



CVM
UNIVERSITY

Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Mechanical Engineering)

Semester: VI

Course Code: 202090602

Course Title: Dynamics of Machines

Course Group: Professional Core Course-XII

Course Objectives: The course aims to introduce fundamentals of vibrations. It deals with analysis of forced vibrations and effect of damping on vibration amplitude under different conditions. It helps to analyze vibrations due rotating and reciprocating unbalance masses and its balancing in single and multi-cylinder engine. Students can learn the parameters affecting critical operating speed for cam-follower mechanism.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Theory		J/V/P*		Total
				Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150 / 53

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	Introduction to Mechanical Vibrations: Elements of simple harmonic motion, concept of natural frequency, Free undamped and damped vibration, forced vibration, resonance, Basic elements and lumping parameters of a vibratory system, Concept of Degrees of Freedom (DOF). Single Degrees of Freedom System (Linear and Torsional): determination of equation of motion and natural frequency of undamped free and torsional vibrations of 1DoF system, equivalent stiffness, equivalent systems. Torsional vibration of two and three rotor system: Torsionally equivalent shaft torsional vibrations of two and three rotor system, geared system.	9



2	<p>Damped free vibration: Types of damping, viscous damping, damping coefficient, under, over and critically damped system, damping factor, damped natural frequency and logarithmic decrement.</p> <p>Forced damped and undamped vibrations: Analytical and graphical solution of forced undamped and damped vibrations of 1 DoF system with harmonic excitation system, magnification factor, transmissibility and effect of frequency on transmissibility and DMF, vibration isolation.</p>	8
3	<p>Multi degree freedom system: Concepts of fundamental natural frequency, Influence coefficient, Dunkerley's and Rayleigh's method to determine fundamental natural frequency of Multi-DOF system.</p> <p>Critical speeds of shaft: with single disc with and without damping having rotating unbalance. Importance of critical speed in design of shaft.</p>	9
4	<p>Balancing of Rotating Masses: Concept of static and dynamic balancing, Analysis of effect of unbalanced masses in single and multiple planes in rotating elements, Bearing reactions.</p> <p>Partial Balancing of reciprocating masses in one plane: Unbalance reciprocating masses in Single Cylinder Engine, balancing of locomotive engines, hammer blow, variation in tractive effort, swaying couple, in uncoupled engine.</p>	8
5	<p>Multi Cylinder Engines: Inline Engines, Effect of firing order and number of strokes on primary and secondary force and couple balance. Analysis of V and radial engine configurations.</p>	6
6	<p>Cam Dynamics: Dynamic analysis of cam follower assembly, undamped response -Johnson's numerical approach, Jump phenomenon, cross over shock, spring surge and windup.</p>	5
Total		45

List of Practicals / Tutorials:

1	Introduction to vibration, causes and remedy of vibrations.
2	To observe natural frequency of different 1 DoF systems
3	To observe torsional vibration (undamped) of single and two rotor shaft system.
4	To observe the free damped vibration of equivalent spring-mass system.
5	To observe damped torsional oscillations and determine the damping coefficient Ct.
6	To observe the forced damped vibration of equivalent spring-mass system.
7	To observe mode shapes during whirling of shaft.
8	To obtain frequency of beam using Dunkerley's rule
9	Static and dynamic balancing of masses.
10	To study jump phenomenon on cam analysis machine

Reference Books:

1	S S Rao, Mechanical Vibrations, Pearson.
2	R L Norton, Kinematics and Dynamics of Machinery, McGraw-Hill.
3	Kenneth J Waldron , Gary L Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley.
4	W T Thomson, Theory of Vibrations with Application, Prentice Hall of India
5	J. Uicker , Gordon R Penstock & J.E. Shigley, Theory of Machines and Mechanisms, Oxford.
6	G K Grover, Mechanical Vibrations, Nem Chand And Brothers



Supplementary learning Material:

1 | NPTEL resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
10%	20%	50%	10%	5%	5%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Analysis of undamped and damped forced vibration.	40
CO-2	Determining natural frequency of multi degree of freedom.	20
CO-3	Balancing of rotating and reciprocating unbalance in various engines.	30
CO-4	Analysis of critical speed for cam-follower system	10

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025