

CE 432: STRUCTURAL DYNAMICS (3-1-0: 4)

Introduction

Importance of structural dynamics for civil engineers, types of dynamic loads, effect of dynamic load on structure, background of the available methods.

Single Degree-of-Freedom System

Degrees of freedom, equation of motion; free vibration of single degree of freedom systems; forced vibration: harmonic and periodic loadings; frequency response functions, force transmission and vibration isolation; response to arbitrary excitation.

Numerical Evaluation of Dynamic Response of SDOF Systems

Time domain analysis: interpolation of excitation, step by step integration, Newmark's method.

Earthquake Response of SDOF Systems

Earthquake excitation, response time history, construction of response spectra; response spectrum characteristics, tripartite plot, and design spectrum.

Two Degree Freedom System

Dynamic equations of equilibrium, free vibration of undamped system, natural modes, coordinate transformation, orthogonality conditions, response to initial condition, harmonic loading.

MDOF Systems

Equation of motions, matrix formulation, natural modes of undamped system, numerical solution for the eigenvalue problems; solution of free vibration response for undamped systems; concept of proportional damping, free vibration analysis of systems with damping.

Earthquake Response of MDOF Systems

Introduction, modal analysis, response time history for earthquake excitations using modal analysis; response spectrum analysis for peak responses; application to multi-storied shear building model.

Introduction to Dynamics of Continuous Systems

Equations of motions for axial vibration of a beam; equations of motion for flexural vibration of a beam; free vibration analysis- boundary value problems, natural frequencies, mode shapes, orthogonality conditions, forced vibration analysis using modal superposition method.

Text Books:

1. A. K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", PHI Ltd.
2. P. Mario, "Structural Dynamics", CBS Publishers.

References:

1. R. W. Clough and J. Penzien, "Dynamics of Structures", McGraw-Hill International Edition.
2. K. Rao, "Vibration Analysis and Foundation Dynamics", Wheeler.
3. J. Biggs and J. M. Biggs, "Introduction to Structural Dynamics", McGraw-Hill.
4. L. Meirovitch, "Elements of Vibration Analysis", McGraw-Hill.