B.Tech 5th Semester (Robotics and Artificial Intelligence)

Lesson Plan: Mechanical Vibrations (PCC-RAI-703/21)

S.N.	Content to be Covered	Lect. No.
UNIT – 1: Introduction (3 Lectures)		
1	Introduction to Mechanical Vibrations – Definition, Importance, and Applications	L1
2	Harmonic Motion and Periodic Motion	L2
3	Basic Vibration Terminology – Amplitude, Frequency, Phase, Period, etc.	L3
UNIT – 2: Single Degree of Freedom Systems (8 Lectures)		
4	Free Vibrations of Undamped Systems – Derivation and Examples	L4
5	Energy Method and Equivalent Systems	L5
6	Free Vibrations with Damping – Logarithmic Decrement, Damping Ratio	L6
7	Forced Vibrations without Damping – Steady-State Response	L7
8	Forced Vibrations with Damping – Equation of Motion, Amplitude, and Phase Angle	L8
9	Magnification Factor and Resonance Phenomenon	L9
10	Transmissibility and Isolation – Concept and Applications	L10
11	Numerical Problems on Damped and Undamped Systems	L11
UNIT – 3: Two Degree of Freedom Systems (6 Lectures)		
12	Concept of Generalized and Principal Coordinates	L12
13	Equation of Motion for Two-Degree Systems	L13
14	Coordinate Coupling and its Removal	L14
15	Lagrange's Equation and Applications	L15
16	Natural Frequencies and Mode Shapes of Two DOF Systems	L16
17	Numerical Problems and Illustrations	L17
UNIT – 4: Vibration Absorbers (4 Lectures)		
18	Tuned Vibration Absorber – Working Principle	L18
19	Determination of Mass Ratio and Frequency Ratio	L19

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20	Damped and Tuned Absorbers – Qualitative Treatment	L20
21	Untuned Viscous Dampers and their Applications	L21
UNIT – 5: Multi Degree of Freedom Systems (7 Lectures)		
22	Derivation of Equation of Motion for Multi-DOF Systems	L22
23	Natural Frequency Calculation – Rayleigh's Method	L23
24	Stodola Method and Its Applications	L24
25	Matrix Formulation and Matrix Iteration Method	L25
26	Holzer Method for Rotating Systems	L26
27	Comparison of Different Methods	L27
28	Numerical Problems on Multi-DOF Systems	L28
UNIT – 6: Vibration Analysis (6 Lectures)		
29	Introduction to Vibration Analysis and Influence Coefficient	L29
30	Stiffness Matrix and Flexibility Matrix	L30
31	Natural Frequencies and Normal Modes	L31
32	Modal Analysis and Orthogonality of Modes	L32
33	Numerical Examples on Vibration Analysis	L33
34	Case Study / Practical Applications	L34
UNIT – 7: Transient Vibrations (6 Lectures)		
35	Impulse and Arbitrary Excitation – Concepts	L35
36	Response to Step Excitation	L36
37	Base Excitation and its Analysis	L37
38	Laplace Transform Solutions for Transient Vibrations	L38
39	Response Spectrum and Its Interpretation	L39
40	Runge-Kutta Method for Solving Vibration Problems	L40

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