PHYSICS 121 Advancing Physics II 2018

Offered:	Semesters 1 and 2
Credit:	15 points
Pre-/Co-requisites:	None
Restriction:	Physics 150

Description

This is a core course for students progressing in the physical sciences. Key topics are electricity, magnetism, wave and ray optics, relativity and quantum mechanics. This is a calculus-based course that focuses on fundamental principles, problem solving and hands-on exercises.

Knowledge of mathematics and physics equivalent to PHYSICS 120, NCEA Level 3 Physics and Mathematics or equivalent is assumed, and students are advised to take the recommended mathematics courses concurrently with this course. This course is a prerequisite for all core second-year physics courses.

Aims

1. To build a sound foundation in physics knowledge and practice for later courses in physics and other physical sciences through consolidating and extending secondary school physics.
2. To encourage curiosity, and develop intellectual, organisational, communication, interpersonal skills.

Skills and knowledge to be gained

Students who pass this course should be able to:

- articulate the big ideas from each topic (electricity, magnetism, wave and ray optics, relativity and quantum mechanics), indicating that they have understood the core concepts;
- translate a physical description of a first-year physics problem to a mathematical formulation, using sketches or diagrams where appropriate;
- evaluate the process and outcomes of an experiment qualitatively and quantitatively;
- solve analytical/numerical problems and complete practical tasks that require application of core concepts to new situations;
- solve basic physics problems using a computer program (e.g. Python);
- justify, in written and verbal form, their approaches to solving a problem or completing a practical task;
- check the validity of the solutions they have reached by methods such as dimensional analysis, order of magnitude, literature review, etc;

- take responsibility for their own learning by consulting available resources, reflecting and asking questions, seeking challenging opportunities and taking action to overcome difficulties;
- work effectively in groups to solve complex problems.

Syllabus

Class meeting times and instructors

Students need to enrol and participate in one of the two streams in this course. Each stream meets three times a week for two hours in the Physics Teaching Laboratory (303-G03). Please ensure that there is no timetable clash with any of the three weekly meeting times for the stream that you enrol in.

Stream 1: M / W 9.00 - 11.00 and F 13.00 - 15.00 (Scott Parkins)

Stream 2: M / W 11.00 - 13.00 and F 15.00 - 17.00 (Neil Broderick)

Course coordinator: Anna Yang

Workload

The time commitment required for studying four first-year university courses in a semester is equivalent to working full-time. Thus, the average weekly workload for this course would be approximately 10 hours a week, including 6 hours in class. It is realistic to expect that the actual workload will vary somewhat from week to week across the semester; a course schedule is provided on Canvas for reference.

Course texts

Required text: Knight, R. (2017). *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics* (4th edition). Pearson. [Global edition].

Hard copies of the required text are available for lending at the university library and for purchase at "ubiq", the bookshop on campus. It is also available as an electronic textbook (eText) for purchase online.

This textbook is used in both Physics 120 Advancing Physics I and Physics 121 Advancing Physics II in 2018.

Other course texts are listed in the Reading List on Canvas and can be freely accessed online.

Access to Mastering Physics

Enrolled students will be provided with an access code for the Mastering Physics online tutorial, homework, and assessment system in the first class.

Core physics topics

Electricity (13 classes): **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; RC circuits.

Magnetism (6 classes): **Magnetic fields**; force on a charged particle moving in a magnetic field; combined E and B, cyclotron; magnetic force on a current, current loop, torque; **Biot-Savart's law**; field due to a long wire, field on axis of loop; force between two current-carrying wires; **Ampere's law**; solenoid; magnetic flux through a loop; induced currents; **Faraday's Law**; Lenz's law; EMF and electric field; generators, motors, eddy current; inductance; LC circuits; **Maxwell's Equations**; introduction to EM waves.

Wave and ray optics (5 classes): **Huygens' Principle**: diffraction, interference; **Snell's Law**: reflection and refraction, dispersion, total internal reflection; **optical instruments**: mirrors, lenses; magnification, image formation, microscopes, telescopes.

Relativity (4 classes): Galilean transformation; **Michelson-Morley experiment**; **Einstein postulates**; simultaneity; time dilation; proper time; length contraction; **Lorentz transformation**; addition of velocities; relativistic momentum; force, work, kinetic energy; mass-energy and momentum.

Quantum physics (6 classes): Blackbody radiation; Planck's law; photoelectric effect; quantum hypothesis; Compton effect; energy and momentum; **Bohr atom**, energy levels; **de Broglie waves**; wave packets, uncertainty; wave functions, **Schrödinger's equation**; particle in a box; quantised energy levels; quantum tunnelling; atomic spectra, Balmer series; hydrogen wave function; electron spin, spin quantum number; electronic shells, periodic table.

Learning activities and teaching methods

Physics 121 is a studio physics course. These two-hour sessions consist of integrated mini-lectures, practical work and tutorial exercises using whiteboards. Students are required to complete pre-readings to make the most of the interactive and collaborative two-hour classes. Instructors are available during specified office hours and the department offers daily 4-hour drop-in tutorial help at the Faculty Assistance Room (from 11 am to 3 pm at 302-170).

Inclusive learning

If you have any physical impairment or special learning need, please consult Student Disability Services for the support options available and contact the

course coordinator to discuss how we could help realise the recommended learning support as early as possible.

Assessments

Overview

To achieve an overall pass in this course, students must meet the practical requirement and also obtain a pass in the written work (see UoA BSc regulations).

Assessment type	Weight	Short description
Pre-readings	5 %	Online pre-readings. Best 25 of 29 marks contribute to the final course grade.
Homework	10 %	Online weekly homework. Best 8 of 9.
Practicals	13 %	Python programming in Physics (2.5 % × 4) and laboratory work (1.5 % × 2). No prior programming experience in Python is required. Work is completed with support mostly in class.
In-class activities	12 %	In-class tutorials and exercises.
Quizzes	5 %	In-class hand-written quizzes. Best 5 out of 6.
Tests	15 %	Two 1-hour evening tests, scheduled on Thursday 16 August and Thursday 4 October. Location to be advised in class and on Canvas.
Final exam	40 %	Time and location of the 3-hour exam will be advised on Student Services Online by the Examinations Office.

Absence policy

While students are expected to complete all assessments in a course, we recognise that students may sometimes miss assessed work for reasons related to academic, medical, personal or whanau circumstances and commitments. In such circumstances, we are able to make some allowance on a case-by-case basis.

You should obtain relevant supporting documentation for all anticipated absences (e.g. musical performances, sports competitions, field trips) and

excused absences (e.g. illness, injuries, medical appointments). In the cases of tangis, funerals and very personal matters, please make direct contact with the course coordinator as appropriate.

For *pre-readings*, *homework* and *quizzes*, the course coordinator will not ask you to provide your supporting documentation until the fifth absence for the pre-readings and the second absence for the latter; more specifically, if you have missed more than four pre-readings, one homework or one quiz, you must provide supporting documentation for all of your absences to apply for aegrotat or compassionate consideration. This means that you should collect and keep supporting documentation concerning all absences this semester.

For *practicals*, *in-class activities* and *tests*, you should inform the course coordinator of anticipated absences as early as possible and of excused absences within a week of their occurrence. The course coordinator will contact you about the academic decision.

For *tests* and *final exam*, you may apply online for aegrotat and compassionate consideration.

- Aegrotat or compassionate consideration for written tests.
- Aegrotat or compassionate consideration for final exam.

Assessed marks are granted at the end of semester on the basis of evidence provided and coursework completion.

Academic integrity

The University expects that, over the course of their study, all students will become independent learners, able to communicate their ideas and the material supporting those ideas clearly and accurately.

The University encourages students to seek ways to improve their writing skills, including through the use of advice on coursework from third parties. When getting help with your university work, you must ensure that this assistance does not endanger the academic integrity and originality of the work. The University views cheating - including "submitting without acknowledgement work to which others have contributed" - as a serious academic offence. When seeking assistance with written work, it is your responsibility to ensure that the third party also understands the limits of providing help.

A student's assessed work may be reviewed against electronic source material using computerised detection mechanisms. Students may be required to provide an electronic version of their work for review.

UoA student policies and regulations:

- Academic integrity and copyright.
- Third party assistance in UG and PG coursework guidelines.