MECHANICAL VIBRATIONS

Course Code	22MEMD1T3	**Year**	I	**Semester**	I
Course Category	Programme core	**Branch**	ME	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	
Continuous Internal Evaluation:	40	**Semester End Evaluation:**	60	**Total Marks:**	100

Course outcomes: At the end of the course, the student will be able to:

CO	Statement	BTL	Units
CO1	Apply the knowledge of mathematics and science to solve the free vibration problems of Single-Degree-of-Freedom Systems.	L3	1
CO2	Identify various types of forced vibration problems and develop the mathematical models, analyze, solve to find the response of Single-Degree-of-Freedom Systems subjected to harmonic excitation.	L3	2
CO3	Identify and develop the mathematical models, analyze, solve to find the free/ forced vibration response of Two-Degrees-of-Freedom Systems and continuous systems	L3	3
CO4	Apply maintenance and condition monitoring techniques to machinery and Diagnose Machinery faults.	L3	4

Contribution of Course outcomes towards achievement of programme outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1									3	1
CO 2	3	3	1	1									3	1
CO 3	3	3	1	1									3	1
CO 4	3	3	1	1									3	1

Syllabus		
Unit	**Contents**	**Mapped CO**
1	**FREE VIBRATION OF SINGLE-DEGREE-OF-FREEDOM SYSTEMS:** Importance of the Study of Vibration, Elementary Parts of Vibrating Systems, Number of Degrees of Freedom, Discrete and Continuous Systems, Classification of Vibration, Vibration Analysis Procedure, Harmonic Motion, Harmonic Analysis, Free Vibration of an Undamped Translational and Torsional Systems, Rayleigh's Energy Method, Free Vibration with Viscous Damping and Coulomb Damping**.**	**CO1**
2	**HARMONICALLY EXCITED VIBRATION:** Equation of Motion, an Undamped System Under Harmonic Force, Damped System Under Harmonic Force, Damped System Under the Harmonic Motion of the Base, Damped System Under Rotating Unbalance, Transfer-Function Approach, Solutions using Laplace Transform, Frequency Transfer Functions, Representation of Frequency-Response Characteristics	**CO2**
3	**TWO-DEGREE-OF-FREEDOM SYSTEMS:** Free Vibration Analysis of an Undamped System, Coordinate Coupling and Principal Coordinates, Forced-Vibration Analysis, dynamic vibration absorber. **MULTIDEGREE-OF-FREEDOM SYSTEMS:** Influence Coefficients, Potential and Kinetic Energy Expressions, Generalized Coordinates and Generalized Forces Using Lagrange's Equations to Derive Equations of Motion, free vibration of Multi degree-of-Freedom Systems. **Continuous Systems**: Transverse Vibration of a String or Cable, Longitudinal Vibration of a Bar or Rod, Torsional Vibration of a Shaft or Rod, Lateral Vibration of Beams.	**CO3**
4	**PREDICTIVE MAINTENANCE TECHNIQUES**: Basics, maintenance philosophies, Bathtub curve, Classification of maintenance, advantages,and disadvantages of maintenance, plant machinery classifications, and recommendations. Introduction to Condition monitoring, definition, Types of condition monitoring **MACHINERY FAULT DIAGNOSIS USING VIBRATION ANALYSIS:** Unbalance, bent shaft, Eccentricity, Misalignment, looseness, Belt drive problems, gear defects, bearing defects	**CO4**

Learning Resources
Text Book(s): 1. Mechanical Vibrations (5^{th} edition) by Singiresu S. Rao, Pearson Education 2. Machinery vibration Analysis & Predictive Maintenance by Paresh Girdhar, Elsevier publishers

References:

1. Elements of Vibration Analysis (2nd edition) by Leonard Meirovitch, McGraw-Hill
2. Mechanical Fault diagnosis and condition monitoring by R. A .Collacott
3. Mechanical Vibrations: theory and applications by (1st edition) S Graham Kelly, Cengage Learning
4. Vibrations (2nd edition) by Balakumar Balachandran and Edward B. Magrab, Cengage Learning