PHYS143

Physics IB

S1 Day 2014

Physics and Astronomy

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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Mark Wardle
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Credit points
3

Prerequisites
(HSC Mathematics Extension 1 Band E3 or HSC Mathematics Extension 2 or equivalent) or corequisite of (MATH130 or MATH132 or MATH133 or MATH135 or MATH136)

Corequisites

Co-badged status

Unit description
This unit, together with PHYS140, provides an overview of physics. This unit includes a broad range of topics suitable for engineering students or those majoring in any of the sciences. This unit begins with topics in classical physics: the physics of oscillations and wave motion, including sound waves, diffraction and the wave behaviour of light, leading to an introduction to geometrical and physical optics and the operation of some optical instruments. The unit then moves on to look at some of the theories of modern physics that influence the way that we view the natural world, and the fundamental laws that govern it. An introduction is given to molecular kinetic theory and the important universal laws of thermodynamics, the latter valid for everything from the boiling of a kettle to exploding black holes. Einstein's theory of special relativity and its counter-intuitive views on space and time, the uncertain world of quantum physics, and what the latter tells us about the structure of atoms and nuclei, conclude the unit. Regular guided laboratory work enables students to investigate the phenomena discussed in the lectures, using modern techniques in a well-equipped laboratory.

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:

- Have an understanding of the general properties of mechanical waves and be able to solve, using maths, problems involving mechanical waves.
- Have an understanding of the nature and physical properties of light (as a wave).
- Have an understanding of the basic principles of physical optics (lenses and mirrors) and be able to apply the thin lens approximation to model simple optical systems.
- Have an understand of the physics of wave interference and be able to describe it using mathematical language. Be able to solve wave interference problems involving thin films and multi-layers.
- Have an understanding of the physics of wave diffraction and, using suitable approximations, be able to describe it mathematically.
- Have an understanding of the physics concepts of temperature, heat and the thermal properties of matter , including thermal expansion and heat capacities.
- Have an understanding of the first law of thermodynamics and the concept of an ideal gas
- Be able to perform physical measurements with an understanding of the statistical nature of measurement uncertainties involved.
- Be able to record experimental results, analysis and conclusions in a clear, concise and systematic manner.
- Have an understanding of the wave/particle properties of photons, electrons and matter in general
- Have an understanding of the electronic structure of the atom
- Have an understanding of the key nuclear concepts such as the structure of the nucleus, isotopes, nuclear binding energy and its connection to nuclear forces and nuclear stability and radioactive decay, fission and fusion.

Assessment Tasks

Name	Weighting	Due
Laboratory work	20%	See lab timetable

Name	Weighting	Due
Tutorial quizes	20%	Tutorial time
Mid session exam	15%	28/4/2014
Final Examination	45%	University Examination Period

Laboratory work

Due: **See lab timetable**
Weighting: **20%**

On successful completion you will be able to:

- Have an understanding of the general properties of mechanical waves and be able to solve, using maths, problems involving mechanical waves.
- Have an understanding of the nature and physical properties of light (as a wave).
- Have an understanding of the basic principles of physical optics (lenses and mirrors) and be able to apply the thin lens approximation to model simple optical systems.
- Have an understand of the physics of wave interference and be able to describe it using mathematical language. Be able to solve wave interference problems involving thin films and multi-layers.
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- Be able to record experimental results, analysis and conclusions in a clear, concise and systematic manner.
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- Have an understanding of the key nuclear concepts such as the structure of the nucleus, isotopes, nuclear binding energy and its connection to nuclear forces and nuclear stability and radioactive decay, fission and fusion.

Tutorial quizes

Due: **Tutorial time**

Weighting: **20%**

At the start of each tutorial you will be given a closed-book quiz based on one question from a set provided in class the previous week. This quiz question will be marked by your tutor and your best 10 quiz results will contribute a total of 20% to your final grade.

On successful completion you will be able to:

- Have an understanding of the general properties of mechanical waves and be able to solve, using maths, problems involving mechanical waves.
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Mid session exam

Due: **28/4/2014**
Weighting: **15%**

A mid-session exam will be held in the first lecture time of week 7. This exam will cover a portion of the week 1-6 content.

On successful completion you will be able to:

- Have an understanding of the general properties of mechanical waves and be able to solve, using maths, problems involving mechanical waves.
- Have an understanding of the nature and physical properties of light (as a wave).

- Have an understanding of the basic principles of physical optics (lenses and mirrors) and be able to apply the thin lens approximation to model simple optical systems.
- Have an understand of the physics of wave interference and be able to describe it using mathematical language. Be able to solve wave interference problems involving thin films and multi-layers.
- Have an understanding of the physics of wave diffraction and, using suitable approximations, be able to describe it mathematically.

Final Examination

Due: **University Examination Period**
Weighting: **45%**

The final examination will be three hours long and will cover content from the entire unit, with a bias toward week 7-13 content. A data page listing relevant physical constants and core formulae will be provided. All questions in the exam will be compulsory i.e. there will be no choice between questions. A non-alphanumeric scientific calculator is required for the final exam.

Copies of past exam papers are available on the e-reserve area of the library web site.

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- Have an understanding of the first law of thermodynamics and the concept of an ideal gas
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isotopes, nuclear binding energy and its connection to nuclear forces and nuclear stability and radioactive decay, fission and fusion.

Delivery and Resources

Classes

Lectures (attend all):

Lecture 1:Monday 1 pm E7B.T1

Lecture 2:Tuesday 11 am E7B.T1

Lecture 3:Wednesday 9 am W5A.T3

Tutorial (register for one and attend this only (compulsory)):

Tuesday 9 am E8A.386

Tuesday 9 am E5A.150

Tuesday 10 am E7B.263

Tuesday 10 am E5A.150

Tuesday 4 pm E8A.341

Tuesday 5 pm E8A.341

Wednesday 1 pm E5A.180

Wednesday 1 pm E5A.150

Laboratory (register for one and attend this only (compulsory)):

Monday 9 am E7B.114

Monday 2 pm E7B.114

Tuesday 2 pm E7B.114

Wednesday 10 am E7B.114

Wednesday 2 pm E7B.114

NB One hour Laboratory introduction sessions will occur in week 1. Full laboratories and tutorials will commence in week 2 of the session.

Required and Recommended Texts and/or Materials

<u>Required Text</u>

Fundamentals of Physics, by Halliday, Resnick, and Walker, extended 10th edition (with Wiley Plus). A used copy is fine, as is the 9th, 8th or 7th edition if you accept that number references to tutorial and assignment questions will require conversion. An electronic version of the textbook is available from the publisher- check their web site (www.wileydirect.com.au) if you are interested.

Required Resources

A copy of the PHYS143 Laboratory Manual should be purchased from the Coop notes bookshop before the laboratory sessions begin.

Technology Used and Required

Unit Web Page

PHYS143 has two web pages associated with it: The primary one is the iLearn page and all class anouncements will be made through this. The textbook publisher provides a useful webpage, with an electronic copy of the text (for students that purchase the textbook) and many practice problems etc.

Please check the iLearn page regularly for material available for downloading.

Teaching and Learning Strategy

This unit is taught through lectures and tutorials and through undertaking laboratory experiments. We strongly encourage students to attend lectures because they provide a much more interactive and effective learning experience than studying 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, lecturers and your tutor.

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.

There are no assignments for PHYS143, instead the lecturer will provide a set of approximately 6 assigned problems for you to work on each week. Outside of the lecture times, you should aim to spend an average of 3 hours per week understanding the lecture material and working on these assigned problems. At the start of each (compulsory) tutorial session you will complete a quiz based closely on one of the assigned questions from the previous week. This quiz will be marked by your tutor and this will contribute to your tutorial mark for the unit. You are free to discuss the assigned problems with your classmates as this is a good way to learn and understand the concepts involved. 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.

There will be a mid-session exam in the first lecture time after the mid-session break. The exam will be 50 minutes long and will cover a portion of the content from weeks 1-6.

Unit Schedule

Schedule of Topics

The unit is divided into two halves. The first half, taught by Professor Mark Wardle covers the physics of waves and the second, taught by Dr James Downes, covers thermodynamics and modern physics.

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.

Topic (Lecturer)	Chapters (H R W extd 10th edn)
WAVES (Mark Wardle) • Mechanical waves • Sound & hearing	• 16.1 to 16.7 • 17.1 to 17.3, 17.6 to 17.7
LIGHT (Mark Wardle) • The nature & propagation of light • Geometrical optics and optical instruments • Interference • Diffraction	• 33.1 to 33.2, 33.4 to 33.7 • 34.1 to 34.6 • 35.1 to 35.5 • 36.1 to 36.2, 36.4
HEAT & THERMODYNAMICS (James Downes) • Temperature, heat, thermal properties of matter, heat capacities • First law of thermodynamics, heat capacities of ideal gas	• 18.1,18.3 to 18.6 • 19.1 to 19.8
RELATIVITY (James Downes)	• 37.1 to 37.4, 37.6
ATOMIC & QUANTUM PHYSICS (James Downes) • Photons, electrons and atoms, the wave nature of particles	• 38.1 to 38.7, 38.8, 39.5
NUCLEAR PHYSICS (James Downes)	• 42.1 to 42.6, 43.1, 43.2, 43.4, 43.5

Learning and Teaching Activities

Lectures

There will be three 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 compulsory tutorial per week, starting week 2. At the start of this tutorial students will answer an assignment-style question based on the previous week's work. The rest of the time students will work through problems related to the previous week's lecture content with the help of their tutor.

Laboratory

Three hour laboratory classes will be held in 8 weeks of the semester. During these students will engage in practical exercises to further their understanding of the physics concepts discussed in lectures and to develop their skills at measurement, analysis and verification of physical models.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/

Requirements in order to complete the unit satisfactorily

Satisfactory performance in all assessment components of this unit is a requirement of a passing grade independent of your numerical mark.

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

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

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

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:

Assessment task

- Laboratory work

Learning and teaching activity

- There will be three 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 compulsory tutorial per week, starting week 2. At the start of this tutorial students will answer an assignment-style question based on the previous week's

work. The rest of the time students will work through problems related to the previous week's lecture content with the help of their tutor.

- Three hour laboratory classes will be held in 8 weeks of the semester. During these students will engage in practical exercises to further their understanding of the physics concepts discussed in lectures and to develop their skills at measurement, analysis and verification of physical models.

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

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in general
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- Have an understanding of the key nuclear concepts such as the structure of the nucleus, isotopes, nuclear binding energy and its connection to nuclear forces and nuclear stability and radioactive decay, fission and fusion.

Assessment tasks

- Laboratory work
- Tutorial quizes
- Mid session exam
- Final Examination

Learning and teaching activities

- There will be three 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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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

- Be able to perform physical measurements with an understanding of the statistical nature of measurement uncertainties involved.
- Be able to record experimental results, analysis and conclusions in a clear, concise and systematic manner.

Learning and teaching activities

- There will be three 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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work. The rest of the time students will work through problems related to the previous week's lecture content with the help of their tutor.
- Three hour laboratory classes will be held in 8 weeks of the semester. During these students will engage in practical exercises to further their understanding of the physics concepts discussed in lectures and to develop their skills at measurement, analysis and verification of physical models.

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.

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Learning outcomes

- Have an understanding of the general properties of mechanical waves and be able to solve, using maths, problems involving mechanical waves.
- Have an understanding of the nature and physical properties of light (as a wave).
- Have an understanding of the basic principles of physical optics (lenses and mirrors) and be able to apply the thin lens approximation to model simple optical systems.
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Assessment tasks

- Laboratory work
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Learning and teaching activities

- There will be three 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 compulsory tutorial per week, starting week 2. At the start of this tutorial students will answer an assignment-style question based on the previous week's work. The rest of the time students will work through problems related to the previous week's lecture content with the help of their tutor.
- Three hour laboratory classes will be held in 8 weeks of the semester. During these students will engage in practical exercises to further their understanding of the physics concepts discussed in lectures and to develop their skills at measurement, analysis and verification of physical models.

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 with an understanding of the statistical nature of measurement uncertainties involved.
- Be able to record experimental results, analysis and conclusions in a clear, concise and systematic manner.

Assessment tasks

- Laboratory work
- Tutorial quizes
- Mid session exam
- Final Examination

Learning and teaching activities

- There will be one compulsory tutorial per week, starting week 2. At the start of this tutorial students will answer an assignment-style question based on the previous week's work. The rest of the time students will work through problems related to the previous week's lecture content with the help of their tutor.
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students will engage in practical exercises to further their understanding of the physics concepts discussed in lectures and to develop their skills at measurement, analysis and verification of physical models.

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 voice their 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 can communicate with you outside of lectures. Please check your students email accounts once a day for messages concerning the unit.

Peter Mason Prize

Peter Mason was a foundation Professor of Physics at Macquarie University. He was a prominent author, ABC science communicator, and respected commentator on science, technology and society. He gave the first lecture at Macquarie University!

The Peter Mason Prize is awarded each year, in accordance with his family’s wishes, to the best performing student in PHYS143.

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.

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 introduce you to some techniques of measurement.

This work is designed to be carried out independently of the lectures, although some of these topics will be discussed in lectures. By providing you with instructional material in the form of the Laboratory Notes manual, together with help from the laboratory demonstrators, the laboratory work has been designed to be tackled independently of the lecture material. 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! All the information you need for each experiment is contained in the Laboratory Manual. There is no need to spend a long time outside the laboratory hours in preparation, however a quick read through the lab notes beforehand will allow you to make better use of your time in the laboratory

Location of the 100-level Physics Laboratory

The laboratory is located on the ground floor of building E7B, at the NE corner (room 114). Entry is from the courtyard at the opposite end to the main staircase.

What to Bring

You will need to bring a copy of the Physics IB Laboratory Notes, which are available from the Coop Bookshop.

You are also required to buy and use a standard science notebook (with ruled and graph pages, not spiral bound). ALL YOUR WORK MUST BE RECORDED DIRECTLY INTO YOUR LABORATORY NOTEBOOK. Loose sheets of paper must not be used. If you feel that your notes are incomprehensible or untidy you may rewrite a more legible report in the same book and simply cross out the original notes.

Both these items should be brought with you to the first lab session.

Laboratory Attendance Requirements

You are required to attend all rostered laboratory sessions. If you miss more than one session without a written explanation then you will not be considered to have satisfactorily completed the laboratory component of the unit. 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 request for special consideration you can start this process at 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.

How to use your Laboratory Notebook

More details are on page ii of the Laboratory Notes manual.

Your notebook should show your collected data and the calculations and graphs resulting from the data. At the end of each section summarise your findings and answer any questions posed in the guiding notes.

At the completion of each laboratory session you must show your book to the laboratory supervisor who will check it and collect for marking. The marker (one of the laboratory demonstrators) will be checking your book to see whether you have kept a satisfactory record of what you have done and what you have concluded. Your marked notebook will be available at the start of your next scheduled laboratory. Be sure to check you book for comments from the marker as this will help you refine you laboratory technique (and increase your laboratory mark). Your notebook will be kept in the laboratory, and must not be removed from the laboratory at any time; this includes any previously filled notebook.

Laboratory Assessment

Details of the laboratory assessment will be outlined in the first session.

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

Introduction laboratories start in the first week of semester. The schedule of labs is posted in the lab and on the PHYS143 iLearn page. Please attend your nominated laboratory session.