

Subject Code: 01ME0601
Subject Name: Dynamics of Machine - II
B.Tech. III Year – (Sem-6) Mechanical Engineering
Type of course: Under Graduate

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

Rationale: Understanding & Analysis of Vibration in Mechanical System.

Teaching and Examination Scheme:

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

COURSE OUTCOME

Student will be able to

- 1 Analyze unbalance force and bearing reaction force in rotating mass and its effects.
- 2 Analyze unbalance force in reciprocating engine and its effects.
- 3 Analyze natural frequency of Vibrating Mechanical system and develop methods to overcome its ill effects.
- 4 Understand critical speed of shaft and analyze the effects of critical speed.
- 5 Understand cam-follower system and analyze forces acting on cam follower system

| SR NO | CONTENTS | TOTAL HOURS | WEIGH TAGE |
|-------|---|-------------|------------|
| 1 | Rotating Mass Balance: 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 | Balancing of Reciprocating Mass: Balancing of slider crank chain mechanisms, Modelling real system for static and dynamic analysis. Inertia force, disturbing force and torque, Balancing of Multi Cylinder Engines: Analysis of Multi Cylinder In-line Engines: Direct and Reverse crank method, optimized configuration of in-line engine. Balancing of Radial Engine : Evaluation of V and radial engine, Analytical & Graphical methods. | 12 | 25 % |

| | | | |
|---|---|----|------|
| | Fundamental of Mechanical Vibrations: 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 | Free Undamped Single Degree of Freedom Vibration System Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy, and Rayleigh’s Method, Free Damped Single Degree of Freedom Vibration System Viscous damping, Under, Critically & Over damped System, Damping Factor, Logarithmic decrement; Free Undamped vibration of Two Degrees of freedom System: Characteristics Equation and basic mode of vibration, torsional vibrations of two and three rotor system, torsionally equivalent shaft, geared system. Forced Vibration: Undamped Forced vibrations, Damped Forced Vibration, Equivalent viscous damping; Externally Applied forces due to unbalanced masses. Vibration Isolation and Transmissibility: Force Transmissibility, Motion Transmissibility Typical isolators & Mounts | 20 | 40 % |
| 4 | Vibration in Rotating System: 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 % |
| 5 | Vibration Measurement: Basic of vibration measurement and analysis Instruments used: Vibrometer, velocity pickup, accelerometer, FFT analyzer. | 04 | 08 % |
| 6 | Cam Dynamics: 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 % |

Distribution of Theory Marks

| R Level | U Level | A Level | N Level | E Level |
|---------|---------|---------|---------|---------|
| 10 | 15 | 15 | 15 | 15 |

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

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.

| Sr No | 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
- 2) www.coursera.org
- 3) www.edx.org
- 4) <http://vlab.co.in/>