Introduction to Earthquake Engineering - Web course

COURSE OUTLINE

The course on Introduction to Earthquake Engineering provides the fundamental concepts, principles and application of earthquake engineering in seismic analysis and design of structures.

The course begins with the Seismology explaining the causes of occurrence of earthquake and its characterization. The seismic analysis of the structures under earthquake excitation is developed. The structural system modeled as discrete and continuous system.

The concept of response spectrum analysis procedure to determine structure response and design earthquake forces is explained. The codal provisions for earthquake resistant design of structures as per Indian Standards are explained.

Finally, the course also covers the soil structure interaction and inelastic response spectra. The advanced course material on Earthquake Engineering will be very useful to undergraduate students, post-graduate students, teachers and practitioners.

A number of chosen problems will be solved to illustrate the design and analysis concepts clearly.

COURSE DETAIL

Sl.No.	Topic	No. of Hours
1.	**Seismology:** • Earth's Interior and Plate Tectonics; • Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters; • Modification of Earthquake due to the Nature of Soil; • Seismic Hazard Analysis I; • Seismic Hazard Analysis II; Discussion on Tutorial Problems.	7
2.	**Earthquake Inputs:** • Time History Records and Frequency Contents of Ground Motion; • Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake; • Combined D-V-A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard Spectrums;	7

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Civil Engineering

Pre-requisites:

Structural Dynamics.

Additional Reading:

1. Journals Related to Earthquake Engineering and Bureau of Indian Standard codes.

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	• Predictive Relationships for earthquake parameters; • Discussion on Tutorial Problems.	
3.	**Dynamics for Earthquake Analysis:** • Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems; • Mode Shapes and Frequencies of MDOF System; Rayleigh Damping Matrix; • Direct Time Domain Analysis of MDOF System; • Direct Frequency Domain Analysis of MDOF System; • Modal Analysis in Time and Frequency Domain; • Discussion on Tutorial Problems.	7
4.	**Response Analysis for Specific Ground Motion:** • Equations of Motion for Single and Multi-Support Excitations and Solutions; • Equations of Motion in State Space and Solutions; • Computational Steps for the Solutions using MATLAB I; • Computational Steps for the Solutions using MATLAB II; • Time History Analysis of 3D Tall Buildings; • Discussion on Tutorial Problems.	6
5.	**Response Spectrum Method of Analysis:** • Concept of Equivalent Lateral Force for Earthquake; • Modal Combination Rules; • Response Spectrum Method of Analysis of Structures and Codal Provisions; • Response Spectrum Method of Analysis for Torsionally Coupled Systems; • Response Spectrum Method of Analysis for Non-Classically Damped Systems; • Discussion on Tutorial Problems.	6
6.	**Seismic Soil - Structure Interaction:** • Fundamentals of Seismic Soil-Structure Interaction; • Direct Method of Analysis of Soil-Structure	6

	Interaction using FEM and Use of ABAQUS Software I; • Direct Method of Analysis of Soil-Structure Interaction using FEM and Use of ABAQUS Software II; • Substructuring Method of Analysis of Soil-Structure Interaction Problem I; • Sub-structuring Method of Analysis of Soil-Structure Interaction Problem II; • Discussion on Tutorial Problems.	
7.	**Inelastic Response of Structures for Earthquake Forces:** • Fundamental Concepts of Inelastic Response Analysis for Earthquake Forces; • Solutions of Incremental Equations of Motions for SDOF Systems; • Solutions of Incremental Equations of Motions for MDOF Systems; • Push over Analysis; • Concepts of Ductility and Inelastic Spectrum; • Discussion on Tutorial Problems.	6
8.	**Base isolation for earthquake resistant design of structures:** • Base isolation concept, isolation systems and their modeling; • linear theory of base isolation; • stability of elastomeric bearings; • codal provisions for seismic isolation, practical applications.	6

References:

1. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992.
2. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.,' Prentice Hall, 1971.
3. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.
4. Ellis L. Krinitzsky, J.M. Gould and Peter H. Edinger, 'Fundamentals of Earthquake Resistant Construction', John Wiley, 1993.
5. Blume J.A., Newmark N.M., Corning L.H., 'Design of Multi-storied Buildings for Earthquake ground motions', Portland Cement Association, Chicago, 1961.
6. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI, 2008.
7. Proc. of World Conferences on Earthquake Engg., 1956-2008.
8. I.S. Codes No. 1893, 4326, 13920 etc.