PHYS149

Physics for Life Sciences

S1 Day 2019

Dept of Physics and Astronomy

Contents

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General Information

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Credit points
3

Prerequisites
(HSC Mathematics Band 4-6 or Extension 1 Band E2-E4 or Extension 2) or MATH130 or MATH123(HD) or WFMA003

Corequisites

Co-badged status

Unit description
This unit develops a conceptual and quantitative approach to key physics topics including: waves, light and sound; electricity; forces and motion; and thermodynamics, with illustrations of these topics using biological or technological applications. It teaches students to apply their knowledge of science to solve problems; to think and reason logically and creatively; and to communicate effectively. The key role of modelling in understanding and describing the natural world is supported by a development of the basic techniques of physical measurements, data analysis and verification of models. Written communication skills for laboratory report writing, and problem-solving techniques, are emphasised throughout the unit.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).

Applying physics principles to solve real-world problems including those involving topics in the life sciences.

Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.

To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.

Using a range of measurement and data analysis tools to collect and analyse data with appropriate precision. The unit includes a comprehensive laboratory component to build this capability. This involves understanding the physics of the problem, performing the measurements (with an awareness of uncertainties), displaying data graphically, and analysing the results (including computer-based processing and presentation).

Demonstrate foundational learning skills including active engagement in their learning process.

General Assessment Information

Satisfactory performance in all the following Assessment Tasks of this Unit is a requirement for a passing grade. Note that this Unit includes hurdle tasks.

Assessment Tasks

Name	Weighting	Hurdle	Due
Tutorial Quizzes	25%	Yes	Weeks 1 - 13
Lab sessions	25%	Yes	Specified weeks
Final examination	50%	No	As timetabled

Tutorial Quizzes

Due: **Weeks 1 - 13**
Weighting: **25%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Two-hour tutorials start in Week 1, Friday. In each tutorial you will work with a tutor on selected problems that cover the lecture material of the previous week.

At some point during each tutorial (starting in Week 1, Friday until last tutorial, Monday Week 13), you will be asked to solve a slightly modified version of one or two problems -- one problem is chosen from the last week's tutorial and another problem is chosen from the current tutorial. You will be asked to hand in your completed work which will be marked and returned to you for feedback. Each individual mark will contribute slightly over 2% to your total mark. You must attend and participate in at least 10 of the 12 weekly tutorials to pass this unit, which implies coming to the class in time and handing in your completed work for the quiz. **This is a hurdle requirement.**

On successful completion you will be able to:

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and

communicate physics ideas and explanations.

- To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.
- Demonstrate foundational learning skills including active engagement in their learning process.

Lab sessions

Due: **Specified weeks**
Weighting: **25%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

During these sessions, you gain an introduction to measurement techniques and equipment, and to data analysis and you also complete four specific experiments chosen from the list. **They commence in week 1.**

Satisfactory completion of laboratories is a hurdle requirement. **You must attend all ten laboratory sessions.** Please contact our admin team [phys149@mq.edu.au] as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a special consideration [https://students.mq.edu.au/study/my-study-program/special-consideration]. Make-up session will be offered in weeks 12 and 13.

Preparation is required for each of the lab sessions 2-10. You will find the Prelab activities in the Laboratory Resources section of iLearn. Your prelab work will account for some of the marks for each laboratory session.

On successful completion you will be able to:

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.
- Using a range of measurement and data analysis tools to collect and analyse data with appropriate precision. The unit includes a comprehensive laboratory component to build this capability. This involves understanding the physics of the problem, performing the measurements (with an awareness of uncertainties), displaying data graphically, and

analysing the results (including computer-based processing and presentation).

- Demonstrate foundational learning skills including active engagement in their learning process.

Final examination

Due: **As timetabled**
Weighting: **50%**

This will be a 3-hour closed-book exam. You are expected to present yourself for the final examination at the time and place designated in the University examination timetable. It is assumed that you will have a scientific calculator to complete some questions. The timetable will be available in draft form approximately eight weeks before the commencement of examinations and in final form approximately four weeks before the commencement of examinations.

The only exception to not sitting the examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to apply for special consideration [https://students.mq.edu.au/study/my-study-program/special-consideration]. *If you receive special consideration for the final exam, a supplementary exam will be scheduled in the week of July 15-26 2019. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.*

On successful completion you will be able to:

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.
- To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.

Delivery and Resources

Required Text

Physics 10e, JD Cutnell and KW Johnson, John Wiley, 10th edition, 2015, ISBN 9781118486894 OR E-Text, ISBN 9781118899175 (also Binder version). http://www.wileydirect.com.au/buy/physics-10th-edition/http://www.wileydirect.com.au/buy/physics-10th-edition/

Note that the textbook, whether hardcopy or e-text, comes with the WileyPlus online tool (www.wileyplus.com) which provides a large database of support material (extra instructional videos) and practice questions. The Course ID you will need is 568448.

Teaching Strategy

PHYS149 consists of lectures, tutorials, laboratory sessions and assessment including tutorial quizzes, laboratory reports and formal exams.

You are expected to attend all lectures. In person attendance is encouraged as the lectures regularly contain live demos which are not well captured by the recording system. If there are unavoidable timetable clashes, you can listen to the Echo recording of each lecture which is accessible from the course iLearn site.

You should spend an average of 9 hours per week studying the unit.

Laboratory (Lab) Sessions

The laboratory will operate in 14SCO (E7B) 114, commencing week 1 (no prelab work is required for this week). It includes important safety information and therefore attendance is mandatory. **Students can't attend their 2nd Laboratory session until they have completed the first.** During the laboratory sessions students will engage in practical exercises to develop their experimental skills and to further their understanding of the physics concepts.

The laboratory component is an essential component of your studies and so counts for an appreciable fraction of your final assessment.

The laboratory work is designed to introduce you to some of the basic skills and techniques that are used in experimental physical science. Some of the activities in the laboratory may not relate directly to the material in the lecture course. This is because the laboratory activities are intended not only to illustrate physical concepts but also to provide training in the experimental skills that are required of practicing physicists, scientists and engineers.

You will be provided with instructional material in the form of **Laboratory Notes** which can be found in the Laboratory Resources section of iLearn, and assisted in the laboratory by a team of demonstrators, many of whom are postgraduate research students. The laboratory program is designed to operate independently of the lectures, although some of the work topics will be discussed in lectures. Indeed there is some advantage in becoming familiar with a topic in an experimental situation before you meet it in lectures. That is often the case in real life!

You will be issued with a Laboratory Notebook in Week 1. For each laboratory session, except in Week 1, you are required to complete some preparatory work (**Pre-Lab**) before attending your nominated Lab session. Typically the Pre-Lab will require you to bring some material to the lab to be pasted into your lab book. A portion of your mark for each lab session is allocated to the Pre-lab work.

Location of the 100-level Physics Laboratory, 14SCO (E7B) 114.

The laboratory is located on the ground floor of building 14SCO, at the NE corner (room 114). Entry is from the courtyard at the opposite end to the main staircase.

Laboratory Attendance Requirements

You are required to attend and to satisfactory complete all rostered laboratory sessions. Each time you attend the laboratory you must sign in and out (legibly) in the attendance book.

If you miss a laboratory session and wish to lodge a "disruption to studies" request you can start this process at https://ask.mq.edu.au. You will require a medical certificate or other form of evidence to complete this process - contact the unit convenor if you are unsure.

Laboratory classes are compulsory and students who do not attend all classes will be deemed to have failed to meet the learning outcomes of the unit. Moreover, it is a hurdle requirement that you must achieve at least 40% for each laboratory activity.

If you miss a laboratory class, or if you fail to meet the hurdle requirement (at least 40%) for any activity, then you must complete a "**Request to schedule a make-up laboratory session"** form. You will find it on iLearn, or you can click the link below. Make-up lessons will be run in weeks 12 and 13.

https://forms.office.com/Pages/ResponsePage.aspx?id=wRTFghenh0C-BtQNIHCtUq6HUEbJg8NKnkgBZ85lP3dUQzJSUlpTSDlGNzJDUEdQODdVVUtBTlVUTC4u

Laboratory Safety

You are required to follow all safety guidelines given in the lab manual, and as outlined by your lab supervisor. Food and drink cannot be taken into the laboratory and students without suitable covered footwear will be refused admission.

Laboratory Schedule

The first laboratory session will be in the **first** week of semester. The schedule of labs is posted in the lab and on the iLearn page. Please attend your nominated laboratory session. If you have difficulty enrolling into a lab session that suits your timetable, then keep trying over a few days as students often move between sessions.

Unit Schedule

Detailed Topic Outline

Chapters and Sections of Textbook covered in the Lectures

Introduction and Mathematical Concepts (Chapter 1)

Section 1.1 The nature of physics

Sections 1.2, 1.3 Units

Sections 1.5-1.8 Vectors

Kinematics in One Dimension (Chapter 2)

Section 2.1 Displacement

Section 2.2 Speed and velocity

Section 2.3 Acceleration

Sections 2.4 - 2.5 Equations of kinematics for constant acceleration and applications

Section 2.6 Freely falling bodies

Section 2.7 Graphical analysis of velocity and acceleration

Forces and Newton’s Laws of Motion (Chapter 4)

Section 4.1 Concepts of force and mass

Section 4.2 Newton' first law of motion

Sections 4.3 - 4.4 Newton's second law of motion

Section 4.5 Newton's third law of motion

Sections 4.6 – 4.9 Types of forces: gravitational force, frictional forces and normal force

Sections 4.11- 4.12 Applications of Newton’s laws of motion

Rotational Dynamics (Chapter 9)

Section 9.1 The Action of Forces and Torques on Rigid Objects

Section 9.2 Rigid Objects in Equilibrium

Work and Energy (Chapter 6)

Section 6.1 Work done by constant force

Section 6.2 Work-energy theorem and kinetic energy

Section 6.3 Gravitational potential energy

Section 6.5 Conservation of mechanical energy

Section 6.7 Power

Section 6.8 Other forms of energy and the conservation of energy

Electricity. (Chapter 18)

Section 18.1 and 18.2 Introduction and charged objects

Section 18.5 Coulomb's Law

Section 18.6 Electric field

Electric potential. (Chapter 19)

Section 19.1. Potential energy

Section 19.2 Electric potential difference

Electric circuits. (Chapter 20)

Section 20.1 Electromotive force and current

Section 20.2 Ohm’s law

Section 20.3 Resistance and resistivity

Section 20.4 Electric power

Section 20.5 Alternating current

Electric circuits. (Chapter 20)

Section 20.6 Series wiring

Section 20.7 Parallel wiring

Section 20.8 Circuits partially in series and partially in parallel

Section 20.11 Measurement of current and voltage

Section 20.14 Safety and the physiological effects of current

Fluids. (Chapter 11)

Section 11.1 Mass density

Section 11.2 Pressure

Section 11.3 Pressure and depth in a static fluid

Section 11.4 Pressure gauges

Section 11.5 Pascal’s principle

Section 11.6 Archimedes’ Principle

Section 11.7 Fluids in motion

Section 11.8 Equation of continuity

Section 11.9 –11.10 Bernoulli's equation and applications

Heat. (Chapter 12)

Section 12.1- 12.2 Temperature scales

Section 12.3 Thermometers

Section 12.6 Heat and internal energy

Section 12.7 Heat and temperature change

Section 12.8 Heat and phase change

Heat transfer. (Chapter 13)

Section 13.1 Convection

Section 13.2 Conduction

Section 13.3 Radiation

Section 13.4 Applications

Thermodynamics. (Chapter 15)

Section 15.1 Thermodynamic systems and surroundings

Section 15.2 Zeroth law of thermodynamics

Section 15.3 First law of thermodynamics

Section 15.7 Second law of thermodynamics

Section 15.8 Heat Engines

Section 15.10 Refrigerators, air-conditioners and heat pumps

Waves and Sound. (Chapter 16)

Section 16.1 Nature of waves

Section 16.2 Periodic waves

Section 16.3 Speed of a wave on a string

Section 16.4 Mathematical description of a wave

Section 16.5 Nature of sound

Section 16.6 Speed of sound

Sections 16.7 – 16.8 Sound intensity and dB

Section 16.9 Doppler effect

Section 16.10 Applications of sound in medicine

Superposition and Interference. (Chapter 17)

Section 17.1 Principle of linear superposition

Section 17.2 Constructive and destructive interference of sound waves

Section 17.3 Diffraction

Section 17.4 Beats

Section 17.5 Transverse standing waves

Section 17.6 Longitudinal standing waves

Electromagnetic waves. (Chapter 24)

Section 24.1 Nature of electromagnetic waves

Section 24.2 Electromagnetic spectrum

Section 24.3 Speed of light

Section 24.5 Energy carried by electromagnetic waves

Section 24.6 Doppler effect and electromagnetic waves

Refraction of Light: Lenses and Optical Instruments. (Chapter 26)

Section 26.1 Index of refraction

Section 26.2 Snell's law and refraction of light

Section 26.3 Total internal reflection

Section 26.5 Dispersion of light

Section 26.6 –26.7 Lenses and formation of images by lenses

Section 26.8 Thin lens equation and magnification equation

Section 26.9 Lenses in combination

Section 26.10 Human eye

Interference and Wave Nature of Light. (Chapter 27)

Section 27.1 Principle of linear superposition

Section 27.2 Young's double slit experiment

Nature of the Atom. (Chapter 30)

Section 30.2 Line spectra

Section 30.3 Bohr model of the hydrogen atom

Section 30.6 Pauli exclusion principle and the periodic table of the elements

Section 30.7 X-rays

Nuclear Physics and Radioactivity. (Chapter 31)

Section 31.1 Nuclear structure

Section 31.2 Strong nuclear force and stability of the nucleus

Section 31.3 Mass defect of the nucleus and nuclear binding energy

Sections 31.4 and 31.6 Radioactivity and radioactive decay

Ionizing Radiation. Elementary Particles(Chapter 32)

Section 32.1 Biological effects of ionizing radiation

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy (***Note:*** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Suggestions for exam preparation

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy.

The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.

Assessment tasks

- Tutorial Quizzes
- Final examination

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.

Assessment tasks

- Tutorial Quizzes
- Lab sessions

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.
- Demonstrate foundational learning skills including active engagement in their learning process.

Assessment tasks

- Tutorial Quizzes
- Lab sessions
- Final examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.

- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.
- Using a range of measurement and data analysis tools to collect and analyse data with appropriate precision. The unit includes a comprehensive laboratory component to build this capability. This involves understanding the physics of the problem, performing the measurements (with an awareness of uncertainties), displaying data graphically, and analysing the results (including computer-based processing and presentation).

Assessment tasks

- Tutorial Quizzes
- Lab sessions
- Final examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.
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analysing the results (including computer-based processing and presentation).

Assessment tasks

- Tutorial Quizzes
- Lab sessions
- Final examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Applying physics principles to solve real-world problems including those involving topics in the life sciences.
- Using a range of measurement and data analysis tools to collect and analyse data with appropriate precision. The unit includes a comprehensive laboratory component to build this capability. This involves understanding the physics of the problem, performing the measurements (with an awareness of uncertainties), displaying data graphically, and analysing the results (including computer-based processing and presentation).

Assessment tasks

- Tutorial Quizzes
- Lab sessions
- Final examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Using the tools, methodologies, language, conventions of physics to test and communicate ideas and explanations. Topic content, laboratories and tutorial/ assignment problems provide opportunities to build an understanding of how to test and communicate physics ideas and explanations.
- To be responsible, critically reflective, self-directed and motivated learners. The nature of the tutorials, tutorial problems and quizzes, and examinations are all designed to develop students as self-learners who know their own learning styles.

Assessment task

- Lab sessions

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Demonstrate foundational learning skills including active engagement in their learning process.

Assessment task

- Tutorial Quizzes

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Knowledge of fundamental physics concepts, principles and theories. Students learn concepts and show their understanding by predicting outcomes of 'thought experiments' (conceptual answers) and calculating outcomes in specific physical situations (numerical answers).
- Demonstrate foundational learning skills including active engagement in their learning process.

Assessment task

- Lab sessions

Changes from Previous Offering

Instead of three lectures per week, two lectures per weeks will be offered. Instead of one-hour tutorial, two-hour tutorial will be offered. Problem solving examples will be largely removed from the lectures and lecture notes and covered in tutorials.

The hurdle requirement is removed from final exam.

Mid-semester exam is rested.