MACQUARIE University SYDNEY·AUSTRALIA

PHYS107

Modern Mechanics

S1 Day 2019

Dept of Physics and Astronomy

Contents

General Information

Unit convenor and teaching staff
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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, together with PHYS106, provides an overview of physics both for students primarily intending to study physics and astronomy beyond first year, and for engineering students who wish to explore physics at a greater depth. As well as broadening their experience in classical Newtonian physics of matter and waves, and Maxwell's theory of electromagnetism, students are introduced to the main theories underlying modern physics: quantum mechanics, thermal physics, and Einstein's theory of relativity, with an emphasis on understanding the interrelationship between these fundamental ideas. PHYS107 deals with the laws of classical mechanics, thermodynamics and entropy, and the effects of energy quantisation. Fundamentals of experimental method and data analysis are taught in well-equipped laboratories which support and complement the lecture course.	

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:

Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.

Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.

Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.

Have an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.

Be able to perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.

Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis; and to express the results with their uncertainty in a physically meaningful way.

Be able to clearly explain physics concepts learned and illustrate these to peers.

General Assessment Information

This unit has hurdle requirements, specifying a minimum standard that must be attained in several aspects of the unit. To pass this unit you must obtain a mark of at least:

50% in the unit overall, as well as

- **at least 40% in each half of the final examination (Section A and Section B), and**
- **at least 40% in each of the laboratory activities, and**
- **a non-zero mark in 10 of 13 quizzes (which also captures attendance and engagement requirements)**

Second-chance hurdle examinations will be offered to eligible students. If you are given a second opportunity to sit the final examination as a result of failing to meet the minimum mark required, you will be offered that chance during the supplementary examination period, which will be scheduled in the week of July 15 - 26 2019. You will be notified of the exact day and time after the publication of final results for the unit.

Assessment Tasks

Name	Weighting	Hurdle	Due
Laboratory Work	20%	Yes	See lab timetable
Tutorials	25%	Yes	Each week
Video Exposition	5%	No	Week 12
Final Examination	50%	Yes	University Examination Period

Laboratory Work

Due: **See lab timetable**
Weighting: **20%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The **first lab session is in week 1**

You must wear enclosed/covered footwear to the laboratory

There are ten lab sessions.

(The Video exposition assessment runs in weeks 9 and 10 during your normal lab time.)

Satisfactory completion of laboratories is a **hurdle requirement.** You **must** attend **all ten** laboratory sessions. The **first lab session is in week 1** and includes work health and safety information. Students will also be assigned to lab groups and computer access will be checked. Session 1 needs to be attended by all students regardless of whether this is their first Physics unit or not. It will be shorter than the other sessions, but attendance is absolutely mandatory – **you cannot do subsequent lab sessions if you do not attend the introductory one**. The **next 9 lab sessions** involve experimental work and will be assessed. You **must** obtain a mark of **at least 40%** for each of the laboratory sessions in order to pass the unit.

Preparation is required for each of the lab sessions 2-10. You will find the **Prelab activities** in the Laboratory Resources section of PHYS107 iLearn webpage. Your prelab work will account for some of the assessment marks for each laboratory session.

You will be issued with a laboratory notebook for use in the laboratory throughout the semester. At the end of the lab session you will leave this book in the laboratory to be marked. The marker (one of the demonstrators) will place a marking sticker at the end of your work and here they will note any issues with your lab work and provide any other feedback. Be sure to check this feedback when you collect your laboratory notebook when you return for your next laboratory session, and to act on it to improve your laboratory skills and capabilities. A maximum mark of 20 will be awarded for each of the lab sessions. To receive full marks you will need to a) complete the prelab work and bring a copy for posting into your notebook, as necessary; b) record your experiment results and analysis clearly and concisely, including identifying and analysing uncertainties in your measurements; and c) demonstrate (through your analysis) a good understanding of the physical principles involved in the experiment. Students work in pairs but must make and submit an independent record. Markers check for independent reporting.

If you miss a session or fail an activity, you must complete a "**Request to schedule a Catch-up laboratory session"** form. Read the sections below for full details about catch up classes and when they are scheduled. **Satisfactory completion of laboratories is a hurdle requirement. You must attend all ten laboratory sessions. They commence in week 1. You must obtain a mark of at least 40% in each of the laboratory activities to have the potential to pass the unit. If you miss a session or fail an activity, 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.** A limited number of catch up classes will be available during the mid-term break and in Week 13.

Request to schedule a make-up laboratory session

On successful completion you will be able to:

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work,

kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.

- Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.
- Have an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.
- Be able to perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
- Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis; and to express the results with their uncertainty in a physically meaningful way.
- Be able to clearly explain physics concepts learned and illustrate these to peers.

Tutorials

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

Tutorial attendance and engagement is compulsory.

It is a hurdle requirement to attend and participate in at least 10 out of 13 tutorials. This includes obtaining a non-zero mark for the quiz. Full attendance is strongly encouraged.**

Tutorials start in Week 1, and are 1 hour 50 minutes long each week.

Each week, through the online iLearn system, a number of problems will be set to be worked through in the tutorials. You are **strongly** encouraged to study the physics from the immediate past two lectures*, including study of the appropriate sections of the textbook, and to try the set problems before each tutorial, so that you can follow through the exposition by the tutor and contribute to problem solving discussions and write-up.

In addition to these problems for tutorial, you will also be given separate assessment problems. During the tutorials each week (usually at the beginning except in week 1) there will be a short (<20min) in-class quiz involving multiple choice, with written problem solving, based on the assessment problems given out in the previous week. (Exception is week 1). You will be asked to show your written work on the quiz sheet. The quizzes will be graded both on the multiple-choice answer, and on the clarity and correctness of your written solution. The marks will be uploaded into iLearn the following week and the marked hardcopies will be returned in class the following week. After that they will be available in the Science Centre, Ground Floor 14WW.

All quizzes will be graded (13 quizzes - quizzes start in week 1**) and we will take the best 10 scores for the semester to contribute to your overall tutorial grade (25%).

Satisfactory attendance and participation in tutorials is a hurdle requirement. We require effective participation in tutorials, entailing a focused work effort and attendance for the full session. If you do not participate effectively in a given week, for example leaving the tutorial early without extenuating circumstances, it will be grounds for receiving a score of zero for that week's quiz, and that quiz will then not count towards passing the hurdle requirement. You must obtain a recorded, non-zero mark in at least 10 out of the 13 scheduled quizzes to have the potential to pass the unit. No additional quizzes will be offered for those who fail to meet this requirement.**

* Except week one, and possibly others if any unavoidable disruption to the normal class schedule occurs.

**There will be 13 tutorials and quizzes unless unavoidable circumstances prevent this being achieved, in which case the hurdle requirement will be reconsidered in view of any new circumstance.

On successful completion you will be able to:

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
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- Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.
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- Be able to clearly explain physics concepts learned and illustrate these to peers.

Video Exposition

Due: **Week 12**
Weighting: **5%**

Special Projects:

The purpose of these is to assist in your understanding of the topics studied by developing a clear focused, video exposition on a particular topic, also including a demonstration, e.g., see the Veritasium YouTube channel.

A list of 10-15 topics for the video exposition will be given out in week 4. Students work as a combined group (maximum 4 in a group), on a particular topic. The normal laboratory class time in weeks 9 and 10 will be available to all students, so **groups should be formed from within your laboratory class**. Groups will choose their topics by week 5 and enter a group name, list of members, and a topic. There will be a starting set of equipment provided in the laboratory sessions for all of the topics on the list to be used to develop the exposition and plan/execute the demonstration for video recording. Before recording students will be asked to have their exposition script reviewed by either a lab demonstrator or lecturer. Groups will be asked to prepare a video of their exposition (max 5 mins) - either using their own phone or via a camera in the lab - by week 12 and upload it to iLearn. The video will be graded based on the clarity of their exposition and not on their skills at video recording.

On successful completion you will be able to:

- Be able to clearly explain physics concepts learned and illustrate these to peers.

Final Examination

Due: **University Examination Period**
Weighting: **50%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

You are expected to present yourself for examination at the time and place designated in the University Examination Timetable (http://www.timetables.mq.edu.au/exam/).

The final examination will be three hours long and will cover content from the entire unit.

The use of calculators in examinations for this unit is permitted but, in accordance with the Faculty's policy, calculators with a full alphabet on the keyboard are not allowed.

The final examination is a hurdle requirement. The first half of the final exam deals with material from the first half of the unit, and the second half of the final exam covers material from the second half of the unit. You must obtain a mark of at least 40% in each half of the final exam to have the potential to pass the unit.

If your mark in the final examination is between 30% and 39% (inclusive), you may be a given a second and final chance to attain the required level of performance; the mark awarded for the second exam towards your final unit mark will be capped at 40%, and you will be allowed to sit the second exam *only if this mark (40%) would be sufficient to pass the unit overall*.

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 re-sit 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.

If you are given a second opportunity to sit the final examination as a result of failing to meet the minimum mark required, you will be offered that chance during the same supplementary examination period, and will be notified of the exact day and time after the publication of final results for the unit.

On successful completion you will be able to:

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.
- Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.
- Have an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.

Delivery and Resources

Classes

Lectures (attend all):

Lecture 1: Tuesday 4 PM - 5 PM, 14 Sir Christopher Ondaatje Ave (14SCO) - 100 Theatrette

Lecture 2: Wednesday 9 AM - 10 AM, 14SCO - 100 Theatrette

Tutorial (Attendance and engagement is compulsory):

Friday 1 PM - 3 PM, 14SCO - 163 Active Learning Space

Practical Laboratories (register for one):

Monday 9 AM - 12 PM, 14SCO - 114

Monday 1 PM - 4 PM, 14SCO - 114

Tuesday 9 AM - 12 PM, 14SCO - 114

Video Exposition Laboratories

These will take place in your scheduled lab time In Weeks 9 and 10.

NB: Required laboratory introduction sessions and tutorials with a practice quiz will occur in Week 1. Full laboratories and tutorials with marked quizzes will commence in the week 2 of the semester. You must complete the Week 1 laboratory introduction before you will be allowed to attend any further labs.

Required and Recommended Texts and/or Materials

Required Text

Matter and Interactions, 4th Edition, by Ruth Chabay and Bruce Sherwood (Wiley, 2015).

Either Volume 1 (Paperback) or the combined Volume (hardbound). Note that Volume 2 will be the required text for PHYS 106 in semester 2. Earlier editions may also be used but readers need to be aware that section numbers, question numbers and some content may be different in earlier editions.

Required Resources

The PHYS107 Laboratory Notes will be available online using iLearn before the laboratory sessions begin in the first week of the semester.

Web Resources

More information on the required text as well as additional resource material can be found at http://www.matterandinteractions.org/

There are also other high quality learning resources on the web which we would recommend to you to use in your studies. The HyperPhysics site hosted by the Department of Physics and Astronomy at Georgia State University is widely acclaimed and used. The site also has mathematics learning resources on under "maths used in physics".

http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html (Mechanics, and, Electricity & Magnetism).

Increasingly there are excellent web-based interactive simulations available – some are in the on-line resources that support the textbook. We encourage you to conduct your own web searches for others, and to develop your own critical judgment of which sites provide high quality resources that assist your learning. Two that we recommend to you are:

• http://www.explorelearning.com/ The Explorelearning Gizmos: follow links to Grade 9-12, Physics, Motion and Force; and Electricity & Magnetism. You will have to register to use this site.

• http://phet.colorado.edu/simulations/index.php?cat=Featured_Sims The University of Colorado, Boulder, Physics Education Technology (PhET) Simulations: follow the links to Motion; Energy, Work & Power; and Electricity, Magnets and Circuits. This site also contains maths resources, for example vector addition.

Technology Used and Required

Unit Web Page

The web page for this unit can be accessed via the PHYS107 iLearn page.

Please check this web page regularly for material available for downloading.

Teaching and Learning Strategy

This unit is taught through lectures and tutorials and through undertaking laboratory experiments and a video exposition activity. We **strongly** encourage students to attend lectures because they provide a much more interactive and effective learning experience than simply reading a text book. The lecturer is able to interpret the physics that you will be learning, showing you the relationships between different components/concepts and emphasising the key physics principles involved. Questions during and outside lectures are strongly encouraged in this unit - please do not be afraid to ask, as it is likely that your classmates will also want to know the answer. You should aim to read the relevant sections of the textbook before and after lectures and discuss the content with classmates and lecturers.

This unit includes a compulsory experimental component. The experiments are stand-alone investigations and may include topics not covered by the lecture content of this course. They are an important part of the learning for this unit and the skills learned are essential for a well-rounded physics graduate.

You should aim to spend an average of 3 hours per week understanding the material and working on the tutorial problems and the problems set for quiz preparation. You may wish to discuss your tutorial and quiz preparation problems with other students, the tutors and the lecturers, but you are required to be able to show your own work for assessment (see the note on plagiarism). Tutorials and quiz preparation problems are provided as key learning activities for this unit. They are not there just for assessment. It is by applying knowledge learned from lectures and textbooks to solve problems that you are best able to test and develop your skills and understanding of the material.

Unit Schedule

Schedule of Topics

The unit is divided into two halves. The first half is taught by Associate Professor Daniel Zucker and the second by Professor Deb Kane.

The textbook sections covered are listed as follows. As a **rough** guide we will be progressing through the listed chapters at a rate of one every week. You should use this as a guide to plan your textbook reading.

The content of the unit is based on the following chapters of the text by Chabay and Sherwood:

Week 1	Interactions and motion: basic mechanics and momentum
2	The momentum principle: Newton’s second law
3	The fundamental interactions: gravitational field, electric field, strong interaction

4	Contact interactions: solids, tension, stress, strain etc, friction, mass--spring oscillation
5	Rate of change of momentum: forces in a system, statics
6	The energy principle: mechanical energy, potential energy in multiparticle systems, gravitational potential energy, electric potential energy
7	Internal energy: spring potential energy, path independence of potential energy, thermal energy, energy flow due to temperature,
8	Energy quantisation: photons, electronic energy levels, the effect of temperature, vibrational levels, rotational levels, other energy levels
9	Multiparticle systems: motion of the centre of mass, rotational kinetic energy, analysing real systems
10	Collisions: internal interactions, inelastic and elastic, head--on with equal / unequal mass.
11	Angular momentum: angular momentum principle, multiparticle systems, systems with zero / non--zero torque, angular momentum quantisation
12	Entropy: limits on the possible: solids, thermal equilibrium, second law, heat capacity, Boltzmann distribution
13	Revision of Unit and Exam Question Preparation

Learning and Teaching Activities

Lectures

There will be two one-hour lectures per week. During these the content of the unit will be explained, example problems will be solved and physics principles demonstrated.

Tutorials

There will be one two-hour tutorial per week. During this time students will take a quiz, review physics concepts and work through problems related to the content of the previous two lectures.

Laboratory

Ten three-hour laboratory classes will be held during the semester. The first is an introductory session. It is held in Week 1, and no pre-lab work is required. It includes important safety information. Attendance is mandatory. Students cannot attend their second 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.

Video Exposition

Groups of students build a 5 minute video demonstration for an interesting physical concept covered within the course. This will develop their depth of understanding of the concepts involved and their ability to communicate the concept clearly and effectively to peers.

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

The Numeracy Centre

The Numeracy Centre provides support to students as they develop the mathematical knowledge, skills and confidence to succeed at university. It offers a number of services designed to support students who are studying mathematics, statistics or any other unit that uses quantitative skills.

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

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.
- Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.
- Have an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.
- Be able to perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
- Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis; and to express the results with their uncertainty in a physically meaningful way.
- Be able to clearly explain physics concepts learned and illustrate these to peers.

Assessment tasks

- Laboratory Work
- Tutorials
- Video Exposition
- Final Examination

Learning and teaching activities

- There will be two one-hour lectures per week. During these the content of the unit will be explained, example problems will be solved and physics principles demonstrated.
- There will be one two-hour tutorial per week. During this time students will take a quiz, review physics concepts and work through problems related to the content of the previous two lectures.
- Ten three-hour laboratory classes will be held during the semester. The first is an introductory session. It is held in Week 1, and no pre-lab work is required. It includes important safety information. Attendance is mandatory. Students cannot attend their second 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.
- Groups of students build a 5 minute video demonstration for an interesting physical concept covered within the course. This will develop their depth of understanding of the concepts involved and their ability to communicate the concept clearly and effectively to peers.

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

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
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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

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.
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Assessment tasks

- Laboratory Work
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- Final Examination

Learning and teaching activities

- There will be two one-hour lectures per week. During these the content of the unit will be explained, example problems will be solved and physics principles demonstrated.
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- Groups of students build a 5 minute video demonstration for an interesting physical concept covered within the course. This will develop their depth of understanding of the concepts involved and their ability to communicate the concept clearly and effectively to peers.

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

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.
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- Be able to clearly explain physics concepts learned and illustrate these to peers.

Assessment tasks

- Laboratory Work
- Tutorials
- Video Exposition
- Final Examination

Learning and teaching activities

- There will be two one-hour lectures per week. During these the content of the unit will be explained, example problems will be solved and physics principles demonstrated.
- There will be one two-hour tutorial per week. During this time students will take a quiz, review physics concepts and work through problems related to the content of the previous two lectures.
- Ten three-hour laboratory classes will be held during the semester. The first is an introductory session. It is held in Week 1, and no pre-lab work is required. It includes important safety information. Attendance is mandatory. Students cannot attend their second 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.
- Groups of students build a 5 minute video demonstration for an interesting physical concept covered within the course. This will develop their depth of understanding of the concepts involved and their ability to communicate the concept clearly and effectively to peers.

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

- Understand and be able to apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.
- Demonstrate an understanding of, and be able to solve, problems involving friction, work, kinetic and potential energy, energy conservation, linear momentum of an individual particle and systems of particles, and applications to gravity, ballistics and harmonic oscillators.
- Demonstrate an understanding of, and be able to solve, problems in rotational motion, including rolling motion, torque, and angular momentum.
- Have an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.
- Be able to perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
- Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis; and to express the results with their uncertainty in a physically meaningful way.
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- Groups of students build a 5 minute video demonstration for an interesting physical concept covered within the course. This will develop their depth of understanding of the concepts involved and their ability to communicate the concept clearly and effectively to peers.

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

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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

- Be able to perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
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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

- Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including

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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 outcome

- Be able to identify, record and understand sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis; and to express the results with their uncertainty in a physically meaningful way.

Changes from Previous Offering

The final examination hurdle requirement has been changed to require a mark of at least 40% in each half of the final exam. This has been done to emphasise the equal importance of material from both halves of the unit.

General Reminders

Student Liaison Committee

The Physics and Astronomy Department values feedback from its students. Once a semester a meeting of the Student Liaison Committee is called and representatives from each of the PHYS/PHTN/ASTR units have an opportunity to represent their and their fellow students opinions about the structure of the unit and how it is taught. Further information and a call for representatives will be made in lectures closer to the meeting date.

Email Communication

The unit web page and your student email account are the primary ways that the unit lecturers and L&T staff can communicate with you outside of lectures. Please check your student email accounts at least once a day for messages concerning the unit.

Laboratory details

Laboratory Requirements

The laboratory component is considered an essential component of your studies and so counts for an appreciable fraction of your final assessment (20%).

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. This work is designed to be carried out independently of the lectures, although some of these 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 Room 114

The laboratory is located on the ground floor of building 14 Sir Christopher Ondaatje Ave, (formerly E7B), at the NE corner (room 114). Entry is from the internal courtyard of the building at the end opposite to the main staircase or from the parkland side of 14SCO at the NE corner.

Laboratory Attendance Requirements

You are required to attend and to satisfactorily 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 "special consideration" request you can start this process at https://students.mq.edu.au/study/my-study-program/special-consideration. You will require a medical certificate or other form of evidence to complete this process - contact PHYS107@mq.edu.au 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 week 12 and week 13 on the following days and times (both weeks): Mon 4pm -7pm; Wed 12 noon-3pm; Wed 3pm-6pm, Thurs 4pm-7pm.

Request to schedule a make-up laboratory session

Laboratory Assessment

Details of the laboratory assessment have been outlined in the first section above.

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.** The wearing of enclosed footwear in laboratories is required by Work Health and Safety legislation. It is a legal requirement with which the University must ensure compliance.

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 spaces may open up as some students move to different sessions.