VI Semester

MECHANICAL VIBRATIONS

(PROFESSIONAL ELECTIVE-IV)

Course Code: 19ME1170

L	T	P	C
3	0	0	3

Course Outcomes: At the end of the course the student will be able to

CO1: Determine natural frequency of undamped and damped single degree freedom systems
CO2: Calculate natural frequencies of two degree freedom system
CO3: Determine natural frequencies of multi degree freedom system
CO4: Apply numerical methods to determine natural frequencies of multi degree freedom system
CO5: Calculate critical speed of shaft and describe vibration measuring instruments

UNIT- I **10 Lectures**

Single Degree of Freedom Systems: Undamped free vibration: Classical method, Energy method, equivalent systems, Damped free vibration- Viscous damping-underdamping, critical damping, overdamping; Coulomb damping, equivalent damping coefficient.

Learning Outcomes: At the end of this unit, the student will be able to

1. determine the natural frequency of undamped single degree of freedom systems (L3)
2. explain different cases of damping (L2)
3. calculate critical damping coefficient of damped vibrations (L3)

UNIT- II **10 Lectures**

Forced vibrations of Single Degree Freedom Systems: Steady state forced vibration, sources of excitation, impressed harmonic force, resonance, impressed force due to rotating unbalance, base excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

Learning Outcomes: At the end of this unit, students will be able to

1. determine response of damped system under forced vibrations (L3)
2. calculate transmissibility ratio (L3)
3. explain different types of isolators and power absorbers (L2)

UNIT- III **10 Lectures**

Two degree Freedom Systems: Principal modes of vibration, two masses fixed on tightly stretched string, double pendulum, torsional system with damping, forced vibration with harmonic excitation, undamped dynamic vibration absorber, untuned viscous damper.

Learning Outcomes: At the end of this unit, the student will be able to

1. develop mathematical model for two degree freedom systems (L6)
2. determine the natural frequencies of tightly stretched string and double pendulum (L3)
3. explain the working principle of vibration absorbers (L2)

UNIT- IV **10 Lectures**

Multi Degree Freedom Systems: Lagrangian method for formulation of equation of motion Rayleigh's method, Dunkerley's method, Stodola method, Rayleigh-Ritz method, Method of matrix iteration.

.

Learning Outcomes: At the end of this unit, the student will be able to

1. calculate natural frequencies using Rayleigh's method (L3)
2. determine natural frequencies using Dunkerley's method (L3)
3. determine natural frequencies and mode shapes of multi degree freedom systems using Stodola and Matrix iteration methods (L3)

UNIT- V **10 Lectures**

Whirling of shafts: Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed.

Vibration measurement and Applications: Piezoelectric transducers and linear variable differential transformer transducer; Vibration pickups: Vibrometer, Accelerometer, Vibration exciters- Mechanical exciters, impact hammer and electrodynamic shaker.

Learning Outcomes: At the end of this unit, the students will be able to

1. calculate the critical speed of shaft (L3)
2. describe various transducers (L2)
3. explain mechanical exciters and electrodynamic shaker (L2)

Text Books:

G. K. Groover, *Mechanical Vibrations*, 8th Edition, Nem Chand & Bros, 2009.

Reference Books:

1. L. Meirovich, *Elements of Vibrations Analysis*, 1st Edition, Tata McGraw Hill, 1986
2. S. Graham Kelly, *Mechanical Vibrations*, 1st Edition, Tata McGraw Hill, 1996
3. Singiresu S. Rao, *Mechanical Vibrations*, 6th Edition, Pearson Education, 2018.