IV B.TECH - I SEMESTER
MECHANICAL VIBRATIONS

Course Code: ME7T4C **Credits: 3**
Lecture: 3 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period/week **Semester end examination: 70 marks**

COURSE OBJECTIVES:

- Introduce the knowledge about vibrations and their applications
- Propose the concept of single, double and multi degree freedom systems for un damped and damped free vibrations
- Study different types of forced vibrations and vibration measuring instruments
- Analyze different problems in shaft due to vibrations
- Determine the natural frequencies in continuous system

COURSE OUTCOMES:
Upon completion of this course the student will be able to:

1. Analyze single degree freedom system for its natural frequency and damped response.
2. Analyze the response of Single degree freedom systems under harmonic excitations
3. Determine the response of Two degree freedom systems under free and forced vibrations
4. Perform modal analysis to determine the natural frequencies of a multi degree of freedom system
5. Analyze continuous systems for the determination of natural frequencies

Pre-Requisites: Dynamics of Machinery

UNITI
FREE RESPONSE OF SINGLE DEGREE FREEDOM SYSTEMS:
Introduction to vibrations, SHM, causes of vibrations, types of vibrations, Free Vibrations D Alembert's Principle, Energy method, Damped Free Vibrations, different types of damping, Viscous damping, critical, under and over damping, logarithmic decrement.

UNIT II
FORCED RESPONSE OF SINGLE DEGREE FREEDOM SYSTEMS:
Introduction, Response of SDF systems to Harmonic excitations, Frequency response plots, Systems with rotating unbalanced masses, whirling of rotating shafts, harmonic motion of base, vibration isolation and transmissibility, vibration measuring instruments.

UNIT III
TWO DEGREE OF FREEDOM SYSTEMS:
Equations of motion, Equilibrium method, Lagrangian method, Free vibration response, Eigen values and Eigen vectors, coordinate Transformations, Coordinate coupling, Orthogonality of Modes, Natural coordinates, semi definite systems undamped vibration absorbers.

UNITIV

MULTI-DEGREE OF FREEDOM SYSTEMS

Equations of motion for linear systems, Flexibility and stiffness influence coefficients, un damped free vibration, the Eigen Value problem, Natural frequencies and mode shapes, Orthogonally of modal vectors, normalization of modal vectors, Decoupling of modes, modal analysis, mode superposition technique, Free vibration response through modal analysis, Forced vibration analysis by modal analysis, proportional damping.

UNIT V

CONTINUOUS SYSTEMS

Free vibration of a string, longitudinal vibrations of bar, transverse vibration of beam, torsion of vibrations of circular shaft for various end conditions. Introduction to Finite element method.

Learning Resources

Text Books

1. L. Meirovich, Elements of Vibration analysis, (2nd edition). Tata Mc-Graw Hill 2007
2. Fundamentals of Vibrations by S. Graham Kelley, Mc Graw Hill publications New Delhi 1996.

Reference Books.

1. Mechanical vibrations, (4th edition) by Singiresu S. Rao Pearson education publications, Delhi, 2004.
2. Theory and problems of mechanical vibrations by S. Graham Kelley, Schaum's outline series Mc Graw Hill publications New Delhi 1996.
3. Theory of vibration with applications by W.T., Thompson. CBS Publishers