III Year II Semester	L	T	P	C
Code: 20ME6321	3	0	0	3

MECHANICAL VIBRATIONS & CONDITION MONITORING

Course Objectives:

1. Provides the importance of study of vibration.
2. Enhances the vibration analysis procedure for physical systems.
3. Determines the amount of damping for a given system.
4. Finds the response of an undamped system under harmonic force.
5. Creates awareness about the vibration isolation materials.
6. Writing the equations of motion for physical systems

UNIT-I HARMONICALLY EXCITED VIBRATION:

Introduction, equation of motion, response of an undamped system under harmonic force, response of a damped system under the harmonic motion of the base, response of a damped system under rotating unbalance, forced vibration with coulomb and hysteresis damping.

TWO DEGREES OF FREEDOM SYSTEMS: Introduction, equations of motion for forced vibration, free vibration analysis of an undamped system, torsional system, coordinate coupling and principal coordinates, forced vibration analysis.

UNIT – II MULTI DEGREE OF FREEDOM SYSTEMS:

Introduction, modeling of continuous systems as multi degree of freedom systems, influence coefficients, potential and kinetic energy expressions in matrix form, generalized coordinates and generalized forces, using Lagrange's equation to derive equations of motion ,equations of motion of undamped systems in matrix form, eigen value problem, solution of the eigen value problem, free vibration of undamped systems, forced vibrations of undamped systems using modal analysis, forced vibration of viscously damped system.

UNIT – III NONLINEAR VIBRATIONS:

Introduction, examples of nonlinear vibration problems, exact methods, approximate analytical methods, sub harmonic and super harmonic oscillations, systems with time dependent coefficients, graphical methods, stability of equilibrium states, limit cycles, chaos.

UNIT – IV VIBRATION CONTROL:

Introduction, vibration nomograph and vibration criteria, reduction of vibration at the source, balancing of rotating machines, whirling of rotating shafts, balancing of reciprocating engines, control of vibration, control of natural frequencies, introduction of damping, vibration isolation, vibration absorbers.

UNIT V FAULT DIAGNOSIS:

Dynamic testing of machines and structures, experimental modal analysis, machine condition monitoring and diagnostics. Condition monitoring and signature analysis applications: Introduction, noise monitoring, temperature monitoring, wear behaviour monitoring, corrosion monitoring, performance trend monitoring, selection of condition monitoring techniques, diagnosis.

TEXT BOOKS:

1. Rao S.S., *"Mechanical Vibrations",* 4th Edition, Pearson Education, Inc., 2004.
2. B.C. Nakra and K.K. Chowdary, *"Mechanical Measurements",* 2nd Edition, TMH, New Delhi, 2004.

REFERENCES:

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

Course outcomes:

Upon successful completion of this course you should be able to:

1. Finds the natural frequencies for a single and multi degree of freedom systems.
2. Provides the information about the vibration measurements.
3. Gives the knowledge about signal analysis.
4. Determines the response of the systems under periodic and no periodic forces.
5. Importance of the machine condition monitoring.
6. Analysis of the free and forced vibration of viscously damped systems.