



Two-Year Postgraduate Programme

Master of Technology

Structure Engineering

(Civil Department)

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering & Technology
Master of Technology in Structural Engineering

1. Vision of the Department

The vision of the Civil Engineering Program is to impart a quality engineering education and ascertain research services to mankind.

2. Mission of the Department

The mission of the Civil Engineering Department is to nurture the intellectual, professional, and personal development of our students in order to prepare and encourage them to be highly competent technocrats and responsible members of society.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the M. Tech Structure Engineering curriculum enables graduates to attain.

PEO 1	Develop technical skills (critical investigation, communication, analytical and computer) and human relations skills (group dynamics, team building, organization and delegation) to enable students to translate the acquired knowledge into action.
PEO 2	To provide an environment for exploring the Research & Development attitude, to help the students for Ph.D / Research and Development.
PEO 3	Demonstrate interpersonal skills, leadership ability, and team building to achieve organizational goals and serve society with professional ethics and integrity.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Engineering knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	Problem analysis:	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	Design/development of solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PLO 4	Conduct investigations of complex problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PLO 5	Modern tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	The engineer and society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	Environment and sustainability:	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	Individual and team work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	Project management and finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	Life-long learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	Demand as per recent development	To embark on a career as an entrepreneur as a structural designer/consultant thereby playing a very important role in society.
PSO 2	Codes for Designing	Familiarity and ability to use Indian and International Codes/ Standards for design of multidisciplinary projects.
PSO 3	Software skill	Analytical and computer skills that enable students to process information under difficult situation and to appropriately apply methods, procedures and techniques to decision making.
PSO 4	Presentation Skills	To inculcate critical analysis and communication skills that enable, students to effectively present their views, both in

		writing or through oral presentations.
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6. Credit Framework

Semester wise Credit distribution of the programme		Category wise Credit distribution of the programme	
		Category	Credit
Semester-1	18	Major Core	27
Semester-2	18	Minor Stream	0
Semester-3	16	Multidisciplinary	03
Semester-4	16	Ability Enhancement Course	02
		Skill Enhancement Courses	08
		Value added Courses	0
		Summer Internship	0
		Research Project/Dissertation	28
Total Credits: 68		Total Credits:	68

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	203200101	Research Methodology & IPR	2	2	0	0
2	203209101	Advanced Structural Analysis	3	3	0	0
3	203209104	Advanced Concrete Lab	2	0	2	0
4	203209105	Design of Advanced Concrete Structures	3	3	0	0
5	203209106	Design of Advanced Concrete Structures Laboratory	2	0	4	0
6		AUDIT-1 (Compulsory Subjects :1)	AUDIT	2	0	0
7		Elective - 1 (Compulsory Subjects :1)	3	3	0	0
8		Elective - 2 (Compulsory Subjects :1)	3	3	0	0
Total			18	16	6	0

AUDIT-1 (Compulsory Subjects :1)						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	203200102	English for Research Paper Writing	AUDIT	2	0	0
2	203200103	Disaster Management	AUDIT	2	0	0
3	203200104	Sanskrit for Technical Knowledge	AUDIT	2	0	0
4	203200105	Value Education	AUDIT	2	0	0
Elective - 1 (Compulsory Subjects :1)						
1	203209130	Theory of Thin Plates and Shells	3	3	0	0
2	203209131	Theory and Applications of Cement Composites	3	3	0	0
3	203209132	Theory of Structural Stability	3	3	0	0
4	203209136	Design of Bridges	3	3	0	0
Elective - 2 (Compulsory Subjects :1)						
1	203209133	Analytical and Numerical Methods for Structural Engineering	3	3	0	0
2	203209134	Structural Health Monitoring	3	3	0	0
3	203209135	Structural Optimization	3	3	0	0
4	203209137	Advanced Solid Mechanics	3	3	0	0
Semester 2						
9	203209151	Seminar & Mini Project	2	0	4	0
10	203209152	FEM in Structural Engineering	3	3	0	0
11	203209156	Advanced Design of Steel Structures	3	3	0	0
12	203209157	Soft Computing for Structural Engineering	2	0	4	0
13	203209158	Structural Dynamics	2	2	0	0
14		AUDIT-2 (Compulsory Subjects :1)	AUDIT	-	-	2
15		Elective - 3 (Compulsory Subjects :1)	3	3	0	0
16		Elective - 4 (Compulsory Subjects :1)	3	3	0	0
Total			18	16	6	0
AUDIT-2 (Compulsory Subjects :1)						
1	203200151	Constitution of India	AUDIT	-	-	2
2	203200152	Pedagogy Studies	AUDIT	-	-	2
3	203200153	Stress Management by Yoga	AUDIT	-	-	2
4	203200154	Personality Development through Life Enlightenment Skills	AUDIT	-	-	2
Elective - 3 (Compulsory Subjects :1)						
1	203209182	Design of HighRise Structures	3	3	0	0
2	203209188	Design of Blast Resistant Structures	3	3	0	0

3	203209189	Design of Earthquake Resistant Structures	3	3	0	0
4	203209190	Condition Assessment and Retrofitting of Structures	3	3	0	0
Elective - 4 (Compulsory Subjects :1)						
1	203209185	Advanced Design of Foundations	3	3	0	0
2	203209186	Soil Structure Interaction	3	3	0	0
3	203209187	Design of Industrial Structures	3	3	0	0
4	203209191	Design of Off Shore Structures	3	3	0	0
Semester 3						
17	203209201	Dissertation Phase I	10	0	20	0
18		Elective-5 (Compulsory Subjects :1)	3	3	0	0
19		Open Elective (Compulsory Subjects :1)	3	3	0	0
Total			18	16	6	0
Elective-5 (Compulsory Subjects :1)						
1	203209230	Design of Prestressed Concrete Structures	3	3	0	0
2	203209231	Analytical and Finite Element Analysis of Laminated Composite Plates	3	3	0	0
3	203209232	Fracture Mechanics of Concrete Structures	3	3	0	0
4	203209234	Structural Materials	3	3	0	0
Open Elective (Compulsory Subjects :1)						
1	203200201	Business Analytics	3	3	0	0
2	203200202	Industrial Safety	3	3	0	0
3	203200203	Operation Research	3	3	0	0
4	203200204	Cost Management of Engineering Projects	3	3	0	0
5	203200205	Composite Materials	3	3	0	0
6	203200206	Waste to Energy	3	3	0	0
7	203200207	Condition Monitoring and Reliability Assessment	3	3	0	0
Semester 4						
20	203209251	Dissertation Phase II	16	0	32	0
Total			16	0	32	0
Total			68			

8. Detailed Syllabus

Semester 1

- a. **Course Name:** Research Methodology & IPR
- b. **Course Code:** 203200101
- c. **Prerequisite:** Knowledge of Electronics and Communication Systems and Technologies. Basic Computer Skills Fundamental Knowledge of Area of Interest in relevant discipline.
- d. **Rationale:** students will apply matrix methods
- e. **Course Learning Objective:**

CLOBJ 1	To develop skills to idealize, formulate, and analyse determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
CLOBJ 2	To present modern methods to determine the force distribution and deformed shapes of structures
CLOBJ 3	To develop skills in interpreting and predicting solutions from structural analysis
CLOBJ 4	To introduce computer-based applications for the analytical methods as presented

f. Course Learning Outcomes:

CLO 1	Analyse the skeleton structures using stiffness analysis code.
CLO 2	Use direct stiffness method understanding its limitations
CLO 3	Applications to Simple Problems
CLO 4	Approximate Solution of Boundary Value Problems
CLO 5	Application of Linear problems
CLO 6	Use of Shape functions

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	2	60	20	-	20	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	20%	5
2	Effective literature studies approaches, analysis Plagiarism, Research ethics,	15%	5
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	15%	5
4	Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	20%	5
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	15%	5
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	15%	5

i. Text Book and Reference Book:

1. Intellectual Property Rights Under WTO T. Ramappa; S. Chand, 2008
2. Research methodology: an introduction for science & engineering students Stuart Melville and Wayne Goddard; Juta & Co Ltd
3. Research Methodology: An Introduction Wayne Goddard, Stuart Melville; Juta and Company Ltd, 2004
4. Research Methodology : A Step by Step Guide for Beginners Ranjit Kumar; PEARSON; 3rd
5. Resisting Intellectual Property Halbert; Taylor & Francis Ltd., 2007
6. Industrial Design Mayall; McGraw Hill, 1992
7. Product Design Niebel; McGraw Hill, 1974

8. Introduction to Design Asimov; Prentice Hall, 1962
9. Intellectual Property in New Technological Age Robert P. Merges, Peter S. Menell, and Mark A. Lemley; 2016

- a. **Course Name:** Advanced Structural Analysis
- b. **Course Code:** 203209101
- c. **Prerequisite:** Basics of Civil Engineering
- d. **Rationale:** students will apply matrix methods
- e. **Course Learning Objective:**

CLOBJ 1	To develop skills to idealize, formulate, and analyse determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
CLOBJ 2	To present modern methods to determine the force distribution and deformed shapes of structures
CLOBJ 3	To develop skills in interpreting and predicting solutions from structural analysis
CLOBJ 4	To introduce computer-based applications for the analytical methods as presented

f. Course Learning Outcomes:

CLO 1	Analyse the skeleton structures using stiffness analysis code.
CLO 2	Use direct stiffness method understanding its limitations
CLO 3	Applications to Simple Problems
CLO 4	Approximate Solution of Boundary Value Problems
CLO 5	Application of Linear problems
CLO 6	Use of Shape functions

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
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1	Influence Coefficients Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.	15%	8
2	Stiffness Method applied to Large Frames Local Coordinates and Global Coordinates.	15%	8
3	Stiffness Matrix Assembly of Structures Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces	20%	10
4	Applications to Simple Problems Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach	15%	8
5	Boundary Value Problems (BVP) Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.	15%	8
6	Linear Element Shape Functions, Solution for Poisson's Equation, General One Dimensional Equilibrium Problem.	15%	6

i. Text Book and Reference Book:

- 1. Matrix Analysis of Framed Structures**
By Weaver and Gere
- 2. The Finite Element Method**
By P. E. and Ward J. P | Addison-Wesley Publication Co
- 3. Computer Methods in Structural Analysis**
By Meek J. L., E and F N
- 4. The Finite Element Method**
By Desai and Able | CBS Publication

- a. **Course Name:** Design of Advanced Concrete Structures
- b. **Course Code:** 203209105
- c. **Prerequisite:** Civil Engineering
- d. **Rationale:** Students will be able to design Advanced Reinforced Concrete Structures
- e. **Course Learning Objective:**

CLOBJ 1	To develop skills to idealize, formulate, and analyse determinate and indeterminate structures (beams, trusses, and frames) using classical and matrix structural analysis methods.
CLOBJ 2	To present modern methods to determine the force distribution and deformed shapes of structures
CLOBJ 3	To develop skills in interpreting and predicting solutions from structural analysis
CLOBJ 4	To introduce computer-based applications for the analytical methods as presented

f. Course Learning Outcomes:

CLO 1	Analyse the skeleton structures using stiffness analysis code.
CLO 2	Use direct stiffness method understanding its limitations
CLO 3	Applications to Simple Problems
CLO 4	Approximate Solution of Boundary Value Problems
CLO 5	Application of Linear problems
CLO 6	Use of Shape functions

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	60	20	-	20	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Multi-storied building Analysis of multi-story frame, Substitute frame method, Design Example	20%	8
2	Flat Slabs General features, Methods of analysis, Design of flat slabs	15%	8
3	Retaining Walls Active and Passive earth pressure, Different types of Retaining Walls, Design of retaining walls	15%	8
4	Elevated Water Tanks Types of Overhead water tanks, Intz type tank, Conical or funnel shaped tanks, Design example	20%	8
5	Bunkers and Silos Difference between bunkers and silos, Rectangular, Circular Bunkers, Design examples, Design of Silos, Silos for cement storage	15%	8

i. Text Book and Reference Book:

1. P. C. Vergese, Advanced Reinforced Concrete Design, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Dr. V.L Shah, Dr.S.R Karve, Advanced Design of Reinforced Concrete Structures, Standard Publishers
3. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers

- a. **Course Name:** Design of Advanced Concrete Structures Laboratory
- b. **Course Code:** 203209106
- c. **Prerequisite:** Basics of Civil Engineering and Structural Analysis
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:.**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analyzing discrete and continuous system
CLO 2	Analyze stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Criteria for Design of Structures Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and	15%	8

	Continuous Systems, Linear and nonlinear behaviour.		
2	Stability of Column Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling	20%	8
3	Stability of Frames Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.	20%	8
4	Stability of Beams lateral torsion buckling.	15%	8
5	Stability of Plates axial flexural buckling, shear flexural buckling, buckling under combined loads.	15%	8
6	Introduction to Inelastic Buckling and Dynamic Stability.	15%	8

i. Text Book and Reference Book:

1. P. C. Vergese, Advanced Reinforced Concrete Design, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Dr. V.L Shah, Dr.S.R Karve, Advanced Design of Reinforced Concrete Structures, Standard Publishers
3. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers

- a. **Course Name:** Theory of Thin Plates and Shells
- b. **Course Code:** 203209130
- c. **Prerequisite:** : Basic Understanding of theory of elasticity
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	0	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	Content	Weightage	Teaching
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No.			Hours
1	Introduction Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.	15 %	8
2	Static Analysis of Plates Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.	20 %	8
3	Circular Plates Analysis under Axi-Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates	20 %	8
4	Static Analysis of Shells Membrane Theory of shells - Cylindrical, Conical and Spherical Shells,	15 %	8
5	Shells of Revolution with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.	15 %	8
6	Thermal Stresses in Plate/ Shell	15 %	8

i. Text Book and Reference Book:

1. Theory of Plates and Shells Timoshenko and Krierger
2. Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
3. Thin Elastic Shells Kraus H.; John Wiley and Sons
4. Theory of Plates Chandrashekhara K; Universities Press
5. Design and Construction of Concrete Shells Ramaswamy G. S.

- a. **Course Name:** Theory and Applications of Cement Composites
- b. **Course Code:** 203209131
- c. **Prerequisite:** : Basics of Civil Engineering and Concrete Technology
- d. **Rationale:**
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.	15%	8
2	Mechanics of Materials Approach to Stiffness-Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness-Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.	20%	8
3	Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.	20%	8
4	Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.	15%	8
5	FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants	15%	8
6	Ferrocement, SIFCON and Fibre Reinforced Concrete.	15%	8

j. Text Book and Reference Book:

1. Theory of Plates and Shells Timoshenko and Krieger
2. Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
3. Thin Elastic Shells Kraus H.; John Wiley and Sons
4. Theory of Plates Chandrashekhara K; Universities Press
5. Design and Construction of Concrete Shells Ramaswamy G. S.

- a. **Course Name:** Theory of Structural Stability
- b. **Course Code:** 203209132
- c. **Prerequisite:** : Basics of Civil Engineering and Structural Analysis
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to solve problems based on structural stability

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	0	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Criteria for Design of Structures Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.	15 %	8
2	Stability of Column Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling	20 %	8
3	Stability of Frames Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.	20 %	8
4	Stability of Beams lateral torsion buckling.	15 %	8
5	Stability of Plates axial flexural buckling, shearflexural buckling, buckling under combined loads.	15 %	8
6	Introduction to Inelastic Buckling and Dynamic Stability.	15 %	8

i. Text Book and Reference Book:

1. Theory of elastic stability Timoshenko and Gere; Tata Mc Graw Hill Ferrocement – Theory and Applications Pama R. P.; IFIC
2. Principles of Structural Stability Theory Alexander Chajes; Prentice Hall, New Jersey
3. Structural Stability of columns and plates Iyengar, N. G. R.; Eastern west press Pvt. Ltd.
4. Strength of Metal Structures Bleich F. Bucking; Tata McGraw Hill

- a. **Course Name:** Design of Bridges
- b. **Course Code:** 203209136
- c. **Prerequisite:** : Design of Reinforced Concrete Structures, Design of Steel Structures
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to design different types of bridges

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	0	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Reinforced Concrete Bridges Standard specifications for Road and Rail Bridges, Design of Slab Culverts, T-Beams and Slab Bridge, Box Culverts and Pipe Culverts, Reinforced Concrete Slab Bridge Decks	20%	8
2	Steel Bridges Steel Truss Bridges, Plate Girder Bridges	20%	8
3	Other types of Bridges Arch Bridges, Suspension Bridges, Cable-Stayed Bridges, Balanced Cantilever Bridges, Prestressed Concrete Bridges	20%	8
4	Bridge Bearings, Joints and Appurtenances General features, Types of bearings, Design principles, Rocker-Roller Bearing, Elastomeric Bearing, Expansion Joints	20%	8
5	Piers, Abutments and Foundations General Features, Bed Blocks, Materials, Types of piers, Design of piers, Design of abutments	20%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Analytical and Numerical Methods for Structural Engineering
- b. **Course Code:** 203209133
- c. **Prerequisite:** : Basics of mathematics and Civil Engineering
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation and extrapolation.	20%	8
2	Solution of Nonlinear Algebraic and Transcendental Equations	15%	8
3	Solution of Systems of Linear Equations, Eigen Value Problems.	15%	8
4	Solution of Ordinary and Partial Differential Equations.	20%	8
5	Implicit & Explicit scheme.	15%	8
6	Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Structural Health Monitoring
- b. **Course Code:** 203209134
- c. **Prerequisite:** : Basics of structural stability and Repair and rehabilitation
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to understand NDT and its applications

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.	15%	8
2	Concepts, Various Measures, Structural Safety in Alteration.	15%	8
3	Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	20%	8
4	Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	15%	8
5	Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	15%	8
6	Case Studies (Site Visits), piezo- electric materials and other smart materials, electro-mechanical impedance (EMI) technique, adaptations of EMI technique.	20%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Structural Optimization
- b. **Course Code:** 203209135
- c. **Prerequisite:** : Basics of Structural Analysis
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to optimize the designs, loads and materials

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction Simultaneous Failure Mode and Design, Classical External Problems.	15%	8
2	Calculus of Variation Variational Principles with Constraints	15%	8
3	Applications Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,	20%	8
4	Geometric Programming and Stochastic Programming.	15%	8
5	Structural Steel and Concrete Members, Trusses and Frames.	15%	8
6	Design Frequency Constraint, Design of Layouts.	20%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Advanced Solid Mechanics
- b. **Course Code:** 203209102
- c. **Prerequisite:** : Civil Engineering
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be solving problems related to theory of elasticity

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity..	15%	8
2	Elementary Concept of Strain, Strain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.	15%	8
3	Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.	15%	8
4	Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	20%	10
5	Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, and Torsion of Thin Tubes.	15%	8
6	Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress- Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	20%	10

i. Text Book and Reference Book:

4. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
5. Ferrocement – Theory and Applications Pama R. P.; IFIC
6. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

Semester 2

- a. **Course Name:** FEM in Structural Engineering
- b. **Course Code:** 203209152
- c. **Prerequisite:** : Basics of Structural Analysis
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to analyse structures using finite element method

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.	15%	8
2	Flexure Element, Element Stiffness Matrix, Element Load Vector.	15%	8
3	Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.	20%	8
4	Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoperimetric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.	15%	8
5	Plane Stress, CST Element, Plane Strain Rectangular Element, Isoperimetric Formulation of the Plane Quadrilateral Element, Axi-Symmetric Stress Analysis, Strain and Stress Computations.	20%	8
6	Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Advanced Design of Steel Structures
- b. **Course Code:** 203209156
- c. **Prerequisite:** : Basics of Structural Analysis
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to analyse structures using finite element method

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	00	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	INTRODUCTION Steel as structural material, Eng. Structures, Philosophy of Design, Property of steel material specification, Limit state design	15%	8
2	LOADING (04 Hours) Various load on structure, Load calculation, Load combination.	15%	8
3	CONNECTIONS General Design consideration introduction to welded, Bolted connections semi rigid and rigid connection, Beam to beam and beam to column connection, moment resistant connection.	15%	8
4	DESIGN OF STRUCTURAL MEMBERS Design of tension members - Design of compression members, built of compression members, - Design of flexural members-Design of slab base gusseted base foundation, Introduction to plate girder.- Introduction to plate girders.	20%	8
5	INDUSTRIAL ROOF Analysis and design of typical industrial roof trusses with gantry girder	15%	8
6	INNOVATIVE STEEL STRUCTURES STUDY Design of steel foot over bridge	20%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Structural Dynamics
- b. **Course Code:** 203209158
- c. **Prerequisite:** : Basics of Earthquake engineering
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	0	2	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems	15%	8
2	Single Degree of Freedom System Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.	20%	8
3	Numerical Solution to Response Numerical Solution to Response using Newmark Method and Wilson Method, Numerical Solution for State Space Response using Direct Integration	15%	8
4	Multiple Degree of Freedom System (Lumped parameter) Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of equation of motion	20%	8
5	Multiple Degree of Freedom System (Distributed Mass and Load) Single Span Beams, Free and Force Vibration, Generalized Single Degree of Freedom System.	15%	8
6	Special Topics in Structural Dynamics (Concepts only) Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Design of High Rise Structures
- b. **Course Code:** 203209182
- c. **Prerequisite:** : Basics of Structural Design
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to bucking analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Design of transmission/ TV tower Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.	25%	12
2	Analysis and Design of RC and Steel Chimney Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata.	25%	12
3	Tall Buildings Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.	25%	12
4	Application of software in analysis and design.	25%	12

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Design of Blast Resistant Structures
- b. **Course Code:** 203209188
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Blast Loading Blast loading over ground and underground structures - design parameters - relevant BIS codes	10%	3
2	DESIGN AGAINST BLAST AND IMPACT Characteristics of internal and external blast - impact and impulse loads - pressure distribution on buildings above ground due to external blast - underground explosion - design of buildings for blast and impact as per BIS codes of practice	25%	12
3	Safety analysis and rating Reliability assessment repairs and Retrofitting techniques of Community Structures - Protection of Nuclear Structures - Dams, bridges and buildings	25%	12
4	Materials for disasters reduction Detailing aspects of structures subject to probable disasters - Construction techniques - Analysis methodology - Techniques for optimal performance - Provisions for artificial disasters - blast and impact.	15%	6

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Design of Earthquake Resistant Structures
- b. **Course Code:** 203209189
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Earthquake Basics Interior of Earth, plate tectonics, faults, consequences of the earthquake, Basic parameters of earthquake, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes (worldwide). Seismic waves & minus; surface and body waves, their classification and characteristics.	10%	3
2	Fundamentals of Earthquake Vibrations of buildings Static load v/s Dynamic load (force control and displacement control), simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, resonance v/s increased response, responses of structures to different types of vibrations like free and forced, damped and un-damped vibration, response of the building to earthquake ground motion, Response to multi-degree (maximum three) of freedom systems up to mode shapes.	25%	10
3	Design Philosophy Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural layout, Introduction to IS: 1893 (Part I), IS 875 (Part V)—seismic load: Seismic Coefficient Method & minus; base shear and its distribution along the height. Introduction to Response spectrum, IS code provisions.	25%	10
4	Lateral Loads on Buildings Lateral Load Distribution (SDOF): Rigid diaphragm effect, centres of mass and stiffness, torsionally coupled and uncoupled system. Lateral Load Analysis: Analysis of frames using approximate methods like portal & cantilever methods IS 1893 codal provisions for lateral load, modelling of walls and strut element.	15%	6
5	Concepts of Detailing of various structural components as per IS: 13920 provisions.	10%	3

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Condition Assessment and Retrofitting of Structures
- b. **Course Code:** 203209190
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Deterioration of Concrete Buildings: Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal Effects, Structural Effects, Faulty Construction. Evaluation of Concrete Buildings: Visual Investigation, Destructive Testing Systems, Non Destructive Testing Techniques, Semi-Destructive Testing Techniques, Chemical Testing.	25%	12
2	Strategy & Design, Selection of Repair Materials, Surface Preparation, Bonding repair Materials to Existing concrete, Placement Methods, Epoxy Bonded Replacement Concrete, Preplaced Aggregate Concrete, Shotcrete/Gunite, Grouting, Injection Grouting, Micro concrete.	25%	12
3	Strengthening Techniques: Strengthening Techniques, Beam Shear Capacity Strengthening, Shear Transfer Strengthening between Members, Column Strengthening, Flexural Strengthening, and Crack Stabilization Seismic Rehabilitation: Guidelines for Seismic Rehabilitation of Existing Buildings, Seismic Vulnerability and Strategies for Seismic Retrofit.	25%	12
4	Introduction to IS 1893:2002, Behaviour of buildings and structures during past earthquakes and lessons learnt goals of earthquake resistant design. Linear static procedure for seismic load calculation – IS 1893-2002, Design the 5 storey earthquake resistant structures.	25%	12

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Advanced Design of Foundations
- b. **Course Code:** 203209185
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.	15%	8
2	Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws	20%	8
3	Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.	20%	8
4	IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.	15%	8
5	Tunnels and Arching in Soils, Pressure Computations around Tunnels. Open Cuts, Sheet piling and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.	15%	8
6	Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Soil Structure Interaction
- b. **Course Code:** 203209186
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.	15%	8
2	Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.	15%	8
3	Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.	15%	8
4	Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.	20%	8
5	Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non- Linear Stress-Strain Characteristics.	15%	8
6	Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.	20%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Design of Industrial Structures
- b. **Course Code:** 203209187
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:** Students will be able to understand the dynamics behavior of structures

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.	20%	8
2	Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures - Lightweight Structures	15%	8
3	Design of square bunker - Jansen's and Airy's theories - IS Code provisions - Design of side plates - Stiffeners - Hooper - Longitudinal beams Design of cylindrical silo - Side plates - Ring girder - stiffeners.	20%	8
4	Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.	15%	8
5	Design of rectangular riveted steel water tank - Tee covers - Plates - Stays - Longitudinal and transverse beams - Design of staging - Base plates - Foundation and anchor bolts -	15%	8
6	Design of stays - Joints - Design of hemispherical bottom water tank - side plates - Bottom plates - joints - Ring girder - Design of staging and foundation.	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement - Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall

- a. **Course Name:** Design of Off Shore Structures
- b. **Course Code:** 203209187
- c. **Prerequisite:** : Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure
- d. **Rationale:** Students will be able to solve problems based on structural stability
- e. **Course Learning Objective:**

CLOBJ 1	Understand the concept of structural stability and the approach for design for stability
CLOBJ 2	Determine the buckling loads for simple beams and columns by analytical methods
CLOBJ 3	Understand the concept of effective length and its use in design
CLOBJ 4	Design a frame
CLOBJ 5	Apply advanced numerical techniques to buckling analysis of structures
CLOBJ 6	Communicate analysis in written and graphical form

f. Course Learning Outcomes:

CLO 1	Use stability criteria and concepts for analysing discrete and continuous system
CLO 2	Analyse stability of columns and frames
CLO 3	Apply different techniques to determine the stability of beams and plates
CLO 4	Understand inelastic buckling and solve complicated problems

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	60	20	-	00	00	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Fixed, Compliant, Floating- Materials and construction of jacket and gravity platforms- Statutory regulations- Allowable stresses- Design methods and Code Provisions- Design specification of API, DNV, Lloyd's and other Classification Societies- Environmental loads- Wind, wave, current, seismic and ice loads- Calculation based on maximum base shear and overturning moments- Design wave height and spectral definition- Morison's Equation-Maximum wave force on offshore structure- Concept of return waves.	20%	8
2	Principles of static and dynamic analyses of fixed platforms-Use of approximate methods- Principles of WSD and LRFD- Allowable stresses and partial safety factors- Design of structural elements in the deck- Introduction to tubular members- Slenderness effect- Column buckling- Design of tubular members for axial, and bending stresses and hydrostatic pressure.	15%	8
3	Possible modes of failure, Eccentric connections and offset connections- Inplane and multiplane connections- Parameters of Inplane tubular joints- Kuang's formulae- Elastic stress distribution- Punching shear stress- Overlapping braces- Stress concentration- Chord collapse and ring stiffener spacing- Stiffened tubes- External hydrostatic pressure- Fatigue of tubular joints- Fatigue behaviour- S-N curves- Palmgren- Miner cumulative damage rule- Design of tubular joints for static and cyclic loads as per API Code.	20%	8
4	Fire, Blast and Collision- Behaviour of steel at the elevated temperature-Fire rating for Hydrocarbon fire- Design of members for high temperature- Blast mitigation-Blast walls- Collision of boats and energy absorption.	15%	8
5	Corrosion mechanism- Types of corrosion- Offshore structure corrosion zones- Biological corrosion- Preventive measures of corrosion- Principles of cathode protection systems- Sacrificial anode method and impressed current method- Online corrosion monitoring- Corrosion fatigue.	15%	8

i. Text Book and Reference Book:

1. Mechanics of Composite Materials R M Jones; CRC Press Taylor & Francis Stresses in Plates and Shells Ugural Ansel C.; McGraw Hill
2. Ferrocement – Theory and Applications Pama R. P.; IFIC
3. New Concrete Materials Swamy R.N.; Academic and Professional, Chapman & Hall