

ME325 MECHANICAL VIBRATIONS

(Dept. Elective - I)

Course Description & Objectives:

An introductory course in linear mechanical vibrations where students acquire the ability to Formulate mathematical models of problems in vibrations using Newton's second law or energy principles, determine a complete solution to the modeled mechanical vibration problems. Correlate results from the mathematical model to physical characteristics of the actual system. Design of a mechanical system using fundamental principles developed in the class.

Course Outcomes:

1. Students will be able to construct the equations of motion for free-body diagrams.
2. And are able to solve for the motion and the natural frequency of (1) a freely vibrating single degree of freedom undamped motion and (2) a freely vibrating single degree of freedom damped motion.
3. To construct the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force. Students will be able to decompose any periodic function into a series of simple harmonic motions using Fourier series analysis.
4. Students will be able to solve for the motion and the natural frequency for forced vibration of a single degree of freedom damped or undamped system.
5. Students will have an ability to obtain the complete solution for the motion of a single degree of freedom vibratory system (damped or undamped) that is subjected to non-periodic forcing functions.
6. To solve vibration problems that contain multiple degrees of freedom. and to obtain numerical solutions to vibration problems by simple algorithms, and display the findings in graphical form.

UNIT - I Single Degree of Freedom Systems:

Introduction, types of vibrations, Frequency and time period for longitudinal and transverse vibrations, Newton's Law of motion - Energy method, Raleigh's method.

UNIT - II Vibrations:

Free vibration, Forced vibration, Damped vibrations, types of damping, logarithmic decrement, Isolation of vibrations & Transmissibility.

UNIT - III Two Degree-of-Freedom Systems:

Two degrees-of-freedom system, Lagrange's equation, modes of vibration, Principal modes, Principles of orthogonality, Generalized coordinates, Coordinate coupling, Dynamic vibration Absorber.

UNIT - IV Multi Degrees-of-Freedom Systems:

Newton's second law to derive equation of motion, Influence co-efficients - Stiffness, Flexibility, Inertia. Eigen values & Eigen vectors.

UNIT - V Transient Vibration of Continuous Systems:

Transient Vibrations - Impulse excitation, Arbitrary excitation, Laplace Transform formulation - Continuous System - longitudinal Vibration of rods, Transverse Vibration of beams, Transverse Vibration of string, Torsional Vibration of shaft.

TEXT BOOKS :

1. G.K. Groover, "Mechanical Vibrations", 4th ed., NEM Chand & Brothers, 2009.
2. L.Meirovitch, "Fundamentals of Vibrations", 1st ed., Tata McGraw Hill, 2009.

REFERENCE BOOKS :

1. S.GrahamKelly, "Schaum's Outlines, Theory & Problems of Mechanical Vibrations", 3rd ed., Tata McGraw Hill, 2007.
2. W.T. Thomson and M.D. Dehlen, "Theory of Vibrations with Applications", 5th ed., Pearson Education, 2007.