

4SE01: EARTHQUAKE ENGINEERING
CREDITS - 3 (LTP: 2,0,1)

Course Objective:

1. To impart the knowledge of behavior of civil engineering structures during earthquakes.
2. To explain seismic analysis of framed and masonry structures.
3. To introduce the concepts of ductile detailing.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
L	T	P		C	Theory Marks		Practical Marks	
			ESE		CE	ESE	CE	100
2	0	2	3	30	20	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	Introduction to seismology Fundamentals of earthquake engineering, plate tectonics, Causes of earthquakes, types of earthquakes, important earthquake parameters such as magnitude and intensity, Philosophy of earthquake resistant design	2
2	Concept of single degree of freedom Systems Concept of natural frequency and degree of freedom, Equation of motion for single degree of freedom (SDOF) system, Concepts of response of SDOF systems (free, forced, undamped and damped), concept of resonance.	3
3	Response of multi degree of freedom Systems Concept of response spectrum, Equations of motion for multi degree of freedom (MDOF) systems, Natural frequencies and mode shape for MDOF systems, Normalization of modes, Dynamic analysis and calculation of base shear of MDOF systems by response spectrum method as per IS 1893, Modal combinations.	6
4	Seismic analysis of buildings Concepts of floor diaphragms and lateral load resisting systems, Importance of strength, stiffness, ductility and configuration, various structural irregularities, calculation of centre of mass, centre of stiffness and eccentricity, lateral-torsional analysis of building as per seismic coefficient Method, Calculation for base shear and its distribution along height.	8
5	Ductile Design and detailing Importance of ductile detailing, capacity design concept, strong column weak beam theory, Concepts of ductile detailing and design of beams and columns as per IS: 13920.	5
6	Seismic analysis & design of masonry buildings Seismic detailing of masonry buildings as per IS: 4326, Provision of various types of bands and vertical reinforcements, Calculation for rigidity of masonry	4

Unit No.	Topics	Teaching Hours
	wall, Concept of lateral load analysis of masonry building.	
7	Special topics Structural controls, Introduction to base isolation and dampers, Introduction to reinforced masonry structures.	2
Total		30

List of References:

1. Mario Paz, “*Structural Dynamics - Theory and Computations*”, Pearson Education
2. Pankaj Agarwal & Manish Shrikhande, “*Earthquake Resistant Design of Structures*”, Prentice Hall of India, New Delhi
3. Jai Krishna A.R, Chandrasekharan A. R, Brijesh Chandra, “*Elements of Earthquake Engineering*”, South Asian Publishers, New Delhi
4. Chopra A. K., “*Dynamics of Structures*”, Pearson Education, New Delhi
5. Ray W. Clough & Joseph Penzien, “*Dynamics of Structures*”, McGraw Hill
6. S. K. Duggal, “*Earthquake Resistant Design of Structures*”, Oxford university Press
7. S. R. Damodarasamy and S. Kavitha, “*Basics of Structural Dynamics and Aseismic Design*”, Prentice Hall of India, New Delhi
8. Dr. C. V. R. Murty, “*Earthquake Tips*”, Indian Institute of Technology Kanpur and Building Materials and Technology Promotion Council, New Delhi
9. IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
10. IS: 1893 - Indian Standard Criteria for Earthquake Resistant Design of Structures
11. IS: 4326 - Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings
12. IS:13920 - Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces
13. IS:13827 - Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings
14. IS:13828 - Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings
15. IS:13935 - Indian Standard Guidelines for Repair and Seismic Strengthening of Buildings
16. SP 22 - Explanatory Handbook on Codes for Earthquake Engineering

Course Outcomes (COs):

At the end of this course students will be able to ...

1. Understand the basics concepts of earthquake engineering.
2. Perform the static and dynamic seismic analysis of buildings.
3. Apply the concepts of ductile detailing for beam, column and beam-column joints.
4. Understand the concepts of structural control strategies and reinforced masonry buildings.