Course Code	Course Title	L	T	P	C
20SE002	STRUCTURAL DYNAMICS	3	1	2	5

PRE-REQUISTE COURSES: BASIC STRUCTURAL ANALYSIS

COURSE OBJECTIVES:

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. This Course aims to introduce students to analytical and Numerical Methods in Structural Dynamics with emphasis on Vibration. Opportunities to optimize system for desired dynamic response and provide the basic framework for studying time-dependent response of mechanical systems to external excitations.

COURSE OUTCOMES:

At the end of the course student will be able to

CO's	Course Outcomes	PO's
1	Write equation of motion for single and multi-degree of freedom systems	1,2
2	Understand the impact of damping on characteristics of vibrating system	
3	Gain knowledge about arbitrary and pulse excitation	3
4	Understand applications of Numerical Methods in Dynamics	4.5
5	Analyse in various theories of failure and plasticity.	1,2

SKILLS:

- ✓ Determine vibration characteristics of structures like frequency, amplitude, impedance, and time period
- ✓ Differentiate the response of single and multi-degree of freedom systems
- ✓ Determine the response of structures for pulse excitation like blast load
- ✓ Differentiate the response of Multi-Degree of Freedom systems

UNIT-I:

INTRODUCTION:, 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): 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:

BEAMS ON ELASTIC FOUNDATIONS: Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi infinite and finite beams – Rigid and flexible – Uniform cross section – Point load and UDL – Solution by finite differences.

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. Mario Paz and leigh, "Structural Dynamics",2 nd edition, CBS Publishers, 2004.
2. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", 1st edition, PHI Learning Pvt Ltd, 2006.
3. Duggal S.K, "Earthquake Resistant Design of Structures", 2 nd edition, Oxford University Press, 2013.

REFERENCES:

1. Chopra A.K, "Dynamics of Structures" Prentice-Hall of India Limited, New Delhi,2006.
2. Paulay T and Priestley M.J.N. "Seismic Design of Reinforced Concrete and Masonry Buildings", , John Wiley & Sons, 1991.

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 New mark's method using MATLAB
6. Generate time history response by CDM and impulse method using MATLAB