LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering

Bachelor of Engineering (B.E.) – Semester - VI

Course Code:	**017103601**
Course Name:	**Dynamics of Machinery**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Engineering Mechanics (017102291), Strength of Materials (017103391)

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
4	**1**	**0**	**5**	**40**

Syllabus

Unit No.	Topic	Prerequisite Topic	Teaching Hours
01	**Balancing of Rotating Masses**		**5 (12%)**
	1.1 Concept of static and dynamic balancing	Centrifugal force (017102291-Unit-02)	
	1.2 Analysis of effect of unbalanced masses in single plane and multiple plane in rotating elements	Moments and couple (017102291-Unit-03)	
	1.3 Numerical based on bearing reactions.	---	
02	**Balancing of Reciprocating Masses**		**5 (12%)**
	2.1 Balancing of reciprocating mass	---	
	2.2 Balancing of locomotives	---	
	2.3 Effects of partial balancing in locomotives, secondary balancing	---	
03	**Gyroscope**		**4 (10%)**
	3.1 Angular velocity and angular acceleration	Moments and couple (017102291-Unit-03)	
	3.2 Gyroscopic couple		
	3.3 Gyroscopic effect on naval ships and aero plane	Gyroscopic couple (017103601-Unit-10.2)	
	3.4 Stability of an automobile four-wheeler		
04	**Introduction to Mechanical Vibrations**		**3 (8%)**
	4.1 Phenomenon of vibration (Cause, advantages, and disadvantages)	Waves and Motion (G-002-Unit-05)	
	4.2 Simple harmonic motion (Terminology and basic Concepts)		
	4.3 Types of vibration		
	4.4 Equivalents of springs and dampers (Spring force and damping force)		
05	**Undamped Free Vibrations**		**3 (8%)**
	5.1 Determination of natural frequency by equilibrium method	Inertia force (017102291-Unit-02)	
	5.2 Energy method	---	
	5.3 Rayleigh's method	Simple harmonic motion (017103601-Unit-3.2)	
	5.4 Undamped free transverse vibration	---	
06	**Damped Free Vibration**		**5 (12%)**
	6.1 Dampers and methods of damping	Types of Damping (G-002-Unit-5.5)	
	6.2 General solution for damped free vibration and damping coefficient and factor	---	
	6.3 Under damped, over damped and critical damped system	General solution for damped free vibration (017103601-Unit-5.2) Under damped (017103601-Unit-5.3)	
	6.4 Damped natural frequency and logarithmic decay		
07	**Damped Forced Vibration**		**5 (12%)**
	7.1 Analytical solution of forced vibrations with harmonic excitation system and vector representation	Inertia force (017102291-Unit-02) Damping force (017103601-Unit-5.1)	
	7.2 Magnification factor	---	
	7.3 Phase difference and transmissibility on frequency of excitation for various damping factors	Analytical solution of forced vibrations (017103601-Unit-6.1)	
	7.4 Concept of vibration isolation		
08	**Torsional Vibration**		**3.5 (9%)**
	8.1 Zero frequency and node Point	Torsion (017103391-Unit-09)	
	8.2 Torsionally equivalent shaft		
	8.3 Torsional vibration in single rotor and two rotor system		
09	**Rotating Unbalance**		**3 (8%)**
	9.1 Whirling of shaft	---	
	9.2 Critical speed of a shaft carrying rotor with and without damping.	---	
	9.3 Application of Dunkerley's method for estimating the critical speed of shafts	Shear force and banding moment (017103391-Unit-04)	

10	**Vibration Measurement**		**3.5 (9%)**
	10.1 Vibration measurement process	---	
	10.2 Classification of vibration measuring instruments	---	
	10.3 Vibrometers-Amplitude measuring instruments	Damped forced vibration (017103601-Unit-06)	
	10.4 Velocity pick-ups and acceleration pick-ups	---	
	10.5 Frequency measuring instruments	---	
	10.6 Measurement of damping	Logarithmic decay (017103601-Unit-5.4)	

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L:	4	T:	1	P:	0

Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	**5**	**5**	MCQ	26%	26
Theory			Theory Descriptive	00%	00
Theory			Formulas and Derivation	19%	19
Theory			Numerical	55%	55
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	**0**		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
1	Minimize unbalance in mechanical systems by means of static and dynamic balancing.
2	Understanding the gyroscopic effect and fundamentals of mechanical vibrations with the application of different methods to derive the equation of motion.
3	Analyze damped free and force vibration.
4	Demonstrate the torsional vibrations, determine critical speed of the shaft and understand vibration measuring instruments.

Suggested Reference Books	
1	Theory of Machines by S. S. Rattan, McGraw Hill Education
2	Mechanical Vibrations by S S Rao, Pearson.
3	Kinematics and Dynamics of Machinery by R L Norton, McGraw-Hill.
4	Theory of Machines by R. S. Khurmi and J. K. Gupta, S. Chand and Company Ltd.
5	Dynamics of Machinery by Farazdak Haideri, Nirali Prakashan

List of Open Source Software/Learning website	
1	http://www.nptel.ac.in
2	www.skill lync.com
3	www.edx.com
4	www.Coursera.org

Real Practical Problem/ Hands on Project

Sr. No.	Real Practical Problem	Linked with Unit
1	Calculate the Static and dynamic balancing of peltonwheel turbine. 	Unit 01

2	How to do wheel balancing of a car and by which equipment? 	Unit 02
3	Calculate frequency of a swing in any garden nearby your home, and check is it equal to what we found in class. 	Unit 03,04
4	Find the Damping factor of a door closer by checking the displacement and velocity at a particular time interval. 	Unit 05
5	Suppose you are riding your bike over a uneven road surface find out critical speed and Amplitude of Vibration in your bike.. Data you have to gather:- 1. Compression of spring because of weight 2. Amplitude and wavelength of road profile approximated by a sine wave 3. Speed of Bike? 	Unit 06
6	Find out frequency of torsion vibration by viscous damping method.	Unit 07
7	In machine one shaft is attached horizontally is simply supported at both ends by bearings. A rotor is attached at middle of the horizontal shaft.	Unit 08,09
8	If there is a racing car and it will overturn, what are the causes of overturning and accident due to motion effects? 	Unit 10