5	Columns with geometric imperfection, Large deflection theory of columns		
2.6	Orthogonality of buckling modes, eccentrically loaded columns		
2.7	Post critical behaviour of frames		
3.	**Torsional Bucking**	**10 Hours**	**22%**
3.1	Introduction		
3.2	Pure torsion of thin walled bars of open sections		
3.3	Non-uniform torsion of thin walled bars of open section		
3.4	Torsional buckling		
3.5	Buckling by torsion and flexure		
4.	**Lateral Buckling of Beams**	**10 Hours**	**22%**
4.1	Differential equations for lateral buckling of columns		
4.2	Lateral buckling of beams in pure bending		
4.3	Lateral buckling of Cantilever beams with point load at the free end		
4.4	Application of Rayleigh-Ritz method		
5.	**Dynamic stability**	**09 Hours**	**20%**
5.1	Introduction		
5.2	Need of dynamic investigation		
5.3	Discrete systems		

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5.4	Langrange – Hamilton formulation for continues systems		
5.5	Stability of continues systems		

C. Course Outcomes (COs):

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

CO1	Understand the analysis of different types of structures pertaining to its stability aspects.
CO2	Apply the knowledge to the structures and also its applications to diverse problems in Civil Engineering.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	2	2	2	2
CO2	–	–	–	–

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

♦ **Text Books:**

1. Timoshenko, S.P., and Gere, J.M., Theory of Elastic Stability, McGraw Hill Intl Edition
2. Ashwini Kumar, Stability of Structures, Tata McGraw Hill Publishing Company Ltd., New Delhi.

♦ **Reference Books:**

1. Gambhir, M. Lal., Stability Analysis and Design of Structures, Springer, 1st edition 2004.
2. Iyengar NGR, Elastic Stability of Structural Elements, Macmillan Publication.
3. Bazant, Z., &Cedolin, L., Stability of Structures, Oxford University Press, Inc., 1991
4. Simitses George J. and Hodges Dewey H., Fundamentals of structural stability, Elsevier Inc., 2006.
5. W. Xie, Dynamic Stability of Structures, Cambridge University Press, 2006.

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CLUE504: ADVANCED CONCRETE TECHNOLOGY (PROGRAMME ELECTIVE-II)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Cement	05
2	Admixtures	04
3	Performance of Concrete	08
4	Additions to concrete & Special Concretes	10
5	Testing of hardened concrete	08
6	Mix design	10

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Cement**	**05 Hours**	11%
1.1	Review of cements including blended cements		
1.2	Manufacture, chemical composition, chemical and physical processes of hydration		
1.3 1.4	Chemical composition of OPC and Modified Portland Cements, Hydration of cement, Microstructure of hydrated cement paste and concrete Aggregate: Properties and grading, Mineral and chemical admixtures in concrete, Structure-property relationships		
2	**Admixtures**	**04 Hours**	09%
2.1	Review of types and classification		
2.2	Effects on properties of concretes		
2.3	Use & Dosage of Admixtures		
3	**Performance of Concrete**	**08 Hours**	18%
3.1	Properties of fresh concrete and hardened concrete, Shrinkage, Creep, Durability of Concrete, Relation between durability and permeability		
3.2	Cracks and crack propagation in concrete, Fracture Strength, Stability of constituents		
3.3	Chemical attack, Corrosion of reinforcing steel, Fire resistance		
3.4	Use of corrosion inhibitors and types of inhibitors, Testing of concretes		
4	**Additions to concrete & Special Concretes**	**10 Hours**	22%
4.1	Review of types		
4.2	Concrete with different cementitious materials		
4.3	General features of use of fly ash, ggbs and silica fume, durability aspects		
4.4	Properties and applications of High strength and high performance concrete		
4.5	Reactive powder concrete, Lightweight, heavyweight, and mass concrete, Fibre reinforced concrete, Self-compacting		

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4.6	concrete, Shotcrete and other special concretes, Polymer Concrete, Epoxy resins and screeds.		
5	**Testing of hardened concrete**		
5.1	Test for strength in compression	**08 Hours**	**18%**
5.2	Test for strength in tension		
5.3	Test Cores		
5.4	Non Destructive Tests		
6	**Mix design**	**10 Hours**	**22%**
6.1	Review of methods and philosophies, simplifying assumptions		
6.2	Principles of concrete mix design, packing density and rheology		
6.3	Methods of concrete mix design, IS Method, ACI Method, DOE Method – Statistical quality control – Sampling and acceptance criteria.		

C. Course Outcomes (COs):

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

CO1	The learner is expected to be able to select the cement type, aggregates, need for admixture and to decide the mix proportions of concrete.
CO2	Student will develop a sight for testing and evaluation of strength and durability of concrete.
CO3	Student can have knowledge on special concrete and its present demand.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	-	-	1
CO2	1	1	-	1
CO3	1	-	-	1

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1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**
  1. Neville, A.M., Properties of Concrete. ELBS Edition (4th ed.) Longman Ltd., London.
  2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill.
  3. Neville, A.M., & Brooks, Concrete Technology, ELBS Edition, London.
  4. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010
  5. Krishnaraju, N., "Advanced Concrete Technology", CBS Publishers.
- **Reference Books:**
  1. Taylor, Concrete Technology, Orchid.
  2. Mehta, P.K., Monteiro, P. J. M., Concrete, Prentice Hall, New Jersey.
  3. Varshney, R.S., Concrete Technology, Oxford, IBH Publisher.
  4. John Newman, B. S. Choo., Advance Concrete Technology 3: process (vol 3).
  5. Malhotra, V.M., and Ramezaniaanpour, A.A., Fly Ash In Concrete, Canmet.
  6. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.

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CLUE505: THEORY & APPLICATIONS OF PLATES & SHELLS (PROGRAMME ELECTIVE-II)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Pure Bending of Plates	05
2	Laterally Loaded Rectangular Plates & Circular plates	14
3	Shells	04
4	Membrane Analysis	10
5	General Theory of Cylindrical Shells	12

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. **Detailed Syllabus:**

1.	**Pure Bending of Plates**	**05 Hours**	**11%**
1.1	Introduction, classification of plates, thin plates and thick plates, small deflection theory and large deflection theory		
1.2	Slope & curvature of slightly bent plates		
1.3	Relations between bending moments and curvature in pure bending of plates		
1.4	Derivation of differential plate equation for isotropic and orthotropic plate element		
1.5	Small deflection theory of thin plates		
2	**Laterally Loaded Rectangular Plates & Circular plates**	**14 Hours**	**31%**
2.1	Differential equation of plates, Boundary conditions – Navier solution for simply supported plates subjected to uniformly distributed load and point load		
2.2	Levy's method of solution for plates having two opposite edges simply supported with various symmetrical boundary conditions along the other two edges loaded with u. d. l.		
2.3	Effect of transverse shear deformation, plates of variable thickness, anisotropic plates - thick plates, orthotropic plates and grids, Large Deflection theory		
2.4	Particular cases or solution for circular plates of different boundary conditions under uniformly distributed pressure		
3	**Shells**	**04 Hours**	**9%**
3.1	Classification of shell structures		
3.2	Stress-strain & force displacement relations		
3.3	Spherical dome, conical shells, cylindrical shells, Elliptic paraboloid, hyperbolic parabolod and conoids		
4	**Membrane analysis**	**10 Hours**	**22%**

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4.1	Importance of membrane theory of shells, shells in the form of a surface of revolution and loaded un-symmetrically with respect to their axes		
4.2	Membrane analysis of shells of revolution and cylindrical shells under different loads		
4.3	Use of stress function in calculating membrane forces of shells		
4.4	Applications of membrane solution of elliptic paraboloids and hyperboloids		
5	**General Theory of Cylindrical Shells**	**12 Hours**	**27%**
5.1	A circular cylindrical shell loaded symmetrically with respect to its axis		
5.2	Symmetrical deformation, pressure vessels, cylindrical tanks		
5.3	Thermal stresses, in extensional deformation, general case of deformation		
5.4	Cylindrical shells with supported edges, approximate investigation of the bending of cylindrical shells		
5.5	Use of a strain and stress function, stress analysis of cylindrical roof shells.		

C. Course Outcomes (COs):

On the successful completion of this course

CO1	The student will demonstrate key factual knowledge of the underlying assumptions in the theory of plates and shells.
CO2	The student will be able to relate the academic material of the theory of plates and shells to real-life problems.
CO3	The solutions will be developed by the students towards understanding of structural behavior using applications of plates & shells.
CO4	Student shall understand the rudimentary principles involved in the analysis and design of plates and shells.

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Course Articulation Matrix

	PO1	PO2	PO3	PSO1
CO1	-	-	1	-
CO2	1	-	-	1
CO3	2	-	1	1
CO4	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- Text Books:
  1. Timoshenko, S. P., Winowsky. S., and Kreger, Theory of Plates and Shells, Mcgraw Hill Internal, New Delhi.
  2. Chandrashekhara, K., Theory of Plates, University Press, 2001
  3. Bairagi, N. K., Plate Analysis, Khanna Publishers, Delhi.
  4. Bairagi, N. K., Shell Analysis, Khanna Publishers, Delhi.
- Reference Books:
  1. Ramaswamy, G. S., Design & construction of concrete shell roofs, CBS Publishers Distributors.
  2. Brush and Almorth, Buckling of bars, plates and shells, McGraw-Hill, Kogakusha.
  3. Hass A.M., Design of Thin Concrete Shells, John Wiley & Sons
  4. Urugal, A. C., Stress in plates and shells, McGraw-Hill Ryerson, Limited.
- Web Materials:

  http://www.rh.edu/~bakm.

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CLUE506: DESIGN OF TALL STRUCTURES (PROGRAMME ELECTIVE-II)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Tall Building	18
2	Cooling towers	10
3	Transmission Line towers	9
4	Microwave towers	8

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Tall Building**	**18 Hours**	**40%**
1.1	Structural systems for (a) floor systems (b) vertical load resisting systems (c) lateral load resisting systems, and (d) connections		
1.2	Interaction of frames and shear wall, Twist of frames, Effects of opening		
1.3	Behaviour of Braced frame structures, rigid frame structures, in filled frame structure		
1.4	flat plate and flat-slab structures, shear wall structures, wall-frame structures, framed-tube structures		
1.5	outrigger-braced structures, suspended structures, core-structures, space and hybrid structures, Analysis of coupled shear walls		
1.6	Various methods of analysis like static linear/nonlinear, dynamic, buckling analysis, construction stage analysis etc.		
1.7	Structural control and energy dissipation devices for tall building		
2	**Cooling towers**	**10 Hours**	**22%**
2.1	Types, components, analysis and design of towers		
3	**Transmission Line towers**	**09 Hours**	**20%**
3.1	Types of loads, Tower Configuration, Analysis and Design of towers		
4	**Microwave towers**	**08 Hours**	**18%**
4.1	Types of loads, Tower Configuration, Analysis and Design of towers		

C. Course Outcomes (COs):

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

CO1	To know the types of tall buildings.
CO2	Students can understand the behaviour of tall buildings subjected to lateral loading.

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CO3	The students can develop knowledge about the basic principles of designing the tall structures as per the existing codes.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	-	1	-	-
CO2	2	1	2	-
CO3	3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**
  1. Woltang Schuller, High- rise building Structures, John wiley and Sons, New York 1976.
  2. Lynn S. Beedle, Advances in Tall Buildings, CBS Publishers and Distributors Delhi, 1996.
  3. B.S. Taranath, Structural Analysis & Design of tall Buildings, McGraw Hill, 1998.
  4. B.S. Taranath, Steel, concrete and composite design of tall buildings, McGraw Hill, 1997.
  5. Handbook of Concrete Engineering - Mark Fintel, Springer

- **Reference Books:**
  1. Tall Building Structures: Analysis and Design- Coull and Smith John Wiley & Sons
  2. Structural Design of Multi-storeyed buildings - U. H. Variani, South Asian Publishers
  3. Transmission Line Structures – A. R. Santhakumar & S. S. Murthy, Tata McGraw- Hill Book Co.
  4. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988
  5. Khanna R.L. and CB of I & P New Delhi (1997) "Manual on "Transmission Line Towers"

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♦ **Other Materials:**

1. IS 11504, Criteria for Structural Design of Reinforced Concrete Natural Draught Cooling Towers
2. IS 802(Part1/Sec1), Indian Standard: "Code of Practice for Use of Structural Steel in Overhead Transmission Line Towers- Materials and Loads"
3. IS 802(Part1/Sec2), Indian Standard: "Code of Practice for Use of Structural Steel in Overhead Transmission Line Towers-Permissible Stresses"
4. IS 11233, Code of practice for design and construction of radar antenna, microwave and TV tower foundations
5. IS: 875,Code of Practice for Design Loads

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M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – II)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

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HSUA501A: ACADEMIC WRITING

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	02	--	30	2
Marks	--	50	--	50	

Pre-requisite courses:

- An Intermediate Guide to Writing in English for University Study https://www.futurelearn.com/courses/english-for-study-intermediate/4/todo/62943

Objectives of the Course:

To facilitate learners to:

- Explore and demonstrate professional communication skills
- Understand the concept and applications of academic writing
- Learn the academic writing style, strategy and approach
- Explore and implement accurate and effective writing in English in academic setting
- Hone their academic writing skills in general

Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Academic Writing and Research Process	05
2.	Anatomy of Academic Writing	05
3.	Key Academic Skills	05
4.	Accuracy in Academic Writing	05
5.	Using and Citing Sources of Ideas	05
6.	Contemporary Practices in Academic Writing	05
	Total hours (Practical):	30
	Total hours (Lab) :	--
	Total hours :	30

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Detailed Syllabus:

1.	Academic Writing and Research Process	5 Hours	
	Introduction to Academic Writing, Academic Writing as a Part of Research, Types of Academic Writing, Features of Academic Writing, Importance of Good Academic Writing in various Academic Works		
2.	Anatomy of Academic Writing	5 Hours	
	Academic Vocabulary, Simple and Complex Sentences, Organizing Paragraphs, The Writing Process, Adopting Academic Writing Style		
3.	Key Academic Skills	5 Hours	
	Note – taking, Note – making, Paraphrasing, Summarizing		
4.	Accuracy in Academic Writing	5 Hours	
	Lexical Range, Academic Language and Structures, Elements of Writing, Proof Reading, Editing, and Rewriting		
5.	Using and Citing Sources of Ideas	5 Hours	
	Academic Texts and their Types, Intellectual Honesty in Academic Writing, Avoiding Plagiarism – Idea Theft, Degrees of Plagiarism, Types of Borrowing, Anatomy of Citations, Common Citation Styles		
6.	Contemporary Practices in Academic Writing	5 Hours	
	Analytical Essays, Graph / Table / Process Interpretation and Description, Writing Reports and Abstract, Writing Research / Concept Papers		

Course Outcome (COs):

At the end of the course, the students

CO1	Will have sound understanding of the concept and applications of academic writing
CO2	Will have acquired enough knowledge of academic writing style, strategy and approach
CO3	Will be able to demonstrate error free and effective academic writing
CO4	Will be able to demonstrate ability to work on project/report/paper writing
CO5	Will have the sound understanding of the Research and Research Methodology
CO6	Will be effectively communicating.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	-	-	1
CO2	3	2	-	3

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CO3	3	3	-	3
CO4	2	2	-	2
CO5	1	-	-	1
CO6	2	-	2	2

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If

there is no correlation, put "-"

Recommended Study Material:

- **Text book:**
    1. Academic Writing for International Students, Routledge
    2. Academic Writing: A Guide for Management Students and Researchers. Monipally, M.M. &Pawar, B.S. Sage. 2010. New Delhi
    3. Effective Academic Writing Level - 1,2,3,4 (Second Edition) By: Alice Savage, Patricia Mayer, Masoud Shafiei, Rhonda Liss, & Jason Davis; Publisher: Oxford

- **Reference book:**
    1. Writing Your Thesis (2nd Edition) by Paul Oliver, Sage
    2. Development Communication In Practice by Vilanilam V J, Sage
    3. Intercultural Communication by Mingsheng Li, Patel Fay, Sage

- **Web material:**

  www.owl.perdue.edu

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Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Finite Element Method	02
2	Plane stress and Plane strain	04
3	One Dimensional Finite Elements	08
4	Finite Elements for Two Dimensional Planar Bodies	10
5	Finite Elements for Three Dimensional Analysis	10
6	Advanced Concepts In The Formulation of Two & Three Dimensional Elasticity Elements	06
7	Finite Elements for Plate Bending Analysis	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1.	**Introduction to Finite Element Method**	**02 Hours**	**05%**
1.1	Brief history of the development		
1.2	Advantages & disadvantages of finite element method		
1.3	Displacement approach		
1.4	Foundations of the FEM-energy principles		
2	**Plane stress and Plane strain**	**04 Hours**	**09%**
2.1	Linear elasticity, equations of equilibrium, stress, strain, constitutive relations		
2.2	Boundary conditions, description of an elasticity problem as a boundary value problem		

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2.3	Plane stress, strain, axial symmetric problems		
2.4	Introduction to plasticity, yield condition, ideal elasto-plastic material		
3	**One Dimensional Finite Elements**	**08 Hours**	**18%**
3.1	Stiffness matrix for the basic bar & beam element representation of distributed loading		
3.2	The assembly process within the PMPE approach		
3.3	Element stresses, shape functions & interpolation polynomials, refined one dimensional elements		
4	**Finite Elements for Two Dimensional Planar Bodies**	**10 Hours**	**22%**
4.1	Triangular elements for plane stress or strain conditions		
4.2	Higher order triangular elements		
4.3	Rectangular elements for plane stress or strain conditions		
4.4	Higher order rectangular elements: Lagrange element family		
5	**Finite Elements for Three Dimensional Analysis**	**10 Hours**	**22%**
5.1	Tetrahedral elements, higher-order tetrahedra		
5.2	Rectangular hexahedral elements, higher-order rectangular hexehedra: Lagrange element family		
6	**Advanced Concepts in the Formulation of Two & Three Dimensional Elasticity Elements**	**06 Hours**	**13%**
6.1	Natural co-ordinates		
6.2	Area or triangular co-ordinates		
6.3	Serendipity rectangles & hexahedra		
6.4	Isoparametric concept, properties of isoparametric elements, numerical integration		
7	**Finite Elements For Plate Bending Analysis**	**05 Hours**	**11%**
7.1	12-Degree of Freedom rectangular element		
7.2	Triangular Elements		

C. Course Outcomes (COs):

On the successful completion of this course

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CO1	Students will be able to solve realistic engineering problems through computational simulations using finite element code.
CO2	Students will be in a position to develop computer codes for any real time problem using Finite Element technique.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	2	1	2	1
CO2	2	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**
  1. Desai &Ables, Finite Element Method, CRC Pr I Llc.
  2. Chandrupatla and Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall PTR, 2002.
  3. Mukhopadhyay, M., Matrix Finite Element Computer & Structural Analysis, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi, India.
  4. Weaver, W., and Gere, J. M., Matrix Analysis of Framed Structure, CBS Publishers & Distributors, New Delhi, India.
- **Reference Books:**
  1. Krishnamoorthy C.S., Finite Element Analysis, Tata McGraw-Hill.
  2. Dawe, D.J., Matrix & Finite Element Displacement Analysis of Structures, Clarendon Press, 1984.
  3. Cook, R.D., Concepts & Applications of Finite Element Analysis, Wiley.
  4. Yang, T.Y., Finite Element Structural Analysis, Prentice Hall.
  5. Rao, S.S., Finite Element Analysis, Elsevier Butterworth-Heinemann.

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CLUC503: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	4	2	6	5
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Single-Degree-of-Freedom (SDOF) Systems	12
3	Multi-Degree-of-Freedom (MDOF) Systems	12
4	Continuous Systems	06
5	Earthquake Basics	04
6	Earthquake Resistant Design	16
7	Special problems and case studies	08

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

B. Detailed Syllabus:

1.	**Introduction**	**02 Hours**	**03%**
1.1	Role of dynamic analysis in structural engineering		
1.2	Dynamics of particles, system of particles & rigid bodies		
1.3	Nature of dynamic loading: Harmonic, Earthquake & Blast loading		
2	**Single-Degree-of-Freedom (SDOF) Systems**	**12 Hours**	**20%**
2.1	Free and forced vibration of single degree of freedom (SDOF) system		
2.2	Response to harmonic, periodic, impulsive and general dynamic loading on an element		

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2.3	Numerical evaluation of dynamic response		
2.4	Earthquake response of linear systems		
3	**Multi-Degree-of-Freedom (MDOF) Systems**	**12 Hours**	**20%**
3.1	Free and forced vibrations of lumped MDOF systems		
3.2	Dynamic analysis and response of linear systems		
3.3	Earthquake analysis of linear systems		
3.4	Numerical evaluation of dynamic response		
3.5	Damped motion of shear building		
4	**Continuous Systems**	**06 Hours**	**10%**
4.1	Equation of motion		
4.2	Undamped free vibrations		
4.3	Forced vibration of bars and beams		
5	**Earthquake Basics**	**04 Hours**	**07%**
5.1	Engineering seismology, rebound theory, plate tectonics, seismic waves, earthquake size and various scales, local site effects, Indian seismicity, seismic zones of India,		
5.2	Theory of vibration, near ground and far ground rotation and their effects		
6	**Earthquake Resistant Design**	**16 Hours**	**27%**
6.1	Concept of seismic design		
6.2	Earthquake resistant design of R.C.C structures as per IS 1893 (Part 1):2002		
6.3	Earthquake resistant construction of R.C.C. elements and detailing aspects as per IS 13920:1993		
6.4	Earthquake resistant design of brick masonry structures as per IS 4326		
7	**Special problems and case studies**	**08 Hours**	**13%**
7.1	Structural configuration, Seismic performance, Soil performance		
7.2	Modern concepts, Base isolation, Adoptive system		

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7.3	Case studies		

C. Course Outcomes (COs):

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

CO1	Determine the natural frequency of a single degree of freedom and multi degree of freedom dynamic systems for given mass, structural properties, and damping.
CO2	Determine the maximum dynamic response of an elastic vibrating structure to a giving forcing function.
CO3	Understand basic earthquake mechanisms, tectonics, types of ground motion, and propagation of ground motion.
CO4	Determine the static design base shear based on the type of structural system, irregularity, location and occupancy and distribution of the static base shear to the structure based on vertical distribution of mass, horizontal distribution of mass, and centers of rigidity.
CO5	The course will also call upon the critical sense of structural engineers in order to allow the seismic evaluation of existing structures.
CO6	Finally, the course will allow structural engineers to acquire new basic knowledge in earthquake engineering that will allow them to communicate better with scientists and engineers of other disciplines in earthquake engineering.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	-	2	-
CO2	2	-	3	1
CO3	1	2	1	-
CO4	1	-	1	-
CO5	3	3	3	2
CO6	3	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

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Recommended Study Material:

- **Text Books:**
  1. Chopra, A.K., Dynamics of Structures, 3rd edition, Prentice Hall, N.J.
  2. Mario Paz, Structural Dynamics Theory and Computation, CBS Publishers & Distributors.
  3. Newmark, N.M. and Rosenblueth E., Fundamentals of Earthquake Engineering, Prentice Hall PTR.
  4. Agarwal, P. and Shrikhande, M., Earthquake Resistant Design of Structures, PHI Learning Private Limited.
  5. Datta, T.K., Seismic Analysis of structures, John Wiely International, May 2010
- **Reference Books:**
  1. Clough, R. and Penzien, J. Dynamics of Structures, McGraw-Hill Book Co.
  2. Mukhopadhyay, M., Structural Dynamics Vibrations and Systems, Ane Books India Publishers.
  3. Roy, R.C., Structural Dynamics an Introduction to Computer Methods, John Wiley & Sons Publications.
  4. Chen, W.F., and Charles, S., Earthquake Engineering Handbook, CRC Press London.
  5. Duggal S.K., Earthquake Resistant Design of Structures, OXFORD University Press.
- **Web Materials:**
  1. http://www.nicee.org/Publications.php
  2. https://www.eeri.org/
  3. http://www.earthquakeengineering.com/
  4. http://www.curee.org
- **Other Materials:**
  1. IS: 875,Code of Practice for Design Loads
  2. IS: 1893 (Part-I), Criteria for Earthquake Resistant Design
  3. IS: 4326 , Earthquake Resisting Design & Construction Building
  4. IS: 13920 , Ductile Detailing of RC Structures
  5. IS: 13827 , Earthquake Resistance of Earthen Buildings
  6. IS: 13828 , Earthquake Resistance Low Strength Masonry Buildings

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Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	-	6	6	4
Marks	-	200	200	

A. Outline of the Course:

The students will be dealing and working on following current/past real life projects.

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Review of Steel Design Concepts	15
2	Design of single storey steel building	15
3	Design of multi storey steel building	15
4	Design of industrial building	15
5	Design of steel bridges	15
6	Design of masonry building	15

Total Hours (Theory): 0

Total Hours (Lab): 90

Total Hours: 90

B. Detailed Syllabus:

1	**Review of Steel Design Concepts**	**15 Hours**	**17%**
1.1	Bolted Connections		
1.2	Welded Connections		
1.3	Design of Tension Members		
1.4	Design of Compression Members		
1.5	Design of Built-up Column		
2	**Design of single storey steel building**	**15 Hours**	**16%**
2.1	Determination of dead load, live load on various components of the buildings and appropriate design in structural software		
3	**Design of multi storey steel building**	**15 Hours**	**17%**

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3.1	Determination of wind load and earthquake load on various components of the buildings and appropriate design in structural software		
3.2	Different lateral load resisting system		
4	**Design of industrial building**	**15 Hours**	**17%**
4.1	Forces on Industrial roof and components design using software		
5	**Design of steel bridges**	**15 Hours**	**17%**
5.1	Determination of various loads on different elements of the steel bridge and appropriate design in structural software		
6	**Design of masonry building**	**15 Hours**	**16%**
6.1	Basic Design Philosophy & Design Considerations		
6.2	Loads acting and codal provisions		
6.3	Analysis & Design		

C. Course Outcomes (COs):

On the successful completion of this course, students will be able to

CO: 1	The students will acquire diverse knowledge about steel and masonry structures during this module.
CO: 2	This course provides detailed knowledge about how to integrate real life projects from scratch to end.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	3	2	2	3
CO2	2	1	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Arya, A.S., &Ajmani, J.L., Design of Steel Structures, Nem Chand &Bros.,India.
2. Ramchandran, Design of Steel Structures Vol. I & II, Standard Book House.

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♦ **Reference Books:**

1. Subramanian, N., Design of Steel Structures, Oxford University Press, USA.
2. Dayarathnam& Wheeler, Design of Steel Structure, Wheeler Publishing, New Delhi.

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CLUE507: DESIGN OF OFFSHORE STRUCTURES (PROGRAMME ELECTIVE-III)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Offshore Structures	04
2	Offshore Structure Loads	06
3	Analysis & Design of Offshore Structures	18
4	Corrosion Protection	08
5	Design of tubular Joints	09

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Introduction to Offshore Structures**	**04 Hours**	**09%**
1.1	Introduction		
1.2	History of Offshore Structures		
1.3	Overview of Field Development		
1.4	Feed Requirements		
1.5	Types of Offshore Platforms		
1.6	Different Types of Offshore Structures		
1.7	Minimal Offshore Structure		
2.	**Offshore Structure Loads**	**06 Hours**	**13%**
2.1	Introduction		
2.2	Gravity Loads, Hydrostatic loads		
2.3	Wind Load, Operational loads, Environmental loads due to wind, wave, current and buoyancy, Morison's Equation		
2.4	Offshore Loads, Maximum wave force on offshore structure, Collision Events		
2.5	Fires and Explosions, Material Strength		
2.6	Materials and their behaviour under static and dynamic loads		
2.7	Various design methods and Code Provisions		
2.8	Concept of Return waves		
3.	**Analysis & Design of Offshore Structures**	**18 Hours**	**40%**
3.1	Jacket tower, Analytical models for jacket structures		
3.2	Static method of analysis		
3.3	Design specification		
3.4	Principles of Static and dynamic analyses of fixed platforms		
3.5	Use of approximate methods		
3.6	Design of structural elements		
3.7	Foundation analysis and dynamics of offshore structures		
3.8	Design of platforms, helipads, Mooring cables and pipe lines.		
4.	**Corrosion Protection**	**08 Hours**	**18%**
4.1	Corrosion		
4.2	Corrosion mechanism and types of corrosion, Biological corrosion		

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4.3	Offshore structure corrosion zones		
4.4	Coatings and Corrosion Protection of Steel Structures		
4.5	Corrosion Stresses Due to the Atmosphere, Water and Soil		
4.6	Principles of cathode protection systems		
4.7	Sacrificial anode method and impressed current method		
5.	**Design of tubular Joints**	**09 Hours**	**20%**
5.1	Introduction to tubular joints, Possible modes of failure		
5.2	Eccentric connections and offset connections, Cylindrical and rectangular structural members		
5.3	In plane and multi plane connections, Parameters of in-plane tubular joints, Kuang's formulae		
5.4	Elastic stress distribution, Punching shear Stress, Overlapping braces, Stress concentration		
5.5	Chord collapse and ring stiffener spacing, Stiffened tubes		
5.6	Fatigue of tubular joints, Fatigue behaviour		
5.7	S-N curves – Palmgren		
5.8	Design of tubular joints as per API Code		

C. Course Outcomes (COs):

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

CO1	Analyze and design of offshore structures. Also students will be able to design the joints.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Chakrabarti, S.K., Handbook on offshore Engineering, Vol.1 & 2, Plainfield, Illinois, USA. 2005.

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2. El-Reedy Mohamad., Offshore structures design, construction and maintenance, Gulf priting publishers.
3. Dawson, T. H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983.
4. Reddy, D. V., & Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ.Co.1991.

♦ **Reference Books:**

1. Chakrabarti, S. K., Hydrodynamics of Offshore Structures, Computational Mechanics Publications, 1987.
2. McClelland, B., & Reifel, M. D., Planning & Design of fixed Offshore Platforms, VanNostrand, 1986.
3. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
4. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.
5. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex.
6. Wiegel, R.L., Oceanographical Engineering, Prentice Hall Inc, Englewood Cliffs, N.J. 1964.
7. Reddy, D.V., &Arockiasamy, M., Offshore Structures, Vol.1, Krieger Publishing Company, Malabar, Florida, 1991.

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CLUE508: DESIGN OF COMPOSITE STRUCTURES (PROGRAMME ELECTIVE-III)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Design of composite slab	13
3	Design of composite beam	13
4	Design of composite column	13
5	Advances in composite and hybrid structures	04

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1.	**Introduction**	**02 Hours**	**4%**
1.1	Overview of composite structure		
2	**Design of composite slab**	**13 Hours**	**30%**
2.1	Definition and general description		
2.2	Design for the construction condition		
2.3	Design of composite slabs, design for shear and concentrated loads		
2.4	Serviceability limits, crack control, shrinkage and creep		
2.5	Fire Resistance		
3	**Design of composite beam**	**13 Hours**	**30%**
3.1	Introduction, Material properties		
3.2	Composite beams, Plastic analysis of composite section, shear resistance, shear connection		
3.3	Full and partial shear connection, transverse reinforcement, Primary and edge beams, serviceability limit state		
3.4	Continuous composite beams		
4	**Design of Composite columns**	**13 Hours**	**30%**
4.1	Introduction, Design of composite columns		
4.2	Simplified design method		
4.3	Illustrative examples of design of composite columns		
4.4.	Longitudinal and transverse shear forces		
5	**Advances in composite and hybrid structures**	**04 Hours**	**6%**

C. Course Outcomes (COs):

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

CO1	Understand fundamentals of composite elements and structures and also provides experience in realistic design practice for students engaged primarily in the areas of structural and construction engineering.
CO2	Apply knowledge of failure modes of steel members and structures practices and its solution to real life problems.

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CO3	Design composite structure and elements using the latest theories and design practices.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	2	2	2	2
CO2	2	2	2	2
CO3	_	_	_	_

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.Chakrabarti, S.K., Handbook on offshore Engineering, Vol.1 & 2, Plainfield, Illinois, USA. 2005.

- **Reference Books:**

1. Duggal.S.K., (2014), Limit State Design of Steel Structures, Tata McGraw-Hill Education, New Delhi.
2. Subramanian. N., (2011), Design of Steel Structures, Oxford University Press, New Delhi.
3. Bhavikatti. S.S., (2012), Design of Steel Structures, I.K. International Publishing House Pvt. Ltd. New Delhi.
4. IS 800 General Construction in Steel — Codeof Practice

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5. IS 801 Code of Practice for use of Cold-Formed Light Gauge Steel Structural Members in General Building Construction
6. IS 811 Specification for Cold formed light gauge structural Steel sections
7. IS 11384 Code of practice for composite construction in structural steel and concreteChakrabarti, S. K., Hydrodynamics of Offshore Structures, Computational Mechanics Publications, 1987.
8. EN 1994 (English): Eurocode 4: Design of composite steel and concrete structures – Part : General rules and rules for buildings

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CLUE509: DESIGN OF COLD FORMED STEEL STRUCTURES (PROGRAMME ELECTIVE-III)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	03
2	Tension Members	07
3	Beams	07
4	Columns	07
5	Connections	07
6	Roof Truss	07
7	Direct Strength Method	07

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

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B. Detailed Syllabus:

1	**Introduction**	**03 Hours**	**7%**
1.1	Introduction, Applications, advantages of cold formed sections, Concept of member buckling, Instability of Thin plates, Plate Buckling effects, Effective width of cold formed steel elements, Codal provisions on load buckling, Effective widths of unstiffened plate elements		
2	**Tension Members**	**07 Hours**	**15%**
2.1	Design of tension members		
3	**Beams**	**07 Hours**	**15%**
3.1	Design of Beams		
4	**Columns**	**07 Hours**	**16%**
4.1	Design of axially compressed column		
4.2	combined bending & compression		
5	**Connections**	**07 Hours**	**16%**
5.1	Design of welded connections,		
5.2	Design of a connection with mechanical fasteners		
6	**Roof Truss**	**07 Hours**	**15%**
6.1	Design of welded roof truss		
7	**Direct Strength Method**	**07 Hours**	**16%**
7.1	Effective Width Method and Direct Strength Method		
7.2	Direct strength method for cold formed steel design		

C. Course Outcomes (COs):

On the successful completion of this course, students will be able to

CO: 1	Develop an understanding of the behavior of cold-formed steel members and connections
CO: 2	Develop an understanding of the design provisions in the IS 801 and IS : 811
CO: 3	Become proficient with both Effective Width Method and Direct Strength Method

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Course Articulation Matrix:

	PO 1	PO 2	PO 3	PSO 1
CO1	3	3	3	3
CO2	2	2	2	2
CO3	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Gambhir & Tata Mc Graw Hill, Fundamentals of Structural Steel Design
2. Sairam K S, Design of Steel Structures, by, Pearson Education India
3. Punmia B. C., Jain A. K., Comprehensive Design of Steel Structures 2nd ed., 2008, Laxmi, New Delhi.
4. Wie - Wen Yu., Cold-formed Steel Structures, McGraw Hill Book Company
5. Duggal, Design of Steel Structure -, Tata Mc Graw Hill.

- **Other Materials:**

1. I.S 800: 2007, "Indian Standard General Construction in Steel - Code of Practice", Bureau of Indian Standards, New Delhi. India
2. IS 801: Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members In General Building Construction
3. IS : 811-1987 Specification for cold formed light gauge structural steel sections

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CLUE5010: STRUCTURAL OPTIMIZATION AND RELIABILITY (PROGRAMME ELECTIVE-IV)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Optimization	02
2	Classical Optimization	10
3	Optimization of trusses, frame etc.	08
4	Introduction to Reliability	05
5	Reliability of structural components	10
6	Reliability based design	10

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction to Optimization**	**02Hours**	**04%**
1.1	optimization techniques for unconstrained and constrained optimization problems		
2	**Classical Optimization**	**10Hours**	**22%**
2.1	Lagrange Multiplier technique		
2.2	Kuhn – Tucker conditions		
2.3	Solution of NLP by direct methods and by series of unconstrained optimization problems, formulation of different types of structural optimization problems.		
3	**Optimization of trusses, frame etc.**	**08Hours**	**18%**

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3.1	Minimum weight design of truss and frame.		
4	**Introduction to Reliability**	**05Hours**	**12%**
4.1	Structural safety- variations - probability distributions - allowable stresses for specified reliability - Probabilistic analysis of loads		
5	**Reliability of structural components**	**10Hours**	**22%**
5.1	Reliability of structural components - Reliability Methods - Reliability index - Partial safety factors		
6	**Reliability based design**	**10Hours**	**22%**
6.1	Reliability based design and reliability of simple structural systems		

C. Course Outcomes (COs):

On the successful completion of this course

CO1	To apply different optimization techniques in structural engineering.
CO2	To apply different structural reliability methods.
CO3	Can develop research proposal on optimization and reliability in design practice.

Course Articulation Matrix

	PO1	PO2	PO3	PSO1
CO1	-	-	1	-
CO2	1	-	1	-
CO3	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Arora, J.S , Introduction to optimization, MGH(Int,Ed.), 1989.
2. Rao, S.S, Optimization: Theory and applications , Wiley Eastern,1992.
3. Structural optimization Majid
4. Kresysig, Advanced mathematics, Wiley; 10 edition (August 16, 2011).
5. Marris, Foundation of structural optimization, Wiley, 1982.

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6. Madsen, H. O., Krenk, S., & Lind, N .C., Methods of Structural Safety, Dover Publications, 2006.

♦ **Reference Books:**

1. Ranganathan, R., Structural Reliability Analysis and Design, 1st Edition, Jaico Publishing House, 1999.
2. Melchers, R.E., Structural Reliability Analysis and Prediction, 2nd Edition, John Wiley & Sons,1999.
3. Thoft, C.P., & Baker, M.J., Structural Reliability Theory and its Application, Springer Verlag, 1982.

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CLUE5011: BRIDGE ENGINEERING (PROGRAMME ELECTIVE-IV)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	4.5
2	Type of Bridges & Loading Standards	13.5
3	Super-Structure Design Aspects	13.5
4	Inspection & Maintenance of Bridges	9
5	Advances in Bridge Engineering	4.5

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction**	**4.5 Hours**	**10%**
1.1	Definition & History		
1.2	Classification		
1.3	Planning for a Bridge & Stages of Planning		
2	**Type of Bridges & Loading Standards**	**13.5 Hours**	**30%**
2.1	Classification & Components		
2.2	Need for Loading Standards		
2.3	Loading Requirements		
2.4	Railway Loading Standards		
2.5	Road Bridge Loading		
2.6	Any Important topic in the relevant unit		
3	**Super-Structure Design Aspects**	**13.5 Hours**	**30%**

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3.1	Historical Development, Types of Bridges & Choice of Materials		
3.2	Design Principles		
3.3	Design Procedure for Bridge Super Structure		
3.4	Composite Construction		
3.5	Any Important topic in the relevant unit		
4	**Inspection & Maintenance of Bridges**	**9 Hours**	**20%**
4.1	Necessary for Inspection of Bridges		
4.2	Procedure & Aspects of Inspection		
4.3	Testing of Bridges		
4.4	Aids for Bridge Inspection & Maintenance		
4.5	Maintenance of Bridge Substructure & Superstructure		
5	**Advances in Bridge Engineering**	**4.5 Hours**	**10%**
5.1	Any advance topic in bridge engineering		

C. Course Outcomes (COs):

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

CO1	Select type of bridge based on the necessity and structural requirement.
CO2	understand design philosophy & design procedure for bridges.
CO3	carry out inspection of bridges & suggest remedial measures

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	1	-	1	1
CO2	1	1	1	1
CO3	1	1	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- **Text Books:**

1. Ponnuswamy, S , Bridge Engineering, TMH, 2009

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2. Raina V K, Raina's Concrete Bridge Practice Analysis, Design and Economics, Shroff
3. Jagadeesh&Jayaram, Design of Bridge Structures, PHI

♦ **Reference Books:**

1. David P. Billington, The Tower and the Bridge: The New Art of Structural Engineering, Princeton University Press, 1985.
2. David J. Brown, Bridges: Three Thousand Years of Defying Nature, MBI Pub., 2001
3. Peter Bishop, Bridge, Reaktion Books, 2008
4. David Blockley, Bridges: The Science and Art of the World's Most Inspiring Structures, Oxford University Press, 2012
5. Frank Johnstone Taylor, Modern Bridge Construction: A Treatise Setting Forth the Elements of Bridge Design and Illustrating Modern Methods of Construction, Technical Press, 1951
6. David Young Hill, Bridge Calculation and Design: For Steel Bridges For steel bridges, Griffin, 1962.
7. M. J. Ryall, G. A. R. Parke, J. E. Harding, The Manual of Bridge Engineering ICE manuals, Thomas Telford, 2000

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CLUE5012: BEHAVIOUR OF STRUCTURES UNDER EXTREME LOADING (WIND, BLAST, FIRE) (PROGRAMME ELECTIVE-IV)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	1
2	Behavior of structure under Fire	16
3	Behavior of structure under Wind	14
4	Behavior of structure under Blast	14

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1.	**Introduction**	**01Hour**	**4%**
1.1	Introduction to various loading		
2	**Behavior of structure under Fire**	**16 Hours**	**36%**
2.1	Design methodology		
2.2	Fire Behavior		
2.3	Thermal response and structural behavior		
2.4	Simplified calculation methods for steel, concrete, timber, masonry members		
2.5	Whole building behavior with help of computer programme and case study		
3	**Behavior of structure under Wind**	**14 Hours**	**30%**
3.1	Overview of wind loading		

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3.2	Wind effect of building and structures		
3.3	Dynamic effects of wind on structures		
4	**Behavior of structure under Blast**	**14 Hours**	**30%**
4.1	Overview of Blast loading		
4.2	Structural blast response analysis		
4.3	Calculation of reaction forces and blast panel connection forces		
4.4	Structural element and connection design for blast loading		

C. Course Outcomes (COs):

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

CO1	Understand the behaviour of structure under loading such as wind, blast, fire etc.
CO2	Applying the Understanding to Design Modification to reduce such effect

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	2	1	_	1
CO2	3	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

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M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – III)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

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Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	-	4	4	4
Marks	-	100	100	

A. Outline of the Course:

- Project Preliminaries include course work on a specialized Subject or a Seminar.
- The course work shall be related to the area of his/her project research work.
- The coursework may be chosen from the existing PG (M. Tech.) Programmes of the registering department or from those of other departments.
- In addition to existing courses of the M. Tech. Programme, a department may offer special courses or seminar topics to the students.
- The specific subject of course work study will be decided by the department level Post Graduate Committee on recommendation of the supervisor(s).
- Student at the beginning of a semester may be advised by his/her supervisor (s) for recommended courses.
- Resident students will satisfy the course requirement by attending Institute and Departmental courses, and submitting technical writings on assigned course.
- Non-resident students (full time research in R&D institutions/industries) will submit equivalent amount of technical writing and reports on seminars from their own places of work.
- Course offered at 3rd Semester will be evaluated at least once during the semester and at the end of the semester as a part of continuous evaluation.
- The course work and report is expected to show clarity of thought and expression, critical appreciation of existing literature and analytical or experiment or software based applications in the field of specialization.
- Course work can be based on topic of the Project Work. It may include literature review, required theoretical input, study and comparison of various approaches for the proposed project work.
- A student has to produce some useful outcome by conducting experiments or simulations.

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- Student can learn all aspects and functionality of specialized software in the institute.
- Student can generate one working test bench using research paper along with results verified from referred paper through simulation and by modify existing work student can produce one research paper (research studies)

B. Course Outcomes (COs):

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

CO1	At the end of the course the student's gets exposure to design a research investigation that incorporates appropriate theoretical approaches, conceptual models, and a review of the existing literature.
CO2	Students will explore the new ideas and the possible areas to work ahead.
CO3	Student will learn the various research methodologies useful for doing project work.
CO4	Student will learn to investigate the chosen topic in depth. This implies collecting and reviewing literature and understanding and interpreting the most up-to-date concepts and theories of your chosen academic field and/or project topic.
CO5	Student will learn to apply the concepts and theories learnt in previous years of study and work placements.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	3	2	3	2
CO2	3	2	1	2
CO3	2	3	3	2
CO4	3	3	2	2
CO5	3	2	3	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- Reading Materials, web materials with full citations:

1. Books, magazines & Journals of related topics
2. Programming Languages: FORTRAN, MATLAB
3. Softwares: AutoCAD, ANSYS, STAAD Pro., ETABS, SAP, ABAQUAS
4. www.sciencedirect.com
5. www.elsevier.com

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CLUP602: PROJECT PHASE-I

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	-	16	16	16
Marks	-	500	500	

A. Outline of the Course:

- The Project shall be related to the major field of his/her PG specialization work.
- The Project should be one of the major pieces of evidence that students are familiar with or that student wants to be familiar with. It should reflect specialist subject by means of deep and sustained study.
- The project will be finalized by the department level Post Graduate Committee on recommendation of the supervisor(s).
- The project work shall be carried out by each candidate independently during the third and fourth semester under the guidance of one of the faculty members of the Department. If the project work is of inter-disciplinary nature, a co-guide shall be taken from the same or any other relevant Department.
- If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission to that effect and the name of co-guide at any of these organizations shall be intimated to the Post Graduate Committee at the beginning of third semester.
- Project I includes literature review, required theoretical input, study and comparison of various approaches for the proposed dissertation work.

B. Course Outcomes (COs):

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

CO1	Students will select a topic that is appropriate for his/her degree specialization.
CO2	At the end of the course the student's gets exposure to construct and justify research questions related to the topic.
CO3	Each student will be in a position to design a research investigation that incorporates appropriate theoretical approaches, conceptual models, and a review of the existing literature.

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CO4	Students will learn to structure a discussion in a coherent and convincing way by synthesizing the material in the context of the research questions.
CO5	Students will be having sufficient collection of the literature/experimental data for the implantation/experimentation in project - II.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	3	2	3	2
CO2	3	2	1	2
CO3	2	3	3	2
CO4	3	3	2	2
CO5	3	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- Reading Materials, web materials with full citations:

1. Books, magazines & Journals of related topics
2. Programming Languages: FORTRAN, MATLAB
3. Softwares: AutoCAD, ANSYS, STAAD Pro., ETABS, SAP, ABAQUAS
4. www.sciencedirect.com
5. www.elsevier.com

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M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – IV)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

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CLUP603: PROJECT PHASE-II

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	-	20	20	20
Marks	-	1000	1000	

A. Outline of the Course:

- Student should carry out the investigation by identifying sources of evidence, accessing those using accepted and rigorous academic methods, and analyzing and interpreting the material gathered by simulation/experimentation.
- A project - II is student's own work and will need to keep up the effort, and the interest, over several months and through several stages.
- Student need to think carefully about the time necessary to carry-out and complete your project work and the relative writing up.
- The project should present an orderly and critical exposition of the existing knowledge of the subject and will embody results of original investigations demonstrating the capacity of the candidate to do independent research work.
- While writing the thesis/dissertation, the candidate will layout clearly the work done by him independently and the sources from which he has obtained other information contained in his/her Dissertation.

B. Course Outcomes (COs):

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

CO1	At the end of the course the student's gets exposure to design a research investigation that incorporates appropriate theoretical approaches, conceptual models, and a review of the existing literature.
CO2	Students will learn to structure a discussion in a coherent and convincing way by summarizing the key arguments and providing suitable and coherent findings.
CO3	Student will be able to draw valid conclusions, relating them to the research topic.
CO4	Students will write a comprehensive review of the literature, including a review of other dissertation research related to their study.

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CO5	Students develop a design of their study with a discussion of the methodology to be used including selection of a sample, instrumentation and its testing, sources of data and the data collection process.
CO6	Students describe how their data will be treated and analyzed and the significance and limitations of their study.

Course Articulation Matrix:

	PO1	PO2	PO3	PSO1
CO1	3	2	3	2
CO2	3	2	1	2
CO3	2	3	3	2
CO4	3	3	2	3
CO5	3	2	3	3
CO6	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Recommended Study Material:

- Reading Materials, web materials with full citations:

1. Books, magazines & Journals of related topics
2. Programming Languages: FORTRAN, MATLAB
3. Softwares: AutoCAD, ANSYS, STAAD Pro., ETABS, SAP, ABAQUAS
4. www.sciencedirect.com
5. www.elsevier.com

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