

COURSE TITLE	DYNAMICS OF MACHINE - II
COURSE CODE	01ME1601
COURSE CREDITS	4

Objective:

- 1 Understanding the basic of vibration & balancing and analysis of vibration in mechanical system.

Course Outcomes: After completion of this course, student will be able to:

- 1 Determine unbalanced forces and bearing reactions in rotating masses, and evaluate their effects on system performance.
- 2 Calculate unbalanced forces in reciprocating engines and assess their influence on dynamic behavior
- 3 Compute the natural frequency of free undamped vibrating systems and apply methods to mitigate adverse effects.
- 4 Evaluate the natural frequency and response of free and forced damped vibrating systems, and recommend suitable measures to minimize adverse effects.
- 5 Demonstrate the various vibration measurement techniques used in practice

Pre-requisite of course: Higher order ODE, PDE, and Kinematics of Mechanism

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
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.	4
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, Analysis of Multi Cylinder In-line Engines: Direct and Reverse crank method, optimized configuration of in-line engine., Evaluation of V and radial engine, Analytical & Graphical methods.	12

Contents : Unit	Topics	Contact Hours
3	Fundamental of Mechanical Vibrations, Free vibration 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, Free Undamped: Longitudinal, transverse, torsional vibration system , Methods for formulation of differential equations by Newton, Energy, and Rayleigh’s Method, Free Damped:Viscous damping, Under, Critically & Over damped System, Damping Factor, Logarithmic decrement;	16
4	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	10
5	Vibration Measurement (using MOOC Course) : Basic of vibration measurement and analysis Instruments used: Vibrometer, velocity pickup, accelerometer, FFT analyzer	0
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Study and confirm relation between the period of oscillation and length of pendulum for simple Study and confirm relation between the period of oscillation and length of pendulum for simple	2
2	Study and confirm relation between the period of oscillation of compound pendulums. Study and confirm relation between the period of oscillation of compound pendulums	2
3	Experimental analysis of Free Un-damped longitudinal Vibration of single degree of freedom system Experimental analysis of Free Un-damped longitudinal Vibration of single degree of freedom system	2
4	Experimental analysis of Free Un-damped torsional vibration of single degree of freedom system Experimental analysis of Free Un-damped torsional vibration of single degree of freedom system	2
5	Experimental analysis of Free Un-damped torsional vibration of two rotor system Experimental analysis of Free Un-damped torsional vibration of two rotor system	2
6	Experimental analysis of Damped torsional vibration Experimental analysis of Damped torsional vibration	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
7	Balancing of rotating mass in different plane Balancing of rotating mass in different plane	2
8	Experimental analysis of forced vibration Experimental analysis of forced vibration	2
9	Experimental analysis of forced damped vibration Experimental analysis of forced damped vibration	2
10	To verify Dunkerley's theorem for lateral vibration To verify Dunkerley's theorem for lateral vibration	2
11	To find first few natural frequencies of a cantilever by impact test in virtual Lab To find first few natural frequencies of a cantilever by impact test in virtual Lab	2
12	To determine critical speed of the shaft and study effect of shaft diameter and end conditions on the same To determine critical speed of the shaft and study effect of shaft diameter and end conditions on the same	2
Total Hours		24

Textbook :

- 1 Mechanical Vibrations 6th edition, S S Rao, , Pearson., 2016
- 2 Kinematics and Dynamics of Machinery, R L Norton, McGraw-Hill, 2017

References:

- 1 Mechanical Vibration 6th edition, Mechanical Vibration 6th edition, V. P. Singh, Dhanpatrai & Co., 2016
- 2 Mechanical Vibration 8th edition, Mechanical Vibration 8th edition, G. K. Grover, Nem Chand & Bros, 2009
- 3 Theory of Machines and Mechanisms, Theory of Machines and Mechanisms, J. Uicker, Gordon R Penstock & J.E. Shigley,, Oxford., 2014
- 4 Design of Machinery 6th edition , Design of Machinery 6th edition , R L Norton, McGraw-Hill., 2020
- 5 Mechanical vibrations and noise engineering, Mechanical vibrations and noise engineering, . A. G. Ambekar, Prentice Hall India Learning Private Limited, 2006

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	15.00	30.00	20.00	15.00	10.00

Supplementary Resources:

- 1 www.nptel.ac.in
- 2 www.coursera.org
- 3 www.edx.org