First Year Curriculum

Admission Year 2026-27

Master of Technology
Structural Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 1

a. **Course Name:** Structural Dynamics
b. **Course Code:** 03020901PC01
c. **Prerequisite:** Physics, Mathematics, Mechanics, Structural Analysis, Earthquake Engineering
d. **Rationale:** Understanding the dynamic behaviour of structures is essential to analyse and design structures subjected to earthquake or wind, or any other type of dynamic loads.
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 with dynamic behaviour.
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	Understand the basics of earthquakes.
CLO 2	Determine the responses of SDOF systems.
CLO 3	Evaluate the responses of MDOF systems.
CLO 4	Analyse the dynamics of linear MDOF systems.
CLO 5	Understand the dynamics of continuous systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**INTRODUCTION** Sources of vibration, types of excitations, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle, Single degree of freedom systems; Mathematical model of physical systems; Equation of motion; Free vibrations of undamped and viscously damped systems	**20%**	**8**
2	**Earthquake Response of SDOF Systems** Earthquake excitation, response history and construction of response spectra; Response spectrum characteristics, tripartite plot, and design spectrum. Time domain analysis: finite difference methods; Frequency domain analysis: basic methodology.	**20%**	**8**
3	**Multi Degree of Freedom Systems** Dynamic equations of equilibrium, static condensation; Symmetric plan and plan-asymmetric systems, Undamped systems: natural modes and their properties; Numerical solution for the eigenvalue problem; Solution of free vibration response for undamped systems; Free vibration analysis of systems with damping.	**20%**	**8**
4	**Dynamic Analysis of Linear MDOF Systems** Introduction, modal analysis; Response-history for earthquake excitations using modal analysis; Response spectrum analysis for peak responses; Concept of Caughey damping as a general type of proportional damping.	**20%**	**8**
5	**Dynamics of Continuous Systems** Equations of motion for axial vibration of a beam; Equations of motion for flexural vibration of a beam; Free vibration analysis; Introduction to forced vibration analysis using modal superposition method. Response of continuous systems to dynamic loads.	**20%**	**8**

i. Text Book and Reference Book:

1. Dynamics of Structures By A.K. Chopra
2. Introduction to Structural Dynamics By John M. Biggs McGraw Hill Book Co..

3. Structural Dynamics By Clough & Penzin.
4. Structural Dynamics - Theory and Computation By Paz
5. Structural Dynamics and Earthquake Engineering By Dr. K. Jagannadha Rao and Er. Srinavas Vasam and S.K. Kataria, Pub. Year 2018
6. Structural Dynamics and Earthquake Engineering By Gopinath and Sudhakar and Yes Dee Publishing Pvt. Ltd., Pub. Year 2022

a. **Course Name:** Structural Dynamics Laboratory
b. **Course Code:** 03020901PC02
c. **Prerequisite:** Physics, Mathematics, Mechanics, Structural Analysis, Earthquake Engineering
d. **Rationale:** Understanding the dynamic behaviour of structures is essential to analyse and design structures subjected to earthquake or wind, or any other type of dynamic loads.
e. **Course Learning Objective:**

CLOBJ 1	To understand and apply fundamental methods of structural dynamic analysis such as Equivalent Static Method, Response Spectrum Method, and Time History Method for seismic loading.
CLOBJ 2	To develop analytical skills for solving dynamic response problems using classical approaches like Newmark Method, Rayleigh's Method, and Duhamel's Integral.
CLOBJ 3	To analyze structural behavior under dynamic loads using numerical and computational techniques, including Fast Fourier Transform and Lagrange's Method.
CLOBJ 4	To interpret and evaluate the dynamic response of structures subjected to earthquake and other time-dependent loads, aiding in safe and efficient structural design.

f. **Course Learning Outcomes:**

CLO 1	Understand the basics of earthquakes.
CLO 2	Determine the responses of SDOF systems.
CLO 3	Evaluate the responses of MDOF systems.
CLO 4	Analyse the dynamics of linear MDOF systems.
CLO 5	Understand the dynamics of continuous systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

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

h. List of Practical:

Sr. No.	Content
1	Equivalent Static Method of Seismic Analysis
2	Response Spectrum Method of Seismic Analysis
3	Time History Method of Seismic Analysis
4	Newmark Method
5	Rayleigh's Method
6	Duhamel's Integral Method
7	Fast Fourier Transform
8	Lagrange's Method

a. **Course Name:** Design of Advanced Concrete Structures
b. **Course Code:** 03020901PC03
c. **Prerequisite:** Basic knowledge Reinforced Concrete Structures
d. **Rationale:** To know about the design of 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	Describe limit state method of design and differentiate it with the previous methods like WSM and ULM
CLO 2	Illustrate different codal provisions for designing the RC structures
CLO 3	Analyze the behavior of flexural members with reference to codal limitations.
CLO 4	Design reinforced concrete structural members like flat slabs, retaining wall.
CLO 5	Design special concrete structures like bunkers, silos & elevated water tanks.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**Multi-storied building** Analysis of multi-story frame, Substitute frame method, Design Example.	**20%**	**9**
2	**Flat Slabs** General features, Methods of analysis, Design of flat slabs.	**20%**	**9**
3	**Retaining Walls** Active and Passive earth pressure, Different types of Retaining Walls, Design of retaining walls.	**20%**	**9**
4	**Elevated Water Tanks** Types of Overhead water tanks: Intz type tank, Conical or funnel-shaped tanks, Design example.	**20%**	**9**
5	**Bunkers and Silos** Difference between bunkers and silos, Rectangular, Circular Bunkers, Design examples, Design of Silos. Silos for cement storage.	**20%**	**9**

i. Text Book and Reference Book:

1. Advanced Reinforced Concrete Design (TextBook) By Varghese P. C
2. Advanced design of concrete structures (TextBook) By Krishna Raju N. and Tata Mc-Graw Hill
3. Advanced Concrete Technology By Zongjin Li
4. Reinforced concrete design By S. Unnikrishna Pillai & Devdas Menon and Tata McGraw Hill
5. Reinforced Concrete Design By Pillai S. U. and Menon D.

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a. **Course Name:** Design of Advanced Concrete Structures Laboratory
b. **Course Code:** 03020901PC04
c. **Prerequisite:** Basic knowledge Reinforced Concrete Structures
d. **Rationale:** To know about the design of 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	Describe limit state method of design and differentiate it with the previous methods like WSM and ULM
CLO 2	Illustrate different codal provisions for designing the RC structures
CLO 3	Analyze the behavior of flexural members with reference to codal limitations.
CLO 4	Design reinforced concrete structural members like flat slabs, retaining wall.
CLO 5	Design special concrete structures like bunkers, silos & elevated water tanks.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

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

h. List of Practical:

Sr. No.	Content
1	Design multistorey buildings
2	Design flat slabs
3	Design retaining walls
4	Design elevated water tanks
5	Design bunkers and silos

a. **Course Name:** Advanced Concrete **Laboratory**
b. **Course Code:** 03020901PC06
c. **Prerequisite:** Basic knowledge of concrete technology and civil engineering fundamentals from undergraduate studies is required for M.Tech Advanced Concrete Laboratory.
d. **Rationale:** To provide hands-on experience and deepen understanding of advanced concrete materials, properties, and testing techniques.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the stress–strain behaviour and strength characteristics of high strength concrete through experimental investigations and correlation studies.
CLOBJ 2	To provide knowledge regarding the effect of cyclic loading on steel and its influence on mechanical and fatigue properties.
CLOBJ 3	To familiarize students with non-destructive testing methods for evaluating the condition and structural integrity of existing concrete members.
CLOBJ 4	To enhance analytical and experimental understanding of beam behaviour under flexure, shear, and torsion in advanced structural applications.

f. **Course Learning Outcomes:**

CLO 1	Analyse the stress-strain behaviour of high strength concrete and establish correlations between cube strength, cylinder strength, split tensile strength, and modulus of rupture.
CLO 2	Evaluate the impact of cyclic loading on the mechanical properties and fatigue behaviour of steel.
CLO 3	Apply non-destructive testing techniques to assess the condition and integrity of existing concrete structures.
CLO 4	Examine and interpret the behaviour of beams subjected to flexure, shear, and torsion for advanced structural applications.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**20**	**-**	**30**	**50**

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

h. List of Practical:

Sr. No.	Content
1	Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2	Effect of cyclic loading on steel.
3	Non-Destructive testing of existing concrete members.
4	Behavior of Beams under flexure, Shear and Torsion.

a. **Course Name:** Research Methodology & IPR
b. **Course Code:** 03020201HM01
c. **Prerequisite:** Basic Analytical and analysis skill
d. **Rationale:** The course introduces AI concepts and tools that can be applied to the design process, enabling students to create innovative, efficient, and user-centric designs in various creative domains.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of mathematical modelling concepts and their applications in research and engineering problem-solving.
CLOBJ 2	To enhance students' experimental and simulation skills for conducting systematic and data-driven research activities.
CLOBJ 3	To provide knowledge of statistical and computational techniques for effective data analysis and interpretation of research findings.
CLOBJ 4	To familiarize students with simulation methods for modelling practical engineering problems and validating research hypotheses.
CLOBJ 5	To develop awareness about Intellectual Property Rights (IPR), including patents, copyrights, trademarks, trade secrets, and technology transfer in research and innovation.

f. **Course Learning Outcomes:**

CLO 1	Understand Mathematical Modeling – Explain the principles of mathematical modeling and its applications in research and problem-solving.
CLO 2	Develop Experimental and Simulation Skills – Gain proficiency in designing and executing experiments, as well as using simulation techniques for data-driven research.
CLO 3	Perform Data Analysis and Interpretation – Apply statistical and computational tools to analyze research data and derive meaningful insights.
CLO 4	Utilize Simulation Techniques – Implement various simulation methods to model real-world scenarios and validate research hypotheses.
CLO 5	Understand Intellectual Property Rights (IPR) – Explain the importance of IPR, including trademarks, copyrights, patents (and their types), trade secrets, and technology transfer in research and innovation.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	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	**Introduction** Research: Definition, Characteristics, Motivation and Objectives, Research Methods vs Methodology, Types of Research — Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.	10%	4
2	**Methodology** Research Process, Formulating the Research Problem, Defining the Research Problem, Research Questions, Research Methods vs. Research Methodology.	10%	4
3	**Literature Review** Review Concepts and Theories, Identifying and Analyzing the Limitations of Different Approaches.	20%	6
4	**Formulation and Design** Concept and Importance in Research, features of a Good Research Design, Exploratory Research Design, Concept, Types and Uses, Descriptive Research Designs, Concept, Types and Uses, Experimental Design: Concept of Independent & Dependent Variables.	20%	6
5	**Data Modeling And Simulations:** Mathematical Modeling, Experimental Skills, Simulation Skills, Data Analysis and Interpretation	20%	6
6	**Introduction To IPR** IPR importance, Trademark, copyright, patent and its types, Trade secret, IPR and Technology Transfer	20%	6

i. Text Book and Reference Book:

1. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches By John W. Creswell, SAGE Publications Ltd
2. Research Methodology: Methods and Techniques By C.R. Kothari, New Age International Publishers.
3. QuaIitative Research By David SiIverman, SAGE Publications Ltd

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a. **Course Name:** English for Research Paper Writing
b. **Course Code:** 03020001MC01
c. **Prerequisite:** Basic Knowledge about sentence formation using different words in present, past tenses and future time. Also, basic knowledge on use of suitable nouns, adjectives, verbs, preposition, etc.
d. **Rationale:** To provide a better insight into the effective use of grammar knowledge especially in writing and to put their own thoughts into writing.
e. **Course Learning Objective:**

CLOBJ 1	To develop students' writing skills and improve the readability, clarity, and effectiveness of academic and research writing.
CLOBJ 2	To familiarize students with the structure and content requirements of different sections of a research paper.
CLOBJ 3	To enhance the skills required for drafting effective research paper titles and other essential academic writing components.
CLOBJ 4	To develop the ability to prepare high-quality research papers suitable for successful first-time submission and publication.

f. **Course Learning Outcomes:**

CLO 1	Understand how to improve your writing skills and level of readability
CLO 2	Learn about what to write in each section
CLO 3	Understand the skills needed when writing a Title
CLO 4	Ensure the good quality of paper at the very first-time submission

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**-**	**50**	**-**	**-**	**-**	**50**

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	**Unit 1** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	16%	5
2	**Unit 2** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	17%	5
3	**Unit 3** Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	17%	5
4	**Unit 4** Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	17%	5
5	**Unit 5** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	16%	5
6	**Unit 6** Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.	16%	5

i. Text Book and Reference Book:

1. Writing for Science By Goldbort R, Springer
2. How to Write and Publish a Scientific Paper By Day R, Cambridge University Press
3. Handbook of Writing for the Mathematical Sciences By Highman N, SIAM. Highman's book
4. English for Writing Research Papers By Adrian Wallwork, Springer New York Dordrecht Heidelberg London.

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a. **Course Name:** Disaster Management
b. **Course Code:** 03021601MC01
c. **Prerequisite:** Basic knowledge of Environmental Science or Geography
d. **Rationale:** This course enables students to understand, assess, and manage various types of disasters, their impacts, and mitigation strategies, thereby fostering resilience and sustainable development.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of different types of disasters, their causes, impacts, and consequences on society and the environment.
CLOBJ 2	To provide knowledge of disaster management principles, disaster response mechanisms, and effective mitigation strategies.
CLOBJ 3	To enhance the ability to assess vulnerability and recommend suitable disaster risk reduction and mitigation measures.
CLOBJ 4	To familiarize students with hazard assessment, vulnerability profiling, and the use of relevant tools and techniques for disaster analysis.
CLOBJ 5	To develop understanding of structural and non-structural approaches used in disaster prevention, preparedness, and mitigation.

f. **Course Learning Outcomes:**

CLO 1	Differentiate types of disasters, identify their causes, and evaluate their impact on the environment and society.
CLO 2	Analyse disaster damage and apply effective management strategies.
CLO 3	Assess vulnerability and recommend appropriate risk mitigation measures.
CLO 4	Develop a hazard and vulnerability profile using relevant tools and techniques.
CLO 5	Classify structural and non-structural disaster mitigation strategies.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**-**	**50**	**-**	**-**	**-**	**50**

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 to Disaster:** Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity Disaster and Development and disaster management Types (Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters and Man-made Disasters) , Global Disaster Trends, Causes, Consequences and Control of Disasters.	**20%**	**12**
2	**Disaster Management Cycle and Framework:** Disaster Management Cycle -Paradigm Shift in Disaster Management, Pre-Disaster -Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster -Evacuation -Disaster Communication -Search and Rescue -Emergency Operation Centre -Incident Command System -Relief and Rehabilitation -Post disaster -Damage and Needs Assessment, Restoration of Critical Infrastructure -Early Recovery -Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.	**30%**	**14**
3	**Disaster Management in India** Disaster Profile, Lessons Learnt from Major Disasters, Disaster Management Act 2005 -Institutional and Financial Mechanism National Policy on Disaster Management, Roles and responsibilities of Government (States, Centre) and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA).	**30%**	**12**
4	**Technology for Disaster Management & Mitigation** Geo-informatics in Disaster Management (GIS, GPS), Disaster Communication System (Early Warning system), Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India.	**20%**	**10**

i. Text Book and Reference Book:

1. Introduction to Disaster Management By Modh Satish, Macmilan Publishers India
2. An overview on natural & man-made disasters and their reduction By R K Bhandani
3. Disaster Administration And Management Text And Case Studies By Goel S. L., Deep &Deep Publication Pvt. Ltd., New Delhi.
4. Disaster Management By B.Narayan, Rawat Publication

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a. **Course Name:** Theory of Structural Stability
b. **Course Code:** 03020901PE01
c. **Prerequisite:** Basics of Civil Engineering and Structural Analysis
d. **Rationale:** To solve problems based on structural stability
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the stability behaviour of discrete and continuous structural systems under different loading conditions.
CLOBJ 2	To provide knowledge of column stability by considering axial, flexural, buckling, and torsional effects in structural design.
CLOBJ 3	To enhance analytical understanding of the stability behaviour of structural frames and their buckling characteristics.
CLOBJ 4	To familiarize students with the stability analysis of beams and plates subjected to various loading and buckling conditions.
CLOBJ 5	To introduce the concepts of inelastic buckling and dynamic stability in structural materials and systems.

f. **Course Learning Outcomes:**

CLO 1	Apply the concept of stability of discrete and continuous systems
CLO 2	Design the stability of columns by considering the buckling and torsion effects
CLO 3	Examine the stability of various frames
CLO 4	Judge the stability of the beam and plate
CLO 5	Evaluate the buckling and dynamic stability for inelastic materials

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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 Continuous Systems, Linear and Nonlinear Behaviour.	16%	8
2	**Stability of Column** Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural, and Torsion Buckling	17%	8
3	**Stability of Frames** Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.	17%	8
4	**Stability of Beams** Lateral torsion buckling.	17%	8
5	**Stability of Plates** Axial flexural buckling, shear flexural buckling, buckling under combined loads	17%	8
6	**Introduction to Inelastic Buckling and Dynamic Stability** Basic details about Buckling and Dynamic Stability	16%	8

i. Text Book and Reference Book:

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

a. **Course Name:** Advanced Concrete Technology
b. **Course Code:** 03020901PE03
c. **Prerequisite:** Basic knowledge of Concrete Technology and Material testing
d. **Rationale:** To know about the advanced method and technologies in concrete design
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the properties and applications of advanced materials used in high-performance and special concretes.
CLOBJ 2	To provide knowledge of the behaviour of concrete under different loading, environmental, and curing conditions.
CLOBJ 3	To enhance the ability to design concrete mixes for various advanced applications such as self-compacting, fibre-reinforced, and high-strength concrete.
CLOBJ 4	To familiarize students with advanced destructive and non-destructive testing techniques for evaluating the durability, workability, and mechanical properties of concrete.
CLOBJ 5	To develop understanding of quality control practices, standards, and procedures involved in the production and placement of advanced concrete.

f. **Course Learning Outcomes:**

CLO 1	Identify the properties and roles of advanced materials used in high-performance and special concretes
CLO 2	Analyse the behaviour of concrete under different loading, environmental, and curing conditions.
CLO 3	Design concrete mixes for various applications, including self-compacting, fiber-reinforced, and high-strength concretes.
CLO 4	Evaluate the durability, workability, and mechanical properties of concrete using advanced testing techniques.
CLO 5	Apply quality control measures and standards in the production and placement of advanced concrete.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**-**	**-**	**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	**Durability of Concrete** Durability, Transport mechanism of fluids and gases in concrete, cracking in concrete - corrosion and carbonation induced cracking, Alkali Aggregate Reaction, degradation by freeze and thaw, chloride attack, sulphate and sea water attack (marine conditions). Examples of alkali aggregate reaction with respect to values. Effect of Alkalis and Sulphates on concrete.	**15%**	**6**
2	**Destructive & Non-Destructive Testing of Concrete** Advanced destructive & non-destructive testing methods: ground penetration radar, probe penetration, pull out test, break off maturity method, stress wave propagation method, electrical/ magnetic methods, nuclear methods and infrared thermography, core test. Fine Damage Assessment, Measurement and Crack Generation Patterns.	**25%**	**10**
3	**Precast Concrete** Development of Precast Concrete, Form free concrete.	**10%**	**4**
4	**Concrete Mix Design** Design of concrete mixes by IS code method - ACI method - Road Note No: 4 methods. Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly-ash cement concrete mixes, design of high density concrete mixes. ACI and PCI Codes for Mix Design of SCC, HPC.	**30%**	**12**
5	**Special Concrete** Lightweight concrete, ultra-lightweight concrete, vacuum concrete, waste material-based concrete, shotcreting, guniting, sulphur concrete and sulphur infiltrated concrete, jet cement concrete (ultra-rapid hardening), gap graded concrete, no fines concrete, high strength concrete, high performance concrete, Self-Compacting Concrete,	**20%**	**8**

	Self-cleaning concrete, Self-healing concrete, Pavement Quality Concrete, Fibre Reinforced Concrete.		

i. Text Book and Reference Book:

1. Advanced Concrete Technology (TextBook) By Zongjin Li
2. Concrete Microstructure, Properties and Materials (TextBook) By P.Kumar Mehta / Paulo J.M.Monteiro
3. Concrete technology By A.R.Shanthakumar, Oxford University Press, India
4. Concrete Technology By M.L.Gambhir, Tata McGraw-Hill Education
5. Concrete Technology By Shetty M. S

a. **Course Name:** Theory and Applications of Cement Composites
b. **Course Code:** 03020901PE05
c. **Prerequisite:** Fundamental understanding of structural mechanics, materials science, and concrete technology at the undergraduate level.
d. **Rationale:** To equip students with advanced knowledge and design skills related to the behaviour, analysis, and applications of composite and cement-based materials in structural engineering.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the classification, terminology, stress–strain behaviour, and engineering properties of composite materials including orthotropic and anisotropic systems.
CLOBJ 2	To provide knowledge of stiffness behaviour and analytical approaches used for evaluating composite materials through mechanics and elasticity theories.
CLOBJ 3	To familiarize students with the types, properties, construction techniques, and mechanical behaviour of cement composites such as ferrocement, fibre reinforced concrete, and SIFCON.
CLOBJ 4	To enhance the ability to analyse, design, and evaluate the applications of cement composite structural elements in various engineering structures.

f. **Course Learning Outcomes:**

CLO 1	Understand the classification, terminology, stress-strain behaviour, and engineering constants of composite materials including orthotropic and anisotropic lamina.
CLO 2	Analyse the stiffness behaviour of composites using Mechanics of Materials and Elasticity approaches and compare different theoretical models like Halpin-Tsai equations.
CLO 3	Demonstrate knowledge of types, properties, construction techniques, and mechanical behaviour of various cement composites including ferrocement, FRC, and SIFCON.
CLO 4	Apply design principles and evaluate applications of cement composites in structural elements for housing, storage, marine, and miscellaneous structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**-**	**-**	**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	**Introduction** 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	**Mechanical Behaviour** 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	**Cement Composites** 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	**Mechanical Properties of Cement Composites** Behaviour of Ferrocement, Fibre Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion	**15%**	**8**
5	**Application of Cement Composites** FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.	**15%**	**8**
6	**Analysis and Design of Cement Composite Structural**	**15%**	**8**

	Elements Ferrocement, SIFCON and Fibre Reinforced Concrete.		

i. Text Book and Reference Book:

1. Advanced New Concrete Materials By Swamy R.N., Academic and Professional, Chapman & Hall
2. Mechanics of Composite Materials By R M Jones, CRC Press Taylor & Francis
3. Ferrocement – Theory and Applications By Pama R. P., IFIC

a. **Course Name:** Structural Health Monitoring
b. **Course Code:** 03020901PE07
c. **Prerequisite:** Basics of structural stability and Repair and rehabilitation
d. **Rationale:** Students will be able to understand NDT and its applications
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of structural distress, deterioration mechanisms, and the factors affecting the health and safety of structures.
CLOBJ 2	To provide knowledge of static field testing methods and techniques for assessing the health and performance of structures.
CLOBJ 3	To familiarize students with dynamic field testing methods, data acquisition systems, and remote structural health monitoring techniques.
CLOBJ 4	To enhance the ability to recommend suitable repair and rehabilitation measures for distressed and damaged structures.
CLOBJ 5	To develop understanding of collapse assessment, investigation procedures, and structural health monitoring (SHM) management practices.

f. **Course Learning Outcomes:**

CLO 1	Diagnosis the distress in the structure understanding the causes and factors
CLO 2	Assess the health of structure using static field methods
CLO 3	Assess the health of structure using dynamic field tests
CLO 4	Suggest repairs and rehabilitation measures of the structure
CLO 5	Assessment of Collapse and Investigation
CLO 6	Investigation Management and SHM Procedures

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**Structural Health** Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.	15%	8
2	**Structural Health Monitoring** Concepts, Various Measures, Structural Safety in Alteration.	15%	8
3	**Structural Audit** Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	20%	8
4	**Static Field Testing** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	15%	8
5	**Dynamic Field Testing** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	15%	8
6	**Introduction to Repairs and Rehabilitations of Structures** 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. Advanced Structural Health Monitoring and Intelligent Infrastructure (TextBook) By J.P. Ou, H. Li and Z.D. Duan, Taylor and Francis Group
2. Structural Health Monitoring (TextBook) By Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, John Wiley and Sons
3. Structural Health Monitoring with Wafer Active Sensors By Victor Giurglutiu
4. Health Monitoring of Structural Materials and Components - Methods with Applications (TextBook) By Douglas E Adams, John Wiley and Sons
5. Structural Health Monitoring with Wafer Active Sensors By Victor Giurglutiu, Academic Press Inc.

a. **Course Name:** Finite Element Analysis of Structure
b. **Course Code:** 03020901PE09
c. **Prerequisite:** Basics of Structural Analysis
d. **Rationale:** To enable students to analyse and design indeterminate and complex structural systems using flexibility and stiffness methods, apply finite element techniques, understand plastic behaviour, and utilize modern computational tools for structural analysis.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the Finite Element Method and its application in structural analysis of engineering systems.
CLOBJ 2	To provide knowledge and practical exposure to the execution of finite element programs and commercial FEA software tools.
CLOBJ 3	To enhance the ability to analyse and solve continuum and structural mechanics problems using finite element techniques.
CLOBJ 4	To familiarize students with the application of finite element analysis in solid mechanics and complex structural systems.
CLOBJ 5	To develop understanding of pre-processing, solution procedures, and post-processing techniques involved in finite element analysis.
CLOBJ 6	To enable students to effectively use commercial finite element analysis software for modelling, analysis, and interpretation of structural behaviour.

f. **Course Learning Outcomes:**

CLO 1	Use Finite Element Method for structural analysis
CLO 2	Execute the Finite Element Program/ Software
CLO 3	Solve continuum problems using finite element analysis
CLO 4	Application to Solid Mechanics
CLO 5	Pre-Processing, Solution, Post-Processing
CLO 6	Use of Commercial FEA Software

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**		
L	**T**	**P**	**C**	**Internal Evaluation**	**ESE**	**Total**

				MSE	CE	P	Theory	P	
3	**-**	**-**	**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	**Introduction** Flexibility Method: Indeterminacy, Compatibility Conditions. Stiffness Method: Local & Global Matrices, Co-ordinate Transformation, Rotation Metrix, Transformation of stiffness matrices, load & displacement vectors	**10%**	**4**
2	**Finite Element Method** Discretisation of a structure, Displacement function, Truss element, Beam element, Plane stress & plane strain, Triangular elements.	**15%**	**8**
3	**Plastic Analysis of Structure** Statically indeterminate axial problem, Beams in pure bending, Plastic Hinge & Mechanism, Plastic moment of resistance, Plastic modulus, Shape factor, Load factor, Plastic analysis	**25%**	**12**
4	**Space & Cable Structures** Analysis of Space trusses, Beams curved in suspension cables, and Suspension bridges with two & three hinged stiffening girders	**25%**	**12**
5	**Computer Implementation of FEM procedure** Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software	**25%**	**12**

i. Text Book and Reference Book:

1. Text book of Finite Element Analysis By Seshu P., PHI
2. Concepts and Applications of Finite Element Analysis By R D Cook, D S Malkus, M E Plesha, and R J Witt, Wiley.
3. Fundamentals of Finite Element Analysis By Hutton David, Mc-Graw Hill
4. Finite Element Analysis By Buchanan G.R, McGraw Hill Publications
5. Advanced Structural Analysis By Devdas Menon, Alpha Science

a. **Course Name:** Advanced Design of Foundations
b. **Course Code:** 03020901PE11
c. **Prerequisite:** Basics of Geotechnical and structural designs
d. **Rationale:** Analyse and design the foundation.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of soil exploration techniques and evaluate the suitability of soil strata for various engineering projects.
CLOBJ 2	To provide knowledge of the analysis and design principles of shallow foundations based on bearing capacity and settlement considerations.
CLOBJ 3	To enhance the ability to analyse and design pile foundations considering load transfer, settlement, and lateral stability requirements.
CLOBJ 4	To familiarize students with analysis methods, design principles, and code provisions related to well foundations and substructure systems.

f. **Course Learning Outcomes:**

CLO 1	Decide the suitability of soil strata for different projects.
CLO 2	Design shallow foundations deciding the bearing capacity of soil
CLO 3	Analyse and design the pile foundation.
CLO 4	Understand analysis methods for well foundation.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**Planning of Soil Exploration** Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.	**15%**	**8**
2	**Shallow Foundations** 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	**Pile Foundations** Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.	**20%**	**8**
4	**Tunnels, Open Cuts** Tunnels and Arching in Soils, Pressure Computations around Tunnels. Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.	**15%**	**8**
5	**Computer Implementation of FEM procedure** Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software	**15%**	**8**
6	**Coffer Dams** Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction	**15%**	**8**

i. Text Book and Reference Book:

1. Text Design of foundation system By N.P. Kurian
2. Foundation Analysis and Design By J. E. Bowles
3. Analysis and Desin of Substructures By Sawmi Saran

Semester 2

a. **Course Name:** Advanced Design of Steel Structures
b. **Course Code:** 03020902PC01
c. **Prerequisite:** Basic Knowledge of Design of Steel Structures
d. **Rationale:** Perform Limit state design of trusses and frames—minimum weight design of steel structure
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the design of steel tension members and connections in accordance with relevant steel design codes and standards.
CLOBJ 2	To provide knowledge of the design principles of flexural members, beams, and girders considering strength, stability, and serviceability requirements.
CLOBJ 3	To familiarize students with the analysis and design of welded plate girders, including shear buckling and stiffener requirements.
CLOBJ 4	To enhance the ability to design industrial steel structures incorporating trusses, gantry girders, portal frames, and bracing systems.
CLOBJ 5	To develop understanding of earthquake-resistant design concepts and advanced design approaches for steel structures as per codal provisions.

f. **Course Learning Outcomes:**

CLO 1	Design tension members using appropriate steel sections and connections by IS 800:2007.
CLO 2	Design flexural members, including beams and girders, considering lateral stability and shear strength.
CLO 3	Design welded plate girders, accounting for shear buckling, stiffeners, and serviceability criteria.
CLO 4	Develop structural designs for industrial buildings, incorporating elements like trusses, gantry girders, and bracing systems.
CLO 5	Apply earthquake-resistant design principles to steel structures, ensuring compliance with relevant codes and standards.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**Portal Frames** Portal Frames – Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures – Lightweight Structures.	20%	9
2	**Steel Gantry Girders** Steel Gantry Girders – 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%	9
3	**Semi rigid design of steel structures** Semi-rigid design of steel structures - Connection flexibility in steel frames - Analysis of continuous beams with flexible connections - Semi-rigid design of steel frames. Introduction to International Codes. (ACI)	20%	9
4	**Introduction to plasticity** Introduction - Nature of plasticity- Assumptions - Stress-strain curve - Bauschinger effect. Plastic Stress- Strain relations - Necessary Elasticity-Plane stress and plane strain - Yield criteria and flow rules - Tresca Theory- Von Mises. Theory-Geometrical representation - St. Venant's theory of plastic flow and torsion –Prandtl-Reuss theory - Concept of slip line field theory.	20%	9
5	**Cold formed steel section design** Types of Cold-Formed Steel Sections and Their Applications, Materials Used in Cold-Formed Steel Construction, and Design Concepts for Flexural Members and Compression Members.	20%	9

i. Text Book and Reference Book:

1. The Mathematical Theory of Plasticity - (TextBook) By R. Hill, Oxford University Press
2. Teaching Resource for Structural steel design (TextBook) By R. Narayanan
3. Plasticity for Structural Engineer By W.F. Chen, D.J. Han
4. Plastic Methods of Structural Analysis By B.G. Neal 5. Plastic Design of Steel Frames By L.S. Beedle

a. **Course Name:** Advanced Design of Steel Structures Laboratory
b. **Course Code:** 03020902PC02
c. **Prerequisite:** Basic Knowledge of Design of Steel Structures
d. **Rationale:** Perform Limit state design of trusses and frames—minimum weight design of steel structure
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the design of steel tension members and connections in accordance with relevant steel design codes and standards.
CLOBJ 2	To provide knowledge of the design principles of flexural members, beams, and girders considering strength, stability, and serviceability requirements.
CLOBJ 3	To familiarize students with the analysis and design of welded plate girders, including shear buckling and stiffener requirements.
CLOBJ 4	To enhance the ability to design industrial steel structures incorporating trusses, gantry girders, portal frames, and bracing systems.
CLOBJ 5	To develop understanding of earthquake-resistant design concepts and advanced design approaches for steel structures as per codal provisions.

f. **Course Learning Outcomes:**

CLO 1	Design tension members using appropriate steel sections and connections by IS 800:2007.
CLO 2	Design flexural members, including beams and girders, considering lateral stability and shear strength.
CLO 3	Design welded plate girders, accounting for shear buckling, stiffeners, and serviceability criteria.
CLO 4	Develop structural designs for industrial buildings, incorporating elements like trusses, gantry girders, and bracing systems.
CLO 5	Apply earthquake-resistant design principles to steel structures, ensuring compliance with relevant codes and standards.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

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

Continuous Evaluation, **ESE**- End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Design of portal frame with hinge base
2	Design of Steel Gantry Girder
3	Semi-rigid design of steel structures
4	Plastic Stress- Strain relations
5	Cold-Formed Steel Sections and Their Applications

a. **Course Name:** Design of Earthquake Resistant Structures
b. **Course Code:** 03020902PC03
c. **Prerequisite:** Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure, Design of Steel Structures
d. **Rationale:** This subject is conceptual applications of principles of dynamics and earthquake-resistant design & detailing of RC structures. This subject helps understand the behaviour of structures subjected to earthquake forces and the earthquake-resistant design of such structures.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of earthquake fundamentals, seismic waves, tectonic activities, and their effects on structures.
CLOBJ 2	To provide knowledge of the dynamic response behaviour of SDOF and MDOF structural systems subjected to earthquake vibrations.
CLOBJ 3	To enhance the ability to apply earthquake-resistant design principles and lateral load distribution concepts in structural design.
CLOBJ 4	To familiarize students with ductile detailing provisions and practices for reinforced concrete structures as per relevant codes.
CLOBJ 5	To develop understanding of the analysis, design philosophy, and detailing requirements of earthquake-resistant steel structures.

f. **Course Learning Outcomes:**

CLO 1	Understand the basics of earthquake.
CLO 2	Determine the response of SDOF & MDOF structural systems subjected to earthquake vibration.
CLO 3	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
CLO 4	Apply the concept of ductile detailing in RC structures.
CLO 5	Determine the design principles of earthquake-resistant steel structures

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**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, their classification and characteristics.	**20%**	**8**
2	**Fundamentals of Earthquake Vibration 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, mode shapes.	**20%**	**8**
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), Seismic Coefficient Method, Introduction to Response Spectrum, IS code provisions.	**20%**	**8**
4	**Ductile Detailing** Concepts of Detailing of various structural components as per IS: 13920 provisions.	**20%**	**8**
5	**Earthquake resistant design of steel structures** The design philosophy for steel structures, Introduction to international codes. Performance of steel structures in past earthquakes, Capacity design concept, Ductility of steel buildings, Seismic behaviour of steel buildings, Stability considerations, Analysis of buildings using equivalent static and response spectrum methods. Seismic Design and detailing of Moment Resistant Frames (MRFs): Beams and	**20%**	**8**

	Columns; Panel Zones and Connections; Concentric Brace Frames (CBFs), Introductions to Eccentric Brace Frames (EBFs) and Special Truss Moment Frames (STMFs).		

i. Text Book and Reference Book:

1. Design of Earthquake Resistant Buildings By Minoru Wakabayashi
2. 'Earthquake Resistance Design of Structures' By B. L Gupta
3. Design of Multi-storey RC buildings for Earthquake Motions By J. A. Blume
4. Dynamics of Structures with Earthquake Engineeirng By A K Jain, Pearson Education, Pub. Year 2023
5. Earthquake Resistant Design of Structures By Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited, Pub. Year 2006
6. EARTHQUAKE RESISTANT DESIGN OF STRUCTURES By S K Duggal, Oxford, Pub. Year 2013

a. **Course Name:** Design of Earthquake Resistant Structures Laboratory
b. **Course Code:** 03020902PC04
c. **Prerequisite:** Mechanics of Solids, Structural Analysis I & II, Design of Reinforced Concrete Structure, Design of Steel Structures
d. **Rationale:** This subject is conceptual applications of principles of dynamics and earthquake-resistant design & detailing of RC structures. This subject helps understand the behaviour of structures subjected to earthquake forces and the earthquake-resistant design of such structures.
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of earthquake fundamentals, seismic waves, tectonic activities, and their effects on structures.
CLOBJ 2	To provide knowledge of the dynamic response behaviour of SDOF and MDOF structural systems subjected to earthquake vibrations.
CLOBJ 3	To enhance the ability to apply earthquake-resistant design principles and lateral load distribution concepts in structural design.
CLOBJ 4	To familiarize students with ductile detailing provisions and practices for reinforced concrete structures as per relevant codes.
CLOBJ 5	To develop understanding of the analysis, design philosophy, and detailing requirements of earthquake-resistant steel structures.

f. **Course Learning Outcomes:**

CLO 1	Understand the basics of earthquake.
CLO 2	Determine the response of SDOF & MDOF structural systems subjected to earthquake vibration.
CLO 3	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings.
CLO 4	Apply the concept of ductile detailing in RC structures.
CLO 5	Determine the design principles of earthquake-resistant steel structures

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

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

Continuous Evaluation, **ESE**- End Semester Examination

h. List of Practical:

Sr. No.	Content
1	Equivalent Static Method of Seismic Analysis
2	Response Spectrum Method of Seismic Analysis
3	Time History Method Of Seismic Analysis
4	Ductile Detailing of Beams
5	Ductile Detailing of Columns
6	Ductile Detailing of Slabs
7	Earthquake-Resistant Design of Steel Buildings

a. **Course Name:** Soft Computing for Structural Engineering Laboratory
b. **Course Code:** 03020902PC06
c. **Prerequisite:** Basic knowledge of structural analysis, strength of materials, and proficiency in engineering mechanics.
d. **Rationale:** To provide hands-on experience in structural modelling, analysis, and design using industry-standard software tools like STAAD Pro, MIDAS Civil, and MATLAB/Python, enabling students to simulate, analyse, and optimize real-world structural systems including buildings and bridges.
e. **Course Learning Objective:**

CLOBJ 1	To develop practical understanding of structural modeling and analysis of frames and trusses using STAAD Pro under various loading conditions.
CLOBJ 2	To provide hands-on knowledge of bridge modeling and analysis using MIDAS Civil, including material properties, meshing, and boundary conditions.
CLOBJ 3	To enhance the ability to perform static and dynamic analysis of bridge structures considering moving and seismic loads using advanced simulation tools.
CLOBJ 4	To familiarize students with soft computing techniques using MATLAB or Python for optimization, simulation, and parametric studies in structural engineering applications.

f. **Course Learning Outcomes:**

CLO 1	Apply STAAD Pro to model and analyse structural components such as frames and trusses under various loads
CLO 2	Demonstrate proficiency in bridge modelling and analysis using MIDAS Civil, including material properties, boundary conditions, and meshing.
CLO 3	Perform static and dynamic analysis of bridge structures considering moving and seismic loads using advanced simulation tools.
CLO 4	Use soft computing techniques with MATLAB or Python for optimization and parametric studies in structural design.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**20**	**-**	**30**	**50**

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

h. List of Practical:

Sr. No.	Content
1	Introduction to STAAD Pro.
2	Various elements and cross-sectional shapes
3	Two Dimensional Portal frame under vertical and horizontal loads
4	Truss Analysis - Roof Truss Analysis
5	Multi-storied building frame
6	Introduction to MIDAS Civil
7	Bridge modelling: Material assignment, boundary conditions, and meshing.
8	Static and dynamic analysis: Moving loads and seismic considerations
9	Parametric study: Effect of vehicle speed on bridge vibration
10	Soft computing simulations using MATLAB/Python for bridge optimization

a. **Course Name:** Design of Prestressed Concrete Structures
b. **Course Code:** 03020902PE01
c. **Prerequisite:** Basics of Civil Engineering, Concrete Technology and Structural Designs
d. **Rationale:** Students will solve problems on the Pre-Stressed Concrete Structure
e. **Course Learning Objective:**

CLOBJ 1	To develop understanding of the fundamental concepts, principles, materials, and pre-stressing techniques used in prestressed concrete structures.
CLOBJ 2	To provide knowledge of the analysis and behaviour of prestressed concrete members subjected to different loading conditions using relevant theories and methods.
CLOBJ 3	To enhance the ability to design prestressed concrete elements for flexure, shear, and bond by applying codal provisions and safety requirements.
CLOBJ 4	To familiarize students with the evaluation of prestress losses and their influence on the strength, serviceability, and performance of prestressed concrete structures.

f. **Course Learning Outcomes:**

CLO 1	Explain the fundamental concepts, principles, and types of pre-stressing techniques used in concrete structures.
CLO 2	Analyse the behaviour of pre-stressed concrete members under various loading conditions using relevant theories and methods.
CLO 3	Design pre-stressed concrete elements by applying codal provisions and safety considerations for flexure, shear, and bond.
CLO 4	Evaluate losses in pre-stressing force and their impact on the performance of pre-stressed concrete structures.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**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	**Introduction to prestressed concrete** Types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.	20%	8
2	**Statically determinate PSC beams** Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.	20%	8
3	**Analysis and Design of Prestressed Concrete Members** Analysis of prestress and bending stresses, Pressure line (Thrust line), Kern distance and eccentricity, Design of sections for flexure: IS:1343 Code provisions, Shear and torsional behaviour, and End block stresses and design of anchorage zones.	25%	12
4	**Composite Construction and Continuous Beams** Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.	25%	5
5	**Special Structures and Modern Trends** Circular prestressing (tanks and pipes), Prestressed concrete bridges, Modern prestressing techniques, Introduction to partially prestressed concrete, and Advances in fiber-reinforced prestressed concrete.	10%	8

i. Text Book and Reference Book:

1. Design of Prestresse Concrete Structure by N Krishnaraju

a. **Course Name:** Cost Management of Engineering Projects
b. **Course Code:** 03021602PE07
c. **Prerequisite:** : Basic civil engineering knowledge.
d. **Rationale:** Project planning management and economics, cost concepts.
e. **Course Learning Objective:**

CLOBJ 1	Understand the principles and processes of strategic cost management in engineering projects.
CLOBJ 2	Develop knowledge of cost concepts, costing systems, and decision-making techniques related to project management.
CLOBJ 3	Analyze project execution stages, project cost control methods, and profit planning techniques.
CLOBJ 4	Apply quantitative techniques and modern management tools for effective cost management and project optimization.

f. **Course Learning Outcomes:**

CLO 1	Explain the principles of strategic cost management in engineering projects.
CLO 2	Apply various cost concepts and costing systems for managerial decision-making.
CLO 3	Analyze cost behavior, profit planning, and project cost control techniques.
CLO 4	Apply quantitative techniques such as PERT/CPM, linear programming, and simulation for cost management.
CLO 5	Evaluate budgeting, pricing strategies, and performance measurement methods in engineering project management.

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** Introduction and overview of strategic cost management process	10	4
2	**COST CONCEPTS** Cost concepts in decision making; Relevant cost, Differential cost, Incremental Cost, Opportunity cost, Objectives of costing system; Inventory valuation, Creation of database for operational control, Provision of data for decision making	18	4
3	**PROJECT** Project meaning, different types, why to manage, cost overrun centers, various stages of project execution from conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed engineering activities. Pre-project execution main clearances and documents. Project team: role of each member. Importance of project site data and significance. Project contracts: types and contents. Project execution, project cost control, Bar charts and Network diagram. Project commissioning: mechanical and process	26	13
4	**COST BEHAVIOR AND PROFIT PLANNING** Marginal Costing: Distinction between Marginal Costing and Absorption Costing; Break-even analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of Constraints, Activity-Based Cost Management, Benchmarking, Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets, Performance budgets, Zero-based budgets, Measurement of divisional profitability pricing decisions including transfer pricing	26	13
5	**QUANTITATIVE TECHNIQUES** Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory	20	10

i. Text Book and Reference Book:

1. Cost Accounting: A Managerial Emphasis
   By Prentice Hall of India
2. Advanced Management Accounting
   By Charles T. Horngren and George Foster
3. Principles and Practices of Cost Accounting
   By Ashish K. Bhattacharya

a. **Course Name:** IOT and Smart Cities
b. **Course Code:** 03020702UE01
c. **Prerequisite:** Basic knowledge of computer networks, communication systems, and smart technologies.
d. **Rationale:** To provide knowledge of IoT technologies, smart infrastructure, communication systems, and intelligent applications used in smart cities for improving urban services, sustainability, security, and quality of life.
e. **Course Learning Objective:**

CLOBJ 1	Develop knowledge of IoT communication technologies, protocols, cloud platforms, and secure architectures.
CLOBJ 2	Analyze smart transportation, energy systems, and smart infrastructure applications using IoT technologies.
CLOBJ 3	Apply IoT security, privacy, blockchain, and smart monitoring techniques for sustainable and intelligent urban systems.

f. **Course Learning Outcomes:**

CLO 1	Explain the concepts, characteristics, and applications of IoT in smart cities.
CLO 2	Analyze IoT communication technologies, protocols, and cloud-based smart city solutions.
CLO 3	Apply IoT technologies for smart transportation, smart energy systems, and infrastructure monitoring.
CLO 4	Evaluate security, privacy, and blockchain challenges in IoT-enabled smart city environments.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**0**	**4**	**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	**UNIT I: INTRODUCTION TO IOT FOR SMART CITIES** Definition and characteristics of smart cities, IoT-based solutions in domains such as Smart Home, Transport & Traffic Management, Smart city planning and infrastructure essentials, Role of AI/ML/DL in IoT-enabled smart cities	18	8
2	**UNIT II: TECHNOLOGIES FOR IOT IoT** communication technologies and recent protocols, Secure IoT architectures overview, Services powered by IoT within smart cities, Cellular IoT and Cloud IoT platforms, Case study comparing MQTT, WebSocket, and HTTP via Node-RED in smart-room setups	22	10
3	**UNIT III: SMART TRANSPORTATION AND ENERGY SYSTEMS** Traffic management systems and sensor networks, Electric Vehicles (EVs) and EV charging infrastructure, Renewable energy integration and smart distribution, Smart grid concepts, Image-processing for traffic control and bus movement analysis case study	18	8
4	**UNIT IV: SMART INFRASTRUCTURE AND CITY PLANNING** Fundamentals of Smart Infrastructure, Smart water management systems, Infrastructure for Connectivity and Monitoring (Wi-Fi, 5G, LPWAN, NB-IoT infrastructure), Rainwater harvesting and solar-based automation	20	9
5	**UNIT V: SECURITY, PRIVACY, AND BLOCKCHAIN IN IOT** Privacy and social values in smart urban environments, IoT information security challenges, Blockchain applications in IoT, Case studies on smart homes, buildings, street-lighting, parking, irrigation, and food-supply chain traceability, Threats and mitigation mechanisms	13	6
6	**UNIT VI: MINI PROJECT / CASE STUDY** Applications and Lab-Based Work	9	4

i. Text Book and Reference Book:

1. Internet of Things for Smart Cities
   By Waleed Ejaz & Alagan Anpalagan | Springer, 2019
2. IoT for Smart Cities
   By Ejaz & Anpalagan | Springer
3. Designing the Internet of Things
   By Adrian McEwen & Hakim Cassimally | John Wiley and Sons, 1st Edition, 2014

a. **Course Name:** Pedagogy Studies
b. **Course Code:** 03020002MC01
c. **Prerequisite:** : A basic familiarity with education systems, classroom teaching–learning processes, and introductory research concepts is required.
d. **Rationale:** This course aims to develop a critical and research-informed understanding of pedagogical practices, curriculum, teacher education, and professional development, with a special focus on evidence-based approaches and contextual challenges.
e. **Course Learning Objective:**

CLOBJ 1	Understand key concepts, theories of learning, curriculum frameworks, and pedagogical approaches in education.
CLOBJ 2	Analyze pedagogical practices used in formal and informal educational environments.
CLOBJ 3	Develop knowledge of research methodologies and evidence-based approaches for evaluating pedagogical effectiveness.
CLOBJ 4	Evaluate professional development models, curriculum practices, and research gaps for improving teaching and learning processes.

f. **Course Learning Outcomes:**

CLO 1	Recall key concepts, theories of learning, and pedagogical terminology relevant to curriculum and teacher education.
CLO 2	Explain diverse pedagogical practices used in formal and informal classroom contexts.
CLO 3	Apply appropriate research methodologies to evaluate the effectiveness of pedagogical practices.
CLO 4	Analyze evidence from educational studies to assess strengths, limitations, and research gaps in pedagogy.
CLO 5	Evaluate professional development models and curriculum frameworks to recommend context-sensitive improvements.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**0**	**0**	**0**	**50**	**-**	**00**	**00**	**50**

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 AND METHODOLOGY** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching	25	6
2	**THEMATIC OVERVIEW** Pedagogical practices used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education	13	6
3	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES** Methodology for the in-depth stage, Quality assessment of included studies, Teacher education (curriculum and practicum), School curriculum and guidance materials supporting effective pedagogy, Theory of change, Strength and nature of evidence for effective pedagogical practices, Pedagogic theory and approaches, Teacher attitudes and beliefs, Pedagogic strategies	25	6
4	**PROFESSIONAL DEVELOPMENT** Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and community, Curriculum and assessment, Barriers to learning such as limited resources and large class sizes	25	6
5	**RESEARCH GAPS** Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact	12	6

i. Text Book and Reference Book:

1. Education for All, the Quality Imperative and the Problem of Pedagogy
   By Alexander, R | CREATE, University of Cambridge, 2008
2. Teaching for Quality Learning at University
   By Biggs, J. & Tang, C | Open University Press, 2011
3. Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education
   By Cochran-Smith, M. & Zeichner, K. | Lawrence Erlbaum Associates, 2005
4. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement

By Hattie, J. | Routledge, 2009
5. Education 2030: Incheon Declaration and Framework for Action
By UNESCO | UNESCO, 2015