PHYS 120 Advancing Physics I 2015

Offered:	Semester 1
Credit:	15 points
Pre/Co-requisites:	None

Description

A course designed for students planning to advance in the physical sciences. It covers basics aspects of motion and its causes, electrostatics, geometric optics, as well as the production, transformation and propagation of energy in its thermal and mechanical forms. Demonstration experiments are a major feature. Students enrolling in this course are generally assumed to have done Physics at school, preferably to NCEA Level 3.

Aims

This course prepares students for more advanced study in physics or other physical sciences. It provides a quantitative and mathematical description of the physical world, with emphasis on the fundamental processes involved and the underlying relationships between areas of physics.

Skills and knowledge to be gained

Students who pass this course should be able to:

- Understanding of dimensional analysis.
- Familiarity with simple kinematics and Newton's Laws.
- Appreciation of conservation of momentum and energy.
- Ability to describe electric charge distributions in terms of forces, fields, potential, and potential energy.
- Appreciation of differences between charged conductors and charged insulators.
- Ability of describe capacitors and resistance, and combinations of capacitors and resistors. Understanding of stored energy and electric power. Concepts of charging and discharging capacitors.
- Good understanding of travelling waves, including sound waves, particle displacement and pressure waves.
- Appreciation of why refraction arises and how to determine the angles involved.
- Ability to draw ray diagrams for a range of simple reflective and refractive situations, including spherical mirrors and thin lenses. Application of lens formulae to describe image position and size.
- Knowledge of the difference between heat and temperature. Ideas around thermal expansion, conduction, convection and radiation, phase changes and latent heat.
- Good familiarity with the Ideal gas law and its applications. Good understanding of the First law, PV diagrams, heat transferred and work, and adiabatic/isobaric/isothermal/ constant-volume processes.
- Appreciation of the physical arguments giving rise to the kinetic theory of gases, and the interpretation of actual specific heats, and thermal motion.
- Ability to discuss heat engines and the Second law, including fundamental ideas around entropy.

Syllabus

- Dimensions and units; dimensional analysis; vectors and 2D kinematics; Newton's Laws

of Motion and their application; work and energy; linear momentum and collisions.

- Electric charge and electrostatic force; electric field; field lines; force on a charged particle in a field; Gauss' Law and applications; charge on a conducting surface; electric potential energy and potential; electric dipole; capacitance; capacitors in series and parallel; energy stored in capacitors; dielectrics; conductors; drift velocity; current density; Ohm's Law; resistors; electric power; resistors in series and parallel; Kirchhoff's Laws; charging and discharging a capacitor through a resistor.

- Travelling waves; amplitude; frequency; angular frequency; wavelength; wavenumber; phase; Transverse and longitudinal waves; pulse shape; motion of the medium; sound; particle displacement; pressure fluctuations; acoustic power and intensity; dB. Loudness; doppler effect; shock waves; EM spectrum and light.

- Ray optics; Huygens' Principle; reflection and refraction; Snell's Law; dispersion; rainbow; total internal reflection; concave spherical mirror; magnification; convex mirrors and virtual images; focal length; sign convention; lenses; combinations of optical elements; lens aberrations.

- Heat and temperature; thermal equilibrium; Zeroth Law; thermal expansion; linear; volume; water; ideal gas; Boyle's, Charles' Gay-Lussac's Laws and Ideal Gas Law; thermometers; triple point; specific heat; calorimetry; phase change; latent heat; thermal conduction; convection; radiation; Stefan-Boltzmann equation; mechanical equivalent of heat; work; PV diagrams.

- First law; cyclic processes; adiabatic; isobaric; isothermal and constant volume processes; kinetic theory of gases; equipartition; molar specific heats of ideal gas; molecular degrees of freedom; distribution of molecular energies and speeds (Maxwell-Boltzmann); heat engines; thermal efficiency.

- Second Law; Kelvin-Planck form; heat pumps and refrigerators; Clausius statement of 2nd Law; reversible and irreversible processes; Carnot engine; real engines; entropy; microstates and macrostates.

Learning activities and teaching methods

Description	Study time
Lectures	45 x 1 hour
Tutorials	4 on-line with multiple attempts possible
Tests	2 x 1 hour multi-choice
Laboratories	4 x 3 hours

Inclusive learning
Students are urged to discuss privately any impairment-related requirements face-to-face and/or in written form with the course convenor/lecturer and/or tutor

Assessment

Form	Weight	Time	When
Assignments	4 x 2.5% = 10%	16 hours	weeks 3, 5, 8, 10
Labs	15%	4 x 3 hours	weeks 3, 5, 8, 10
Tutorials	8%	4 x 3 hours	weeks 4, 6, 9, 11
Tests	2 x 6% = 12%	2 x 1 hour	weeks 6, 11
Exam	55%	3 hours	exam period

Academic Integrity
The University of Auckland will not tolerate cheating, or assisting others to cheat, and views cheating in

coursework as a serious academic offence. The work that a student submits for grading must be the student's own work, reflecting his or her learning. Where work from other sources is used, it must be properly acknowledged and referenced. This requirement also applies to sources on the world-wide web. A student's assessed work may be reviewed against electronic source material using computerised detection mechanisms. Upon reasonable request, students may be required to provide an electronic version of their work for computerised review. Please visit the below link for further information: https://www.auckland.ac.nz/en/about/learning-and-teaching/policies-guidelines-and-procedures/academic-integrity-info-for-students.html

Resources

All lecture notes, plus study notes, plus past tests and exams, plus practice tests and exams, plus recordings of all lectures, are on CECIL.

Feedback

Marked script and model solutions to assignments; marked exam script (if requested)

Enrolment

Typical enrolment Semester 1: 300