Course 3: Oscillations and Waves

Course code: BSCPH103 **Credit: 3**

BLOCK 1 Simple Harmonic Motion:

Unit –1: **Simple Harmonic Motion I:** Basic Characteristics of Simple Harmonic Motion, Oscillations of a Spring-Mass System; Differential Equation of SHM and its Solution

Unit –2: **Simple Harmonic Motion II:** Phase of an oscillator executing SHM, Velocity and Acceleration, Transformation of Energy in Oscillating Systems, Kinetic and Potential Energies.

Unit–3: **Physical Systems and Pendulums**: Examples of Physical Systems Executing SHM: Simple Pendulum, Compound Pendulum, Torsional Pendulum.

Unit–4: **Superposition of harmonic oscillations**: LC circuit, principle of superposition, Superposition of two collinear harmonic oscillations of same/different frequencies, Oscillations in two dimensions

Unit–5: **Superposition of two mutually perpendicular harmonic oscillations**: Superposition of two mutually perpendicular harmonic oscillations of the same/different frequencies; Lissajous Figures.

BLOCK 2: Damped and Forced Oscillations:

Unit–6: **Damped Oscillations:** Differential equation of a damped oscillator and its solutions, heavy damping, critical damping, weak damping; characterising weak damping: logarithmic decrement; relaxation time, quality factor

Example of a weakly damped system - LCR circuit; differential equation of an undamped oscillator and its solution;

Unit–7: **Forced Oscillations and Resonance**: differential equation of a weakly damped forced harmonic oscillator and its solutions, steady state solution, resonance. Examples of forced vibrations and resonance, power absorbed by a forced oscillator, quality factor

BLOCK 3 Basic Concepts of Wave Motion:

Unit–8: **Wave Motion**: Formation of a Wave; Graphical Representation of Wave Motion, Relation between Wave Velocity, Frequency and Wavelength; Mathematical Description of Wave Motion:

Unit–9: **Phase, Energy and Intensity of wave**: Transported Phase and Phase Difference, Phase Velocity, Energy Transported by Progressive Waves, Intensity and the Inverse Square Law;

Unit–10: **One-dimensional Wave Equation**: One-dimensional Wave Equation Waves on a Stretched String, Waves in a Field, Waves in a Uniform Rod; Waves in Two and Three Dimensions;

Unit–11: **The Doppler Effect**: Source in Motion and Observer Stationary, Source Stationary and Observer in Motion, Source and Observer both in Motion; Shock Waves.

Unit –12: **Principle of Superposition and types of waves**: Principle of Superposition of Waves; Stationary Waves, Properties of stationary waves, Velocity of a Particle at any Point in a Stationary Wave, Harmonics in Stationary Waves.