# PHYS1010

## Modern Mechanics

Session 1, Weekday attendance, North Ryde 2020

*Department of Physics and Astronomy*

## Contents

# General Information

Unit convenor and teaching staff
Lecturer / Tutor
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Credit points
10

Prerequisites
(HSC Mathematics Band 4 and above or Extension 1 Band E2 and above or Extension 2) or MATH1000 or MATH130 or WFMA003 or WFMA0003

Corequisites

Co-badged status

Unit description
This unit, together with PHYS1020, provides an overview of physics primarily for students intending to study physics and astronomy beyond first year, but also suitable for those specialising in any of the sciences. 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. PHYS1010 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:

**ULO1:** apply Newton's laws of motion, in particular for systems in equilibrium, and to solve problems involving static equilibrium.

**ULO2:** solve kinetics problems involving linear and rotational motion using the concepts of forces, torques, work, and energy conservation.

**ULO3:** demonstrate an understanding of the physics concepts of temperature; heat; and, the thermal properties of matter, including thermal expansion and heat capacities.

**ULO4:** perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.

**ULO5:** identify, record and explain sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis.

**ULO6:** clearly explain physics concepts learned and illustrate these to peers.

# Assessment Tasks

**Coronavirus (COVID-19) Update**

Assessment details are no longer provided here as a result of changes due to the Coronavirus (COVID-19) pandemic.

Students should consult iLearn for revised unit information.

Find out more about the Coronavirus (COVID-19) and potential impacts on staff and students

# General Assessment Information

**The 'estimated time on task' for each assessment item is an estimate of the *additional* time needed to complete each assessment outside of all scheduled learning activities. These estimates assume that you actively engage with all scheduled learning activities *and* spend an additional 28 hours of self-led study during the session.**

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 the final examination, and**
- **at least 40% in each of the individual 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. You will be notified of the exact day and time after the publication of final results for the unit.

## Laboratory Work

Due: **See lab timetable on iLearn**

**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 (i.e., no thongs, sandals, open-toed shoes, etc.).**

There are ten lab sessions.

(The Video exposition assessment runs in Weeks 12 and 13 during normal lab session times.)

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**.

**Preparation is required** for each of the lab sessions 2-10. You will find the **Prelab activities** in the Laboratory Resources section of the PHYS1010 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, which you will find on iLearn. A limited number of catch up classes will be available during the mid-term break and in Week 13. **You must obtain a mark of at least 40% in each of the laboratory activities to have the potential to pass the unit.**

## Tutorials

Due: **Each week**

**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, when it will be at the end) 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, or, in the case of Week 1, the problems given out in the Week 1 tutorial. 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 and the marked hardcopies will be returned in class the following week.

All quizzes will be graded (13 quizzes**) 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.**

* Unless an 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.

## Video Exposition

Due: **End of Week 13**

The purpose of these projects is to assist in your understanding of the topics studied by developing a clear focused, video exposition on a particular subject, 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 12 - 13 will be available to all students, so **groups should be formed from within your laboratory class**. Groups will choose their topics by Week 6 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 - at the end of Week 13 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.

## Final Examination

Due: **University Examination Period**

**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. You must obtain a mark of at least 40% in the final exam to be eligible 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 would be sufficient to pass the unit overall.

If you receive special consideration for the final exam, a supplementary exam will be scheduled after the end of the normal exam period. 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.

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.

# Delivery and Resources

**Coronavirus (COVID-19) Update**

Any references to on-campus delivery below may no longer be relevant due to COVID-19.

Please check here for updated delivery information: https://ask.mq.edu.au/account/pub/display/unit_status

## Classes

**Lectures (attend all):**

Lecture 1: Tuesday 1 PM - 2 PM,  14 Sir Christopher Ondaatje Ave (14SCO) - 100 Theatrette

Lecture 2: Wednesday 1 PM - 2 PM,  14SCO - 100 Theatrette

**Tutorial (Attendance and engagement is compulsory):**

Thursday 12 PM - 2 PM, 14SCO - 163 Active Learning Space

**Practical Laboratories (register for one):**

Friday 9 AM - 12 PM, 14SCO - 114

Friday 1 PM - 4 PM, 14SCO - 114

**Video Exposition Laboratories**

These will take place in your scheduled lab time In Weeks 12 and 13.

**NB: Required laboratory introduction sessions and tutorials with an introductory quiz will occur in Week 1. Full laboratories and tutorials 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 PHYS1020 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 PHYS 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 PHYS1010 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 at least an average of 2-3 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

### Coronavirus (COVID-19) Update

The unit schedule/topics and any references to on-campus delivery below may no longer be relevant due to COVID-19. Please consult iLearn for latest details, and check here for updated delivery information: https://ask.mq.edu.au/account/pub/display/unit_status

### 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 | Topics Covered |
|---|---|
| 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 |

# 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.)*

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/p

olicy-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 help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

# 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.

# Changes since First Published

| Date | Description |
| --- | --- |
| 17/02/2020 | Added David Spence to the unit as an additional lecturer / tutor. |