Course Code	Course Name	Credits
MEDLO7043	**Advanced Vibration**	**03**

Objectives :

1. To study the Multi-degree of freedom system.
2. To study different vibration measurement and control methods, and required instruments.
3. To study basic concepts of Random Vibrations.
4. To study the basic concepts of nonlinear vibrations.

Outcomes: Learner will be able to…

1. Estimate natural frequency of mechanical element / system.
2. Understand the concepts of Vibration Isolation and Control.
3. Analyse vibratory response of mechanical element / system.
4. Analyse vibration of Continuous system.
5. Analyse Random Vibrations.
6. Analyse Non-Linear Vibrations.

Module	Contents	Hours
1	**Multi Degree of Freedom System:** **1.1 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 **1.2 Eigen Values and Eigen vectors:** for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	**06**
2	**2.1 Vibration Isolation and Control:** Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers, and Vibration dampers, Passive, semi-active, and active vibration control	**06**
3	**3.1 Vibration Measurement:** Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis. **3.2 Modal analysis and Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine condition monitoring and diagnosis.	**06**
4	**Vibration of Continuous Systems:** Vibration of string, Longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.	**07**
5	**Random Vibrations:** Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response.	**07**
6	**Non-Linear Vibrations:** Introduction, Sources of nonlinearity, Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations, Runge-Kutta 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**.

Text/Reference Books:

1. W.T. Thomson and M.D. Dahleh, "Theory of Vibration with Applications", 3rd Edition 2002, Pearson Education

2. G.K. Grover, "Mechanical Vibraitons", 5th Edition 2009, Nem Chand and Bros, ISBN: **978-8185240565**

3. W.W. Seto, "Mechanical Vibrations- Schaum's Outline Series", McGraw Hill, ISBN: 9780070563278

4. S.S. Rao, "Mechanical Vibrations", 5th Edition 2004, Pearson Publications

5. Leonard Meirovitch, "Fundamentals of Vibration", 1st Edition 2010, McGraw Hill, ISBN: 978-1577666912.

Links for online NPTEL/SWAYAM courses:

https://nptel.ac.in/courses/112107212 – Introduction to Mechanical Vibration, IIT Roorkee
https://nptel.ac.in/courses/112103111 – Mechanical Vibrations, IIT Guwahati
https://nptel.ac.in/courses/112103022 – Nonlinear Vibration, IIT Guwahati
https://nptel.ac.in/courses/112104211 – Principles of Vibration Control, IIT Kanpur