

COURSECONTENT

STRUCTURAL DYNAMICS								
II Semester: SE								
Course Code	Category	Hours/ Week			Credits	Maximum Marks		
2522014	Core	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
contactClasses:45	Tutorial Classes: Nil	Practical Classes: Nil			TotalClasses:45			
Prerequisites: NIL.								

Course Overview:

This course introduces the fundamental principles of vibration analysis for engineering structures, covering both discrete and continuous systems. It focuses on the formulation of equations of motion using methods such as Newton's laws, D'Alembert's principle, virtual work, and Hamilton's principle. The course examines the dynamic behavior of single and multi-degree of freedom systems, including free and forced vibrations, damping, and modal analysis. Practical methods like Holzer and Stodola techniques are discussed for vibration analysis. It also extends to continuous systems, particularly the vibration of beams and determination of natural frequencies and mode shapes.

Course Objectives:

1. To understand the fundamentals of vibrations and formulate equations of motion using various principles.
2. To analyze free and forced vibrations of single-degree-of-freedom systems under different dynamic loadings.
3. To study multi-degree-of-freedom systems, determine natural frequencies/mode shapes, and compute dynamic response.
4. To apply practical vibration analysis methods such as Stodola and Holzer techniques for mode estimation.
5. To analyze vibration behavior of continuous systems, particularly beams, and determine their natural frequencies and mode shapes.

Course Outcomes: After completion of the course, students will be able to

1. Formulate equations of motion for vibratory systems using Newton's laws, D'Alembert's principle, virtual work, and Hamilton's principle.
2. Analyze the dynamic response of single-degree-of-freedom systems under various loading conditions including damping and periodic forces.
3. Evaluate natural frequencies and mode shapes of undamped multi-degree-of-freedom systems using eigenvalue analysis.
4. Apply Stodola and Holzer methods for fundamental and higher mode vibration analysis.
5. Derive governing differential equations for beam vibrations and determine natural frequencies and mode shapes for various end conditions.



UNIT-I:

Theory of Vibrations: Introduction-Elements of vibratory system –Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. —Fundamental objectives of dynamic analysis –Types of prescribed loading – Methods of discretization- Formulation of equations of motion by different methods—Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

UNIT-II

Single Degree of Freedom Systems : Free vibrations of single degree of freedom system –undamped and damped vibrations- critical damping- Logarithmic decrement –Forced vibration of SDOF systems —Half Power (Band-Width) Method- Harmonic excitation- Vibration Isolation— Response to support motion- Force transmitted to the foundation- Transmissibility- Dynamic magnification factor—Phase angle.

Response to General Dynamic Loading—Duhamel's Integral-Constant Force, Rectangular load, Triangular load, Response to Periodic loading-Fourier series expression of periodic loading-Response to Fourier series loading

UNIT-III

Multi Degree of Freedom Systems: Selection of the degrees of Freedom - Evaluation of structural property matrices-Formulation of the MDOF equations of motion-Undamped free vibrations-Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response — Normal co-ordinates- Uncoupled equations of motion-Orthogonal properties of normal modes-Mode superposition procedure.

UNIT-IV

Practical Vibration Analysis: Introduction – Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.

UNIT-V

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case —Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions.

REFERENCES:

1. Dynamics of Structures by Ray W. Clough & Joseph Penzien, Second Edition, CBS Publishers & Distributors
2. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
3. Structural Dynamics by Mario Paz and William Leigh, Fifth Edition, Springer
4. Theory of Vibrations by W.T. Thomson, Pearson
5. Fundamental of Structural Dynamics by Roy. R. Craig, John Wiley & sons



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ELECTRONICSOURCES:

<https://nptel.ac.in/courses/105106049>

<https://nptel.ac.in/courses/112103111>

MATERIALSONLINE:

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper–I
6. Model question paper–II
7. Lecture notes
8. E-Learning Readiness Videos(ELRV)