Course Code	Course/Subject Name	Credits
MEDLO7031	**MECHANICAL VIBRATION**	**4**

Objectives:

1. To study basic concepts of vibration analysis
2. To acquaint with the principles of vibration measuring instruments
3. To acquaint with the practices of monitoring health conditions of the systems

Outcomes: Learner will be able to…

1. Develop mathematical model to represent dynamic system.
2. Estimate natural frequency of mechanical element / system.
3. Analyse vibratory response of mechanical element / system.
4. Estimate the parameters of vibration isolation system and
5. Control the vibrations to the acceptable level using basic vibration principles
6. Handle the vibration measuring instruments

Module	Details	Hrs.
1	**1.1 Basic Concepts of Vibration:** Introduction, classification, terminology, modelling vibration analysis **1.2 Free Undamped Single Degree of Freedom Vibration System:** Longitudinal, transverse, torsional, vibration system, methods for formulation of differential equations by D'Alembert's Principle, Newton, Energy, Lagrangian and Rayleigh's method	**08**
2	**Multi Degree of Freedom System:** **2.1 Undamped free vibration:** Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotor and geared systems **2.2 Eigen Values and Eigen vectors:** for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	**10**
3	**Free Damped Single Degree of Freedom Vibration System:**Types of dampers, Viscous damped system- translatory and rotary systems, Coulomb's damping- final rest position of body in coulomb damping, motion with negative damping factor,	**06**
4	**4.1 Forced Single Degree of Freedom Vibratory System:**Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation **4.2 Vibration Isolation and Control:** Conventional Methods: By mass /Inertia, stiffness, damping (vibration isolation principles) Force Transmissibility, motion transmissibility, typical isolators & mounts. Introduction to Semi-Active and Active Vibration control.	**10**
5	**5.1 Vibration Measuring Instruments:**Principle of seismic instruments, vibrometer, accelerometer- undamped, damped **5.2 Introduction to Conditioning Monitoring and Fault Diagnosis:**Introduction to conditioning monitoring and fault diagnosis,Condition & Vibration Monitoring Techniques, Condition / vibration monitoring data collection. Signature analysis	**07**
6	**Non-Linear Vibration:**Basics of Non-linear vibration, systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase –plane technique, Duffing's equation, Jump phenomenon, Limit Cycle, Perturbation method.	**07**

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Mechanical Vibrations by S.S.Rao, fourth edition, Pearson Education
2. Mechanical Vibraitons by G. K. Grover
3. Fundamentals of Mechanical Vibration by S.Graham Kelly, Tata McGraw Hll
4. Vibration Analysis by P. Srineevasan, Tata McGraw Hill
5. Mechanical Vibrations- Schaum's outline series, William W.Seto, McGraw Hill
6. Theory and Practice of Mechanical Vibrations by J.S.Rao, K. Gupta, New Age International Publications
7. Mechanical Vibrations by Den, Chambil, Hinckle
8. Mechanical Vibrations by J.P.Den Hartog, McGraw Hill Book Company Inc
9. Introduction to Dynamics and Control by Leonard Meirovitch, Wiley, New York
10. Elements of Vibration Analysis by Leonard Meirovitch, McGrmv- Hill, New York
11. Dynamics and Control of Strucdtures by Leonard Meirovitch, Wiley, New York
12. Matrices and Transformations by Antony J. Pettofrezzo, Dover, New York
13. Principles of Vibration by Benson H. Tongue, Oxford University Press
14. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
15. Vibrations by Balakumar Balachandan, Edward Magrab, Cengagae Learning