This module is one of 3 comprising PHYS 1001 Physics 1 (Regular). This document describes details of this module and should be read in conjunction with the more general Unit of Study Outline for PHYS 1001 Physics 1 (Regular).

GENERAL GOALS
- To understand the characteristics and causes of oscillations, using Newton's laws and appropriate force laws (e.g. the spring law).
- To gain a qualitative and quantitative understanding of wave motion in various media.

MODULE DEFINITION – OSCILLATIONS AND WAVES

ASSUMED KNOWLEDGE
You will be assumed to understand the concepts: displacement, velocity, speed, acceleration, force, Newton's laws, energy and work, potential and kinetic energy, conservation of energy, Hooke's law, and moment of inertia.

SPECIFIC OBJECTIVES

PERIODIC MOTION: (Chapter 13)
Text sections: Intro (p 419), 14.1 to 14.4 (omit "Angular SHM" and "Vibrations of molecules"), & 14.5 to 14.8

Specific objectives – after studying this chapter you should be able to:
- Describe and define periodic motion and simple harmonic motion (SHM).
- Use the period, amplitude and phase to describe SHM, and find the position, velocity and acceleration.
- Use and distinguish frequency and angular frequency.
- Relate the force law (e.g. Hooke's law for a spring) and the mass to the period in SHM.
- Explain the interchange of potential and kinetic energy in mechanical oscillations.
- Use energy conservation in solving for parameters of an oscillating system.
- Explain the motion of the simple and physical pendulums; recognise the approximation used in deriving the small-amplitude formula for the period of a pendulum.
- Explain the behaviour of a damped oscillator, including the effects of different degrees of damping.
- Explain the phenomenon of resonance.
- Sketch resonance diagrams (amplitude vs driving frequency).
- Explain the dependence on driving (forcing) frequency, natural frequency, and degree of damping.

MECHANICAL WAVES: (Chapter 15 & part of 16)
Text sections: Intro (p 487), 15.1 to 15.4 & 16.2 (omit “Speed of sound in gases”)

Specific objectives – after studying these sections you should be able to:
- Define and describe wave motion.
- Distinguish and describe transverse and longitudinal waves.
- Explain the critical difference between the motion of a wave and the motion of a particle in the medium as the wave passes.
- Understand and use the parameters: amplitude, period, frequency, angular frequency, wave number and wavelength.
- Use the mathematical expression for a sinusoidal travelling wave.
- Explain the main characteristics of the general wave equation.
- Explain the role of tension and mass/length and use the expression for wave speed on a stretched string.
WAVE INTERFERENCE AND NORMAL MODES: (Parts of Chapters 15 & 16)

Text sections: 15.6 to 15.8 & 16.4 to 16.5

Specific objectives – after studying these sections you should be able to:
- Use the principle of superposition and the boundary conditions for a stretched string with a fixed or free end to explain the form of reflected pulses.
- Describe standing waves on a stretched string, recognising nodes and antinodes, and the relation to superposition of two travelling waves.
- Explain and use the mathematical expression for a standing wave.
- Describe the basis for production of normal vibration modes of a stretched string or an air column.
- Explain the terms fundamental, harmonics, overtones.
- Use the expressions for frequency of the various modes.
- Explain the phenomenon of resonance. Use the phase of the interfering waves to determine the conditions for and location of constructive and destructive resonance.
- Explain the role of resonance in excitation of normal modes.

SOUND AND HEARING: (Parts of Chapters 15 & 16)

Text sections: Intro (p 527), 16.1, revise 16.2, 16.3 & 16.6 to 16.9

Specific objectives – after studying these sections you should be able to:
- Explain the role of pressure and displacement in a sound wave.
- Explain the phase difference between pressure and displacement values in a travelling sound wave.
- Explain the ways in which loudness, pitch and timbre affect the perception of sound.
- Explain the formation of beats by the superposition of sounds of two closely spaced frequencies.
- Use the equation for beat frequency.
- Explain the increase or decrease in detected frequency due to the Doppler effect, with either source and/or listener moving.
- Use the equation for Doppler shift of frequency.
- Explain why a different Doppler effect formula applies for electromagnetic waves.
- Explain the characteristics of supersonic motion and the formation of shock waves.
- Use the expression relating shock cone half angle to the Mach number.