PHYS102-20S2
Engineering Physics B: Modern Physics and Electromagnetism (2)

15 points, 0.125 EFTS, Summer Semester 2020.

Version 9th November 2020.

Description

PHYS102 is a valuable course for students advancing in physical sciences and engineering who need a good understanding of electromagnetism and concepts of modern physics. The first section introduces aspects of Modern Physics such as Quantum Mechanics, subatomic particle physics and elements of Cosmology, Einstein's Theory of relativity. The second section extends the Electromagnetism of PHYS101 to DC and AC circuit theory, more advanced magnetic field concepts, which then leads to Maxwell's equations and electromagnetic waves.

Summary of the Course Content

The topics covered in this course are:

- Introduction to Quantisation through Planck's Law, wave-particle duality
- The quantum wavefunction and Schrodinger's equation
- Quantum tunneling - potential barriers and wells
- Quantum theory of matter
- Particle physics, fundamental forces, quarks and the Standard Model, Cosmology
- Gauss's Law determination of electric fields, Faraday cage
- DC circuit analysis from Kirchoff's Laws, RC circuits
- Biot-Savart and Ampere's Laws for magnetic field determination
- Basic AC circuits, RL and RLC
- Maxwell's equations and electromagnetic theory
- Gravitation, Kepler's Laws
- Special Theory of Relativity

Learning Outcomes

The goal of this course is to provide foundation knowledge of Modern Physics and Electromagnetism for students advancing in physical science and engineering degrees. Students will obtain basic competency in analysing and solving physical problems in these areas. They will also obtain basic physics laboratory skills and data analysis techniques.

Students will have developed and be able to demonstrate:

- basic scientific competency to solve appropriate physics problems in the concepts of the course
- basic physics laboratory skills
- data recording and analysis associated with physics laboratories
- writing and associated communication skills.

Textbook:

The **required text** is Volume 2 from either:

1. Serway, Jewett, Wilson & Wilson (SJW^2) "Physics Vol. 2" Asia-Pacific edition (2013).
2. Serway, Jewett, Wilson, Wilson & Rowlands "Physics for Global Scientists and Engineers" (2017).

Since this course is for students who have a good level of physics and mathematics preparations, some relevant but elementary sections of the text will not be covered. Allow yourself study time with the text to catch up on these. Chapters 1 and 2 of the text are assumed to be known for PHYS111, 101 and 102.

Course Supervisor

We want you to benefit from this course as much as possible, and your personal feedback is welcome at all times. Please contact me if you have any problems or queries. Note, however, that if you have a problem with the laboratories or the tutorials, in the first instance you are expected to see Cliff Franklin (Labs), or Morag Hills, your tutor (Tutorials and homework) respectively.

Prof. Roger J. Reeves, Course Supervisor
Room 618, West Building
roger.reeves@canterbury.ac.nz

Course Lecturers

	**Professor Roger Reeves** (roger.reeves@canterbury.ac.nz) Introduction to Quantum Mechanics Wave-particle duality, Uncertainty Principle Models of the Atom Nuclear Physics – decays and reactions, Particle Physics, Fundamental forces Quarks and the Standard Model, Elements of Cosmology. (6 weeks)
	**Dr Steven Marsh** (steven.marsh@canterbury.ac.nz) Electric flux, Gauss's law DC circuits and Kirchoff's Laws Capacitors and RC circuits Magnetic field Laws (Biot-Savart, Ampere), General form of Faraday's law, RL and RLC circuits, Basic AC circuits (selected topics) Maxwell's equations and electromagnetic waves (4 weeks)
	**Associate Professor Michael Albrow** (michael.albrow@canterbury.ac.nz) Universal Laws of gravitation (Newton, Kepler), Theory of Relativity. (2 weeks)
	**Morag Hills** (Senior Tutor) morag.hills@pg.canterbury.ac.nz
	**Cliff Franklin**, Lab Supervisor: Room 322 Ernest Rutherford cliff.franklin@canterbury.ac.nz

ASSESSMENT

A satisfactory performance in the laboratory and homework are required for a passing grade in this physics course. A minimum of 45% in the final exam is required for a passing grade in this course.

15%	Online homework via Learn (12 assignments worth 1.5% each with a maximum credit of 15%)
10%	Research Project Report
10%	Laboratory
65%	Final Examination

LEARN

This course will make extensive use of LEARN (http://www.learn.canterbury.ac.nz). LEARN is a web-based learning resource and most course announcements and handouts will be on LEARN.

ONLINE HOMEWORK PROBLEMS VIA WEBASSIGN

There will be 12 weekly sets of online problems starting in week 1.

HOMEWORK IS NOT HOSTED ON THE LEARN SITE.

The HW assignments are available from the Textbook publisher website called WEBASSIGN. Instructions on accessing this site are in a document on the Learn Page.

Each assignment will be opened on Mondays of each week – except for a break over the Christmas period. The due date for completion of ALL assignments is at the end of the course, but it is your interests to work through them as you follow the material.

Each HW contributes equally even if there are more questions in a particular week. Your best 10 weeks will be counted towards your final grade.

Note that WebAssign has a feature that allows students to leave a message for the instructor, eg to ask for help or an extension. **DO NOT USE THIS FEATURE** – such messages will not get attended to as WebAssign is not monitored frequently.

FINAL EXAMINATION

The final examination tests your grasp of the lectures, problems completed on-line and in tutorials, and reading material. Approved calculators will be required.

To obtain an advancing grade for this course you must score at least 45% on the final exam AND 50% for the course overall. If you score less than 45% on the exam while obtaining >50% overall, the maximum grade you can be allocated is R. Note that this is not a progressing grade i.e. **you will not be able to use PHYS102 as a prerequisite for any other course.**

Previous years exam papers are downloadable from the library website.

HELPDESK

For students present in Christchurch an optional help-desk will be scheduled. An additional Zoom session will be scheduled where students from outside Christchurch can dial-in and ask questions. The Course Tutor, Morag, will be there to help you and we really hope you will make use of this opportunity to ask questions and improve your learning. You are welcome to discuss online problems (but don't expect to be given the answers!) as well as the course material in general.

HELPDESK times will be announced on the LEARN website.

LABORATORIES

Supervisor: Cliff Franklin, Room 322 of the Ernest Rutherford Building.

The course includes 4 laboratory sessions of 3 hours each, running in the weeks starting 18 and 25 January. You are required to be physically present on campus for these weeks.

The laboratories are situated on level 3 of the Ernest Rutherford Building in Room 312.

Before attending this first session, you must purchase a red or green laboratory notebook from the Copy Centre in the main library. If you have a notebook from PHYS101 you may use that instead. Laboratory manuals are provided free of charge by the Department in the first laboratory. Bring your manual and notebook to all laboratory sessions.

The laboratory work complements the lecture material. Some experiments introduce you to particular experimental techniques, whilst others illustrate lecture topics.

10% of the course credit is based on checkpoint marks assessed by the demonstrators for your laboratory notebook during the laboratory.

Satisfactory performance in the laboratory work is required to pass the course as a whole.

Lab exemption: An exemption from the lab component of the course will be granted to students who have passed the laboratory component of an identical or comparable course with above average grades, but failed the course on other grounds. Since laboratory work is designed to reinforce the lecture content as well as teach practical skills, exempted students are encouraged to participate in any labs from which they feel they could benefit. Laboratory course credit can only be used to gain one consequent exemption.

RESEARCH GROUP PLACEMENT

During the weeks starting 18 and 25 January, you will be allocated a place in a research group. You will be expected to spend time during these weeks learning about the research that the group carries out.

ONE formal report based on this placement will be required to be handed in. This report is worth 10%. We will provide you with information to guide you in the format and style expected for this report.

GENERAL INFORMATION

The School has general policies that apply to all courses regarding such matters as Dishonest Practice, Allowed types of calculators, Marks and Grades boundaries, Late Work, Academic Liaison, Assistance for Students with Disabilities, Reconsideration of Grades, Special Consideration Applications, etc. This information is available on the *Physics & Astronomy Undergraduate Courses* section of the Learn site.

EXPECTATIONS AND REQUIREMENTS OF STUDENT PARTICIPATION IN PHYSICS AND ASTRONOMY COURSES

An important principle operating in all our courses will be that of

***LEARNING THROUGH ACTIVE PARTICIPATION*.**

This means that you must be prepared to attend all the lectures, laboratories and tutorials and attempt all the homework assignments and all course tests. If you are unable to meet all these commitments, then you may not be well suited to studying physics.

The only exceptions to full participation in all aspects of the course will be

- students who have been issued with a written laboratory exemption;
- students who produce a doctor's certificate (or other evidence) to the Laboratory Supervisor (in the case of missed laboratory work) or to the Course Coordinator (in case of missing other work).

READING, HOMEWORK AND STUDY

You will get as much out of this (or any) course as you put in to it. **Here are some ways you can best help yourself.**

- **Reading.** *Read* the relevant part of the text before each lecture. (A reading and problem list will be circulated.) You will understand and enjoy it more, and learn much faster.
- **Problem-solving.** Nothing teaches more thoroughly than solving problems. *Attempt* the set work, especially the electronic quizzes and homework, as well as past exams, and go over it with your tutor.
- **Study.** *Work over* your lecture notes with the text and problems. *Write a digest* of your notes, summarizing key points in your own way on one sheet of paper for each lecture. These summaries are invaluable in problem solving, in laboratories and in revising.