Course Name:
Advanced Earthquake Engineering

Course Number:
20165

Credit:
3

Course Content (outline):

1. Fundamental of Structural Dynamics
   1.1. Response spectrum: Definition of spectral values of displacement, velocity, acceleration, pseudo-velocity and pseudo-acceleration, Tri-Partite spectral diagrams
   1.2. MDOF systems, effect of the support excitation on a 2D MDOF shear building, determining the elastic force distribution in the floors, shear and overturning moment in the base and floors, the effective modal mass, various forms of damping matrix
2. General topics of seismology and seismicity
   2.1. Definitions of engineering seismology: tectonic theory, intensity and magnitude of the earthquake, and their measurement criteria, types of earthquake waves, estimation of energy released by the earthquake, types of faults and their seismicity, near fault earthquakes
   2.2. Features of engineering seismology: Effective duration of the earthquake records and the methods of their determination, the frequency content of earthquake records, the generation of artificial records, scaling of earthquake records
3. Seismic hazard analysis
   3.1. Deterministic seismic hazard analysis including determining seismic sources, selecting the earthquake governing each source, selecting the appropriate attenuation relationships, calculating the parameters of the design earthquake
   3.2. Probabilistic seismic hazard analysis including determination of point, line and area seismic sources, determination of recurrence relations, distribution of earthquakes in terms of magnitude and average rate of occurrence, probabilistic occurrence models (Poisson model), selection of the appropriate attenuation relationships, generating seismic hazard curves for each source and the combined seismic hazard curve, Calculation of the design parameters
4. Design spectrum
   4.1. Determine the specific site response spectrum
   4.2. Methods for determining the design spectrum including Newmark-Hall method, Mohraz method, ATC 3.06 instruction, codes of UBC97, ASCE-7-05, ASCE-7-10, and the general method of spectral extraction
   4.3. General definition of ductility and behavior factor, determining the nonlinear design spectrum of yield displacement (acceleration) and total displacement
5. Numerical solutions for equations of motion
   5.1. Integrating methods and finite difference (explicit and implicit)
   5.2. Newmark-Beta method, convergence and stability criteria, Wilson-θ method
   5.3. Step by step method for determining nonlinear dynamic responses
6. Other topics

6.1. Equations of motion of structures with eccentricity
6.2. Investigating of multiple supports excitation
6.3. Definition of damage criteria and generating fragility curves for different structures

References:

- Anil K. Chopra, "Dynamics of Structures, Theory and Application to Earthquake Engineering", 3rd Edition, Prentice Hall, 2007. (Its Farsi Translation is also available)
- Clough, R.W. and Penzien, J., "Dynamics of Structures", 3nd Edition, McGraw-Hill, New York, 2003.
- Naeim, F., "The Seismic Design Handbook", 2nd Ed., 2001.