

**Subject Code: 01ME0601**
**Subject Name: Dynamics of Machine**
**B.Tech. III Year – (Sem-6) Automobile Engineering**
**Type of course:** Engineering

**Prerequisite:** Higher order ODE, PDE, and Kinematics of Mechanism

**Rationale:** Understanding & Analysis of Vibration in Mechanical System.

**Course Outcome**

Student will be able to

- 1 Understand unbalance force and bearing reaction force in rotating mass.
- 2 Understand unbalance force in reciprocating engine.
- 3 Understand natural frequency of Vibrating Mechanical system
- 4 Understand critical speed of shaft term and cam-follower system.

**Teaching and Examination Scheme:**

Teaching Scheme( Hours)			Credits	Evaluation Scheme					Total Marks
Theory	Tutorial	Practical		Theory Marks			Practical Marks		
				ESE	IA	CSE	Viva (V)	Term Work	
4	0	2	5	50	30	20	25	25	150

Sr. No	Contents	Duration	Weightage
1	<b>Rotating Mass Balance:</b> Understanding static and dynamic balancing, Investigation of effect of unbalance rotating mass (Single & Multi plane), Methods for measuring unbalance force & mass. Bearing reactions.	04	08
2	<b>Balancing of Reciprocating Mass:</b> Balancing of slider crank chain mechanisms, Modelling real system for static and dynamic analysis. Inertia force, disturbing force and torque, <b>Balancing of Multi Cylinder Engines:</b> Analysis of Multi Cylinder In-line Engines: Direct and Reverse crank method, optimized configuration of in-line engine. <b>Balancing of Radial Engine :</b> Evaluation of V and radial engine, Analytical & Graphical methods.	12	25

	<b>Fundamental of Mechanical Vibrations:</b> Vibration and oscillation, Reason for generation of vibration, Parameters of Vibration- spring, mass, damper, Damper models, Motion –periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, static equilibrium position, Vibration classification.	02	04
3	<b>Free Undamped Single Degree of Freedom Vibration System</b> Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy, and Rayleigh’s Method, <b>Free Damped Single Degree of Freedom Vibration System</b> Viscous damping, Under, Critically & Over damped System, Damping Factor, Logarithmic decrement; <b>Free Undamped vibration of Two Degrees of freedom System:</b> Characteristics Equation and basic mode of vibration, torsional vibrations of two and three rotor system, torsionally equivalent shaft, geared system. <b>Forced Vibration:</b> Undamped Forced vibrations, Damped Forced Vibration, Equivalent viscous damping; Externally Applied forces due to unbalanced masses. <b>Vibration Isolation and Transmissibility:</b> Force Transmissibility, Motion Transmissibility Typical isolators & Mounts	20	40
4	<b>Vibration in Rotating System:</b> Whirling of shafts, Critical speed and its practical influence in the design of shafts, Application of Dunkerley’s method and Rayleigh’s method for determination of critical speed of shafts	04	08
6	<b>Vibration Measurement:</b> Basic of vibration measurement and analysis Instruments used: Vibrometer, velocity pickup, accelerometer, FFT analyzer.	04	08
7	<b>Cam Dynamics:</b> Dynamics of force-closed cam follower system: Jump phenomenon: Reason for Jump, response of spring force and static mass on jumping of cam.	03	07

R Level	U Level	A Level	N Level	E Level	C Level
20	15	15	15	15	10

**Legends: R:** Remembrance; **U:** Understanding; **A:** Application, **N:** Analyze, and **E:** Evaluate, **C:**Create

**Reference Books:**

1. S S Rao, Mechanical Vibrations, Pearson.
2. R L Norton, Kinematics and Dynamics of Machinery, McGraw-Hill.
3. J.Uicker , Gordon R Penstock & J.E. Shigley, Theory of Machines and Mechanisms, Oxford.
4. V. P. Singh, Mechanical Vibration
5. R L Norton, Design of Machinery, McGraw-Hill.
6. A. G. Ambekar, Mechanical vibrations and noise engineering
7. G. K. Grover, Mechanical Vibration.

**List of the Experiment**

- 1 Balancing of rotating mass in different plane.
- 2 Analysis of unbalanced reciprocating mass.
- 3 Experimental analysis of Free Undamped longitudinal Vibration of single degree of freedom system
- 4 Experimental analysis of Free Undamped torsional vibration of single degree of freedom system
- 5 Experimental analysis of Free Undamped torsional vibration of two rotor system
- 6 Experimental analysis of Damped torsional vibration
- 7 Experimental analysis of forced vibration
- 8 Experimental analysis of forced damped vibration
- 9 To verify Dunkerley's theorem for lateral vibration
- 10 To determine critical speed of the shaft and study effect of shaft diameter and end conditions on the same.
- 11 To determine jump speed and effect of dead weight and spring force on it.

**List of Open Source Software/learning website:**

1. [www.nptel.ac.in](http://www.nptel.ac.in)
2. [www.coursera.org](http://www.coursera.org)
3. [www.edx.org](http://www.edx.org)
4. <http://vlab.co.in/>