MECHANICAL VIBRATIONS

Subject Code: 13ME2201 **L P C**
4 0 3

Pre requisites: Theory of machines

Course Educational Objectives:
To make the student learn
1. the types and causes of vibrations and the parameters that affect vibrations
2. the importance of vibration analysis in mechanical design of machine parts
3. lumped parameter concept to represent a system as a set of masses, springs and dampers
4. methods of modelling single-, two-, and multi-degree freedom systems
5. the disasters that can occur due to vibrations and the methods of mitigating them.

Course Outcomes:
The student will be able to
1. explore the need and importance of vibration analysis in mechanical design of machine parts
2. derive the governing differential equations of different vibratory systems
3. analyze the mathematical model of a linear vibratory system to determine its response
4. analyze free and forced, undamped and damped vibratory systems
5. determine the frequencies and response of vibratory systems to different kinds of excitation
6. predict and avoid the occurrence of resonance

UNIT – I
Transverse vibrations, single concentrated load, uniformly distributed load, several loads, Dunkerley‘s method, energy method, whirling of shafts. Torsional vibrations – single rotor, two-rotor, three-rotor systems, torsionally equivalent shaft, geared system.

UNIT – II

Two degree of freedom systems – Principal modes of vibration – two masses fixed on tightly stretched string – double pendulum – torsional system with damping – forced vibration with harmonic excitation – undamped dynamic vibration absorber – untuned viscous damper

UNIT – III

Multi degree of freedom systems – exact analysis - free vibrations – equations of motion – influence coefficients - generalized co-ordinates – Co-ordinate coupling – natural frequencies and mode shapes – eigenvalues and eigenvectors - orthogonal properties of normal modes – modal analysis.

UNIT – IV

Multi degree of freedom systems – Numerical methods – Rayleigh`s method – Dunkerley`s method – Stodola's method – Rayleigh Ritz method – Method of matrix iteration – Holzer's method for natural frequencies of multi rotor systems.

UNIT – V

Continuous systems – vibration of strings – longitudinal vibrations of bars – torsional vibrations of circular shafts - lateral vibration of beams Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed

TEXT BOOK:

1. Rao S.S. ,"*Mechanical Vibrations*",4e, Pearson Education Inc.,2004.

REFERENCES:

1. G.K. Grover, "*Mechanical Vibrations*", Nemchand & Bros, Roorkee, 8e, 2009.
2. William T Thomson & Marie Dillon Dahleh, "*Theory of Vibrations with application*", 5e, Pearson Education Publication, 2007.
3. Tse, Morse and Hinkel, "*Mechanical Vibrations*", Chapman and Hall, 1991.
4. Den Hartong J.P., "*Mechanical Vibrations*", McGraw Hill, 1986.
5. V.P.Singh, "*Mechanical vibrations*",3e, Dhanpat Rai& Co.,2006.