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 2023-24

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.

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

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)
CHARUSAT Campus, At Post: Changa – 388421, Taluka: Petlad, District: Anand
Phone: 02697-247500, Fax: 02697-247100, Email: info@charusat.ac.in
www.charusat.ac.in

Academic Year 2023-2024

CHARUSAT

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

To ensure uniform system of education, duration of undergraduate and post graduate programmes, eligibility criteria for and mode of admission, credit load requirement and its distribution between course and system of examination and other related aspects, following academic rules and regulations are recommended.

1. System of Education

The Semester system of education should be followed across The Charotar University of Science and Technology (CHARUSAT) both at Undergraduate and Master's levels. Each semester will be at least 90 working day duration. Every enrolled student will be required to take a specified load of course work in the chosen subject of specialization and also complete a project/dissertation if any.

2. Duration of Programme

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

3. Eligibility for admissions

Minimum second class is required for admission into M.Tech programme.

4. Mode of admissions

Admission to M.Tech. programme will be as per Government of Gujarat guidelines. The eligibility norms require a condition to have a bachelor degree in related field and marks obtained in qualifying exam (like GATE) or common entrance test of Government of Gujarat. The detail eligibility norms will be as per Government of Gujarat guidelines.

5. Programme structure and Credits

As per annexure – 1 attached

6. Attendance

All activities prescribed under these regulations and enlisted by the course faculty members in their respective course outlines are compulsory for all students pursuing the courses. No exemption will be given to any student regarding attendance except on account of serious personal illness or accident or family calamity that may genuinely prevent a student from attending a particular session or a few sessions. However, such unexpected absence from classes and other activities will be required to be condoned by the Principal.

Student's attendance in a course should be 80%.

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, for 30% of the marks for the course; and

7.1.1 Final examination by the University through modes such as; written paper or practical test or oral test or presentation by the student or a combination of any two or more of these, is set to 70% of the marks for each the course.

7.2 Internal Evaluation

7.2.1 A student shall be evaluated through Continuous Evaluation and Semester End Examination.

7.2.2 The weight of continuous assessment and End-semester examination shall be varying from UG to PG and from Faculty to Faculty as approved by Academic Council.

7.2.3 During the semester, a student shall be going through continuous assessment. The continuous assessment will be conducted by the respective Department / Institute. At the end of semester a student shall be evaluated through semester end examination comprising of theory and/or practical, viva-voce, term work components as decided by Academic Council.

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

7.3 University Examination

7.3.1 The final examination by the University for 70% of the evaluation for the course will be through written paper or practical test or oral test or presentation by the student or a combination of any two or more of these.

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

7.4 Performance at Internal & University Examination

7.4.1 Minimum performance with respect to internal marks as well as university examination will be an important consideration for passing a course.

Details of minimum percentage of marks to be obtained in the examinations (internal/external) are as follows:

Minimum marks in University Exam per subject	Minimum marks Overall per subject
40%	50%

7.4.2 If a candidate obtains minimum required marks per subject but fails to obtain minimum required overall marks, he/she has to repeat the university examination till the minimum required overall marks are obtained.

8. Grading

8.1. The total of the internal evaluation marks and final University examination marks in each course will be converted to a letter grade **on** a ten-point scale as per the following scheme.

Range of Marks (%)	≥80	≥75 <80	≥70 <75	≥65 <70	≥60 <65	≥55 <60	≥50 <55	<50
Grade	AA	AB	BB	BC	CC	CD	DD	FF
Grade Point	10	09	08	07	06	05	04	00

8.2 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 = $\Sigma C_i G_i / \Sigma C_i$ where C_i is the number of credits of course i
G_i is the Grade Point for the course i
and i = 1 to n, n = number of courses in the semester

(ii) CGPA = $\Sigma C_i G_i / \Sigma C_i$ where C_i is the number of credits of course i
G_i is the Grade Point for the course i
andi = 1 to n, n = number of courses of all semesters up to which CGPA is computed.

(iii) No student will be allowed to move further in next semester if CGPA is less than 3 at the end of an academic year.

9. Award of Degree

9.1 Every student of the programme who fulfils the following criteria will be eligible for the award of the degree:

9.1.1 He/She should have earned minimum required credits as prescribed in course structure; and

9.1.2 He/She should have cleared all internal and external evaluation components in every course; and

9.1.3 In addition to above, the student has to complete the required formalities as per the regulatory bodies, if any.

9.1.3 In addition to above, the student has to complete the required formalities as per the regulatory bodies, if any.

9.2 The student who fails to satisfy minimum requirement of CGPA will be allowed to improve the grades so as to secure a minimum CGPA for award of degree. Only latest grade will be considered.

10 Award of Class:

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

Distinction	CGPA ≥ 7.5 & ≤ 10.0
First class	CGPA ≥ 6.0 & < 7.5
Second class	CGPA ≥ 5.0 & < 6.0
Pass class	CGPA < 5.0

11 Transcript:

The transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken, credits earned, grades obtained, SGPA,CGPA, class obtained, etc.

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
(CHARUSAT)

FACULTY OF TECHNOLOGY & ENGINEERING (FTE)

CHOICE BASED CREDIT SYSTEM

FOR

MASTER OF TECHNOLOGY

A. 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)

1.1. Core Courses

1.1.1 University Core (UC)

University Core Courses are those courses which all students of the University of a Particular Level (PG/UG) will study irrespective of their Programme/specialisation.

1.1.2 Programme Core (PC)

A 'Core Course' is a course which acts as a fundamental or conceptual base for Chosen Specialisation of Engineering. It is mandatory for all students of a particular Programme and will not have any other choice for the same.

1.2 Elective Course (EC)

An 'Elective Course' is a course in which options / choices for course will be offered. It can either be for a Functional Course / Area or Streams of Specialization / Concentration which is / are offered or decided or declared by the University/Institute/Department (as the case may be) from time to time.

1.2.1 Institute Elective Course (IE)

Institute Courses are those courses which any students of the University/Institute of a Particular Level (PG/UG) will choose as offered or decided by the University/Institute from time-to-time irrespective of their Programme /Specialisation

1.2.2 Programme Elective Course (PE)

A 'Programme Elective Course' is a course for the specific programme in which students will opt for specific course(s) from the given set of functional course/ Area or Streams of Specialization options as offered or decided by the department from time-to-time.

1.2.3 Cluster Elective Course (CE)

A 'Institutional Elective Course' is a course which students can choose from the given set of functional course/ Area or Streams of Specialization options (eg. Common Courses to EC/CE/IT/EE) as offered or decided by the Institute from time-to-time.

1.3 Non Credit Course (NC) - AUDIT Course

A 'Non Credit Course' is a course where students will receive Participation or Course Completion certificate. This will not be reflected in Student's Grade Sheet. Attendance and Course Assessment is compulsory for Non Credit Courses.

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	**HS 141.02A**	Foreign Languages (French)	0	2	2	2	-	-	30	70	100
	OR						OR				
	HS 105.02A	Academic Speaking And Presentation Skills	0	2	2	2	-	-	30	70	
	MA742	Numerical And Statistical Techniques (Programme Core-I)	3	2	5	4	30	70	25	25	150
	CL741	Advanced Structural Analysis (Programme Core-II)	4	2	6	5	30	70	25	25	150
	CL742	Design Practices-I (Programme Core-III)	0	6	6	4	0	0	100	100	200
	CLXXX	Programme Elective-I	3	2	5	4	30	70	25	25	150
	CLXXX	Programme Elective-II	3	2	5	4	30	70	25	25	150
					29	**23**					**900**
Sem 2	**HS106.02A**	Academic Writing	0	2	2	2	0	0	30	70	100
	CL743	Finite Element Analysis (Programme Core-IV)	3	2	5	4	30	70	25	25	150
	CL744	Structural Dynamics & Earthquake Engineering (Programme Core-V)	4	2	6	5	30	70	25	25	150
	CL745	Design Practices-II	0	6	6	4	0	0	100	100	200

		(Programme Core-VI)										
	CLXXX	Programme Elective-III	3	2	5	4	30	70	25		25	150
	CLXXX	Programme Elective-IV	3	2	5	4	30	70	25		25	150
	XXXXX	University Elective	0	2	2	2	0	0	30		70	100
					31	**25**						**1000**
							Internal		**External**			
							Report	**Seminar**	**Report**	**Seminar**	**Viva**	**Total**
Sem 3	**CL811**	Project Preliminaries				4	50	50	--	50	50	200
	CL812	Project Phase – I				16	100	100	100	100	100	500
						20						**700**
Sem 4	**CL814**	Project Phase - II				20	200	200	200	200	200	1000
						20						**1000**
		GRAND TOTAL				**88**						**3600**

University Electives

EE782.01	Energy Audit & Management	OC733.01	Introduction to Polymer Science
CE771.01	Project Management	MA771.01	Reliability & Risk Analysis
ME781.01	Occupational Health & Safety	MA772.01	Design of Experiments
CA730	Internet & Web Designing	RD701.01	Introduction to Analytical Techniques
CA 842	Mobile Application Development	RD702.01	Introduction to Nanoscience & Technology
PT796.01	Fitness & Nutrition	PSE55	Astrophysics, Space & Cosmos
MB651	Software Based Statistical Analysis	PH891	Community Pharmacy Ownership
NR 755	First Aid & Life Support	PH892	Intellectual Property Rights

Programme Electives

Semester 1 (Programme Elective-I)		Semester 1 (Programme Elective-II)	
CL761	Design of Foundation Systems	CL764	Advanced Concrete Technology
CL762	Prestressed Concrete Structures	CL765	Theory and Application of Plate & Shells
CL763	Stability Analysis	CL766	Design of Tall Structures

Semester 2 (Programme Elective-III)		Semester 2 (Programme Elective-IV)	
CL767	Design of Offshore Structures	CL770	Structural Optimization & Reliability
CL768	Design of Composite Structures	CL771	Bridge Engineering
CL769	Design of Cold Formed Steel Structures	CL772	Behavior of Structures under Extreme Loading

M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – I)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

HS141.02 A: FOREIGN LANGUAGES (French)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	02/01	--	30/15	**02**
Marks	--	100	--	100	

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		

	(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.

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

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)

If there is no correlation, put "-"

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

HS105.02 A: ACADEMIC SPEAKING AND PRESENTATION SKILLS

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	30/15	--	30/15	02
Marks	--	100	--	100	

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

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

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

MA742: 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.

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.

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.

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

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.

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).

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%**

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:

	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

CL761: 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

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		

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

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.

CL762: 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

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		

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)

CL763: 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

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		

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.

CL764: 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

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		

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

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.

CL765: 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

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%**

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.

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.

CL766: 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

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.

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"

❖ **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

M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – II)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

HS106.02 A: ACADEMIC WRITING

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	**30/15**	--	30/15	**2**
Marks	--	100	--	**100**	

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**

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

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

CL743: FINITE ELEMENT ANALYSIS

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		

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

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.

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		

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		

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 "-"

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

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%**

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.

❖ **Reference Books:**

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

CL767: 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

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		

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.

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.

CL768: 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

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.

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

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

CL769: 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

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

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

CL770: 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%**

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.

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.

CL771: 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%**

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

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

CL772: 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		

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 "-"

M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – III)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL811: PROJECT PRELIMINARIES

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.

- 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

CL812: 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.

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

M. Tech. (Civil-Structural Engineering) Programme

SYLLABI

(Semester – IV)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL814: 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.

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