PHYS102-23S2
Engineering Physics B: Modern Physics and Electromagnetism (2)
15 points, 0.125 EFTS, Semester 2 2022.

Version 15th July 2023.

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 **recommended text** is Volume 2 from either:

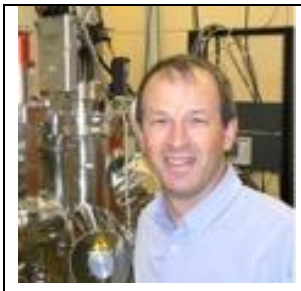
1. Serway, Jewett, Wilson & Wilson (SJW^2) "Physics Vol. 2" Asia-Pacific edition (2013).
2. Serway, Jewett, Wilson, Wilson & Rowlands "Physics for Global Scientists and Engineers" (2017).

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 – contact details below.

Prof. Roger J. Reeves, Course Supervisor
Room 623, von Haast Building
roger.reeves@canterbury.ac.nz

	**Professor R. J. 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)
	Jamie Steel (Senior Tutor) jamie.steel@pg.canterbury.ac.nz
	**Cliff Franklin**, Lab Supervisor: Room 322 Ernest Rutherford cliff.franklin@canterbury.ac.nz

ASSESSMENT

A satisfactory performance in the laboratory, tutorials and homework are required for a passing grade in this physics course.

10%	Online homework (12 assignments worth 1% each with a maximum credit of 10%)
5%	Active participation in at least 10 of 12 tutorials
25%	Term Test – TBA but expected to be in week 6 (NOT ONLINE)
15%	Laboratory
45%	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.

TUTORIALS

PHYS102 includes 12 tutorial sessions, **starting in week 1**. UC Timetabling should have assigned you to a tutorial stream. If you need to change your allocation, please email the Lab Supervisor – contact details are above.

A tutor will guide your approach to solutions of the problems. Your participation in tutorials is essential – you learn physics by solving problems – and is important preparation for the test and exam. You will receive credit for *active* participation.

A tutorial sheet of questions/problems will be posted on Learn at the beginning of each week. ONE of the problems is to be attempted BEFORE the tutorial. The working of this problem will be checked at entry to the tutorial. An "Honest" attempt at this question will be required to obtain the participation mark for that week.

An "honest" attempt means that you need to have demonstrated some knowledge of the relevant physics of the question. The answer does not need to be correct however.

ONLINE HOMEWORK PROBLEMS

There will be 12 weekly sets of online problems **starting in week 1.** Instructions on accessing the assignment will be available from Learn.

The assignment will be opened on a Wednesday and will cover questions from that week's lectures.

The online problems have a deadline of 11:59 pm on the Wednesday, one week following the start date. (approx. 7 days to complete)

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.

TERM TEST

An evening TERM TEST for PHYS102 will be held. We have requested it to be in week 6. This test will be an in-person test located on the campus. The location will be announced via Learn and your Timetable will update.

The material to be covered in the Test will also be announced via Learn. Approved calculators will be required.

Submit a **Special Consideration** application if you miss the Test through illness or your performance is impaired. The mark from the final examination will be used to allocate the test mark in such situations.

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 48% on the final exam AND 50% for the course overall. If you score less than 48% 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.**

HELPDESK

Tutors will be available at set times at a drop-in Help Desk. They are there to help you and we really hope you will make use of this opportunity to ask questions and have your problems solved throughout the semester. You are welcome to discuss the week's tutorial and online problems (but don't expect to be given the answers!) as well as the course material in general.

HELPDESK times will be announced in lectures and on the LEARN website.

LABORATORIES

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

The course includes 9 laboratory sessions of 3 hours each, running through terms 3 and 4. Your laboratory stream is allocated by UC Timetabling. If you need to change your lab allocation please see Cliff Franklin.

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

Labs start in week 2.

Before attending this first session, you must purchase a red or green laboratory notebook. If you have a notebook from PHYS101 you may use that instead. Laboratory manuals are provided free of charge by the School 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. **ONE formal report** based on these weekly notes will also be required to be handed in. This report is worth 5%. Special sessions will be held to guide you in the format and style expected for these formal reports.

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.

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. https://apps.canterbury.ac.nz/1/science/phys-chem/PHYS%20-%20Course%20Outlines/General.PDF

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 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.