Subject: Mechanical Vibrations								
Program: B.Tech. Mechanical Engineering				**Subject Code: ME0705**			**Semester: VII**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
2	2	2	4	24/60	24/60	16/40	16/40	200

Course Objectives

1. Understand basics of vibration.
2. Understand of single degree of freedom systems- forced undamped and damped vibrations.
3. Understand Multi-Degree of freedom systems and Natural Frequency calculations.
4. Understand continuous system.

CONTENTS

UNIT-I

[10 hours]

Introduction

Vibration terminology, Harmonic and periodic motions, Beats phenomenon, uses and effects, practical applications and current research trends

Single Degree of Freedom Systems – Free Undamped and Damped Vibrations

Free undamped vibrations using Newton's second law, D'Alemberts principles, Energy method, Rayleigh's method, free damped vibrations, logarithmic decrement, under damped, over damped and critically damped conditions**.**

UNIT-II

[12 hours]

Single Degree of Freedom Systems –Forced Undamped and Damped Vibrations

Forced harmonic undamped vibration, Damped free Magnification factor, Transmissibility, Vibration Isolation, Equivalent viscous damping, Rotor unbalance, Excitation and Stability analysis

Two Degree of Freedom Systems

Generalized and Principal coordinates, derivation of equations of motion, Lagrange's equation, Coordinate coupling, Forced Harmonic vibration.

UNIT-III

[14 hours]

Multi-Degree of Freedom Systems

Derivation of equations of motion for MDOFs, influence coefficient method, Properties of undamped and damped vibrating systems: flexibility and stiffness matrices, reciprocity theorem, Modal analysis.

Natural Frequency Calculations

Rayleigh method, Stodala method, Matrix iteration method , Holzer's method and Dunkerley's method, Whirling Speed of shaft.

UNIT-IV

[14 hours]

Continuous Systems

Introduction to continuous systems, lateral vibration of string, transverse vibrations of the beam, Orthogonality of eigenvectors.

Vibration Measurement Apparatus

Vibration measuring instruments, acceleration and frequency measuring instruments, FFT analyzer**.**

Course outcomes

On the completion of this course, students will be able to...

1. Comprehend basic concepts of vibrations and importance of vibration with respect to machine design
2. To model any mechanical/structural components whose frequencies are required to be calculated
3. Theoretically find natural frequencies of any damped/undamped as well as free/forced vibration system
4. Find measured natural frequencies of any structure, component

List of Experiments

Sr. No.	Title	Learning Outcomes
1	To study frequency of simple pendulum.	After studying this experiment, student will able to understand, • Theoretical derivation of angular vibrations • Find experimental frequencies of simple pendulum • Reasons for why theoretical frequencies are deviating from experimental one
2	To study frequency of compound pendulum.	After studying this experiment, student will able to understand, • Theoretical derivation of compound pendulum/bar • Find experimental frequencies of simple pendulum • Reasons for why theoretical frequencies are deviating from experimental one

3	To study frequency of sprig mass system.	After studying this experiment, student will able to understand, • Theoretical derivation of Linear vibrations • Find experimental frequencies of simple pendulum • Reasons for why theoretical frequencies are deviating from experimental one
4	To study frequency of lateral vibration system.	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of Lateral vibrations • Reasons for why theoretical frequencies are deviating from experimental one
5	To study frequency of torsion vibration system (single Rotor).	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of torsional vibrations • Reasons for why theoretical frequencies are deviating from experimental one
6	To study free damped vibration system.	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of damped torsional vibrations • Reasons for why theoretical frequencies are deviating from experimental one

7	To study whirling speed of shaft.	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of whirling shaft • Reasons for why theoretical frequencies are deviating from experimental one
8	To study forced damped vibration system.	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of forced damped vibration systems • Reasons for why theoretical frequencies are deviating from experimental one
9	To study frequency of roller rolls without slip inside cylinder	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of Lateral vibrations • Reasons for why theoretical frequencies are deviating from experimental one
10	To study frequency of U tube filled with liquid	After studying this experiment, student will able to understand, • Theoretical and experimental frequencies of liquid filled in U tube • Reasons for why theoretical frequencies are deviating from experimental one

Reference Books

1. Mechanical Vibration by Singiresu S. Rao, Pearson Education
2. Mechanical Vibrations by G. K. Groover, Nemchand & Bro
3. Theory of Vibration with Application by Willium T Thomson, Pearson Education
4. Theory and Problems of Mechanical Vibrations by Graham Kelly, schaum series
5. Fundamental of Mechanical Vibrations by Graham Kelly Mcgraw hill

Web resources

1. Mechanical Vibrations (http://nptel.ac.in/courses/112103111/)