Course Code	Course Title	L	T	P	C
17CE003	STRUCTURAL DYNAMICS	3	0	3	5

Course Objective:

1. The objective is to provide the fundamental understanding of the structural dynamics.
2. The problem solving ability for dynamic response in civil engineering design, analysis and research.
3. Introduce students to analytical and numerical methods in structural dynamics with emphasis on vibration.
4. Opportunities to optimize system for desired dynamic response.
5. To provide the basic framework for studying time-dependent response of mechanical systems to external excitations.

Course Outcomes:

The students will be able to

1. Write equation of motion for single and multi-degree of freedom systems
2. Understand the impact of damping on characteristics of vibrating system
3. Gain knowledge about arbitrary and pulse excitation
4. Write generalized equation to represent dynamic behavior of multi degree of freedom systems in global scale

Activities:

1. Construct a working model spring and Damper system
2. Make a mathematical model of a residential building and write equation of motion to find out natural frequency and amplitude
3. Construct a working model to demonstrate free and forced vibration

Skills:

1. Determine vibration characteristics of structures like frequency, amplitude, impedance, and time period
2. Differentiate the response of single and multi-degree of freedom systems
3. Determine the response of structures for pulse excitation like blast load

UNIT-I: Introduction

Introduction to Dynamic analysis; Elements of vibratory systems; single degree of freedom system, natural frequency ,force displacement relationship, damping force.

UNIT-II: Equation of Motions, Problem Statement, Solution Methods of Single Degree of Freedom Systems (SDOF)

Equation of motion, mass-spring-damper system, methods of solution of differential equation. Undamped free vibration, viscously damped free vibration, energy in free vibration.

UNIT-III: 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-IV: 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-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.

TEXTBOOKS:

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

REFERENCES:

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

LABORATORY EXPERIMENTS

List of experiments:

1. Basic programming in MATLAB
2. Plotting of SFD, BMD and deflection diagrams for propped cantilever &simply supported beams in MATLAB
3. Study of Free and forced damped vibration using MATLAB
4. Plot the response spectrum for El-Centro ground motion using MATLAB
5. Generate time history response by Newmark's method using MATLAB
6. Generate time history response by CDM and impulse method using MATLAB