

AE-412: Automobiles Vibration System Analysis										
L	T	P	Credit	Area		CWS	PRS	MTE	ETE	PRE
3	0/1	2/0	4	DEC		15/25	25/-	20/25	40/50	-

**Objectives:** This course aims to introduce the student with fundamentals of vibrations, multi-degree of freedom systems, dynamic analysis and frequency analysis

AE-412: Automobiles Vibration System Analysis		Contact Hours
<b>Unit-1</b>	Introduction: Simple Harmonic Motion, Terminology, Newton's Law, D'Alembert's Principle, Resonance, Introduction to Mechanism of Damping. Damped and Undamped Oscillations. Degrees of Freedom. Various Mechanisms of Damping. Equivalent Viscous Damping	8
<b>Unit-2</b>	Single Degree of Freedom Systems: Free Vibrations, Free Damped Vibrations, Forced Vibrations With and Without Damping. Support Excitation and Vibration Measuring Instruments. Amplitude and Phase Response Diagrams. Generalized Single Degree of Freedom Systems for Continuous Structures and Computation of K, M and C.	6
<b>Unit-3</b>	Multi Degree of Freedom Systems: Two / Three Degree of Freedom Systems, Static and Dynamic Coupling, Vibration Absorbers, Principal Coordinates, Principal Modes, Orthogonality Conditions Hamilton's Principle, Lagrange's Equation and Application. Longitudinal Vibration, Lateral Vibration, Torsional Vibration of Shafts, Dynamical Equations of Equilibrium of Elastic Bodies, Natural Frequencies and Mode shapes Determination	6
<b>Unit-4</b>	Frequency Analysis: Methods Determining Natural Frequencies and Mode Shape. Natural Vibrations of Solid Continua. Determination of Eigen Values and Eigen Modes. Introduction to Approximate Methods for Frequency Analysis Rayleigh Ritz Method for Vibration Analysis. Diagonalization of Stiffness, Mass and Damping Matrices Using Orthogonality Conditions	8
<b>Unit-5</b>	Dynamic Analysis: Matrices for Dynamic Analysis. Kinematically Consistent Load Systems and Determination of [K], [M], [C] and [L] Matrices. Normalization and Formulation of Modal Equations.	7
<b>Unit-6</b>	Steady State Analysis: Steady State Response, Using Fourier Analysis for Decomposing Complex Periodic Load Functions, of Modal Equations Using S-Plane Representation. Transient Response Analysis of Modal Equations Using Duhamel's Integrals	7
<b>Total</b>		42

Reference Books:	
1	Theory of vibration with applications / William Tyrrell Thomson / Prentice-Hall, 1972 /0139145494, 9780139145490
2	Mechanical Vibrations/New Chand, 2009 / 8185240566, 9788185240565
3	Introductory Course on Theory & Practice of Mechanical Vibrations / J.S. Rao, Dr. K. Gupta / Wiley Eastern, 1984 / 0852267835, 9780852267837
4	Mechanical Vibrations / Rao / Pearson Education India, 2003 / 8177588745, 9788177588843

CO1	To understand basics of automobiles vibration system.
CO2	To discuss single degree of freedom systems.
CO3	To explain multi degree of freedom systems.
CO4	To analyze methods determining natural frequencies and methods for frequency analysis
CO5	To implement dynamic analysis and normalization and formulation of modal equations.
CO6	To apply knowledge of Steady State Analysis for case studies.

**CO-PO/PSOMatrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	1	1
CO2	3	3	2	3	1	0	0	0	0	0	0	1	2	1	1
CO3	3	3	3	3	1	0	0	0	0	0	0	2	3	3	2
CO4	3	3	3	3	1	0	0	0	0	0	0	1	3	3	2
CO5	2	2	2	2	2	0	0	0	0	0	0	1	2	2	2