

(CE505) STRUCTURAL DYNAMICS

Objective of the Course:

The objective is to provide the fundamental understanding of the structural dynamics and the problem solving ability for dynamic response in civil engineering design, analysis and research. Introduce students to analytical and numerical methods in structural dynamics with emphasis on vibration and to opportunities to optimize system for desired dynamic response.

UNIT-I:

Equation of Motions, Problem Statement, Solution Methods of Single Degree of Freedom Systems (SDOF)

Basic concepts of structural dynamics; single degree of freedom system, force displacement relationship, damping force, equation of motion, mass-spring-damper system, methods of solution of differential equation.

Free Vibration (SDOF):

Undamped free vibration, viscously damped free vibration, energy in free vibration.

UNIT-II:

Response to Harmonic and Periodic Excitations (SDOF)

Harmonic vibration of undamped systems, Harmonic vibration with viscous damping, response to vibration generator, natural frequency and damping from harmonic test, force transmission and vibration isolation, vibration measuring instruments, energy dissipated in viscous damping. Response to periodic force.

UNIT-III:

Response to Arbitrary, Step and Pulse Excitations (SDOF)

Response to unit impulse, response to arbitrary force, step force, ramp force, response to pulse excitations, solution methods, effects of viscous damping.

Numerical Evaluation of Dynamic Response (SDOF)

Time stepping methods, methods based on interpolation of excitation, central difference method, newmark's method, stability and computational error, analysis of nonlinear response by newmark's method.

UNIT-IV:

Earthquake Response to Linear Systems (SDOF)

Earthquake excitation, equation of motion, response quantities, response history, response spectrum concept, deformation, pseudo-velocity and pseudo acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics, elastic design spectrum, comparison and distinction between design and response spectra.

Generalised Single Degree of Freedom Systems

Generalised SDOF systems, rigid body assemblages, systems with distributed mass and elasticity, lumped mass system-shear building, natural vibration frequency by Rayleigh's method.

UNIT-V:

Multi -degree of freedom systems (MDOF)

Equation of motions: simple system-two storey shear building, general approach for linear systems, static condensation, symmetric plan systems: ground motion. Multiple support excitation, methods of solving the equation of motions.

Free Vibration (MDOF) Natural frequencies and modes: systems without damping, modal and spectral matrices, orthogonality of modes, normalization of modes. Solution of undamped free vibration systems, solution methods for eigen value problem.

TEXT BOOKS:

1. Dynamics of structures by Anil K Chopra; Prentice-Hall of India Limited, New Delhi. 3rd edition 2006.
2. "Structural dynamics" by Mario Paz and Leigh; CBS Publishers, 1st edition 1985.

REFERENCE BOOKS:

1. Structural Dynamics for Structural Engineers by G. C. Hart & K. Wang; John Wiley & Sons. 1st edition 1991.
2. Dynamics of Structures by R.W. Clough and P.E. Penzien, McGraw-Hill. 1st edition 1975