

## Paper-II : 1162 Oscillations, waves and Acoustics

### UNIT - I

**Free oscillations of simple systems:** Equilibrium; concept of potential well, small oscillations approximation, solutions, linear and transverse oscillations of a mass between two springs, diatomic molecule, reduced mass concept.

**Damped and forced oscillations:** Damped oscillations; critical damping, Q of an oscillator. Forced oscillator with one degree of freedom; Transient and steady state oscillations, resonance energy absorption, low and high frequency responses.

### UNIT - II

**Free oscillations of system with two degrees of freedom:** Two dimensional oscillator; normal modes, longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum.

**Fourier analysis:** Fourier series and Fourier coefficients; simple examples (square wave, saw-tooth wave, half and full wave rectifier), use of exponential representation for harmonic oscillations, expression for Fourier coefficients

### UNIT - III

**Wave equation:** Waves in a one-dimensional chain of particles; classical wave equation; wave velocity, boundary conditions and normal modes, dispersion relations, dispersion waves.

**Waves in continuous media:** Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, dispersion in waves, group velocity and phase velocity

**Superposition of waves:** Linear homogenous equations and the superposition principle, interference in space and energy distribution; beats and combination tones.

### UNIT -IV

**Ultrasonics:** Production, detection, and applications of ultrasonic waves

**Vibrations in bounded systems:** Normal modes of a bounded system; harmonics, the quality of sound, Chladni's figures, Vibration of a drum. Noise and Music; Limits of human audibility; intensity and loudness, bel and decibel. Music scale and musical instruments.

### UNIT - V

**Reflection, refraction, and diffraction of sound:** Acoustic impedance of a medium, percentage reflection, and refraction at a boundary, impedance matching for transducers. Diffraction of sound; principle of a sonar system, sound ranging.

**Applied acoustics:** Transducers and their characteristics, recording and reproduction of sound, measurement of frequency, velocity, waveform, and intensity. The acoustics of halls, reverberation period

Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

**Text book**

1. Waves & Oscillations, Satya Prakash, Pragati Prakashan
2. Oscillations, Waves and Acoustics (In Hindi) by Kakani, Bhandari & Kalra

**Reference Books:**

1. Waves and Oscillations, Berkley Physics Course Vol. III
2. Vibrations and waves, I.G. Main (Cambridge University Press)
3. The Physics of Vibrations and Waves, H.J. Pain, McMillan (1975).