PHYS3010

Advanced Electromagnetism and Optics

Session 1, Special circumstances, North Ryde 2021

Department of Physics and Astronomy

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Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group activities on campus, and most will keep an online version available to those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

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Credit points
10

Prerequisites
(PHYS201 or PHYS2010) and (PHYS202 or PHYS2020) and (MATH235 or MATH2010) and (MATH236 or MATH232 or MATH2020 or MATH2110)

Corequisites

Co-badged status

Unit description
This course continues our development of the classical theory of electromagnetism, the first example of a unified theory in physics and the origin of the concept of fields. We apply Maxwell's equations to derive a full dynamical description of electromagnetism in free space with an emphasis on the generation and propagation of electromagnetic waves. We use the concepts of interference and diffraction to determine how light propagates through and interacts with optical systems. Interference underpins practical devices such as the Fabry-Perot interferometer or multilayer dielectric filters while diffraction is critical for analysing beam propagation and image formation. Modern optical techniques are studied in the regular laboratory program that also reinforces the use of advanced data analysis and report writing techniques and thus provides a strong foundation for future research project work.

Important Academic Dates

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

Learning Outcomes

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

ULO1: derive and apply mathematical formalisms to explain fundamental concepts and phenomena in electromagnetism.

ULO2: explain how the underlying theory of electromagnetism is linked to everyday phenomena, as well as scientific and engineering applications.

ULO3: apply theoretical concepts underpinning central topics in optics to experimental scenarios.

ULO4: carry out multi-part experimental investigations of physical phenomena using complex control and measurement equipment, recording your results accurately in a lab book.

ULO5: compare experimental and theoretical results, and compile your findings in professional reports.

General Assessment Information

Assignments

As for all physics units, problem solving is an essential aid to understanding the physical concepts involved and the mathematical tools that must be used. Regular assignments will be set and the problems marked and returned within two weeks. There will be four assignments overall: two assignments in the first half of the course on electromagnetism, and two assignments in the second half of the course on optics. Informal group discussion regarding the assignment problems is encouraged, but students should present their own solutions and should explicitly acknowledge those they have worked with on the assignment. You should also note that the examination in general contains material related to the assignment work.

3000-level students should not need to be reminded that working on problems is an essential part of any physics course. It is only by attempting problems that an understanding of new (and sometimes strange) concepts is obtained. Do not hesitate to seek help if you are having difficulties with the assignment problems.

Extension Requests: Given the importance we place on assignments as a key aid to learning we expect assignments to be submitted on time. In turn, we undertake to return your assignments (provided they were submitted on time), marked and with feedback within two weeks of their due date. This will allow us to provide you feedback in time to aid your ongoing learning through the course. Extensions will only be considered if requested with valid reasons **prior to the due date**.

Perusall

This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks).

You will be required to do preclass readings on the online platform 'Perusall' . We will set readings due at the start of weeks 2 to 11, with 1% allocated for reading and making comments on that week's text. To pass the hurdle requirement, you must comment on at least 6 weeks of reading material. A guide to using Perusall will be provided in week 1.

Laboratory work

This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

During the session, you are required to carry out four experiments. The first two labs will take three weeks, and the second two will take two weeks. Labs start in Week 1!

You will submit one draft report, and two final reports according to the lab timetable provided on iLearn. These dates are not negotiable except in cases of serious illness or misadventure. A late penalty may otherwise be imposed. The two final reports are **each** worth 10% of the unit total.

Your draft report is not formally assessed, but will be carefully reviewed and returned to you with corrections and feedback to enable you to produce a improved final report to resubmit for grading. This submission of a first draft is a necessary part of acquiring the skills for constructing a professional scientific report. No draft of the second report is required, but you can of course ask for informal feedback.

Logbooks with the record of experimental data are to be kept, and will be retained at the end of the session. Your records of the two experiments that you did not write full reports for will be assessed, **each** of the two worth 5% of the unit total. Logbooks will be assessed for readability, layout, completeness and clarity. While not a formal report, a full record of the experiment in your logbook must include relevant calculations and graphs for each experiment. Raw results with no analysis are not acceptable.

The two formal reports (20%) and the two lab book records (10%) make a total of 30% for the laboratory assessment.

Satisfactory completion of the laboratory assessment is a hurdle task. You must achieve at least 40% in each of the four assessed tasks to pass the unit. If you fail to reach this mark, you must arrange to retake that assessment item, after discussion with the marker.

End-of-session examination

This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

There will be a 3 hour end-of-session final exam to be held in the University Examination Period.

You should have a scientific calculator for use during the final examination. Note that calculators with text retrieval are not permitted for the final examination.

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. 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.

Assessment Tasks

Name	Weighting	Hurdle	Due
Pre-class reading	10%	Yes	Weekly, weeks 2 to 11
Final examination	40%	Yes	Examination period
Lab reports	20%	Yes	See iLearn schedule
Assignments	20%	No	Monday Wk 5, 8, 11, 13
Lab record	10%	Yes	see iLearn schedule

Pre-class reading

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 24 hours
Due: **Weekly, weeks 2 to 11**
Weighting: **10%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Engagement with assigned pre-class reading.

On successful completion you will be able to:

- derive and apply mathematical formalisms to explain fundamental concepts and phenomena in electromagnetism.
- explain how the underlying theory of electromagnetism is linked to everyday phenomena, as well as scientific and engineering applications.
- apply theoretical concepts underpinning central topics in optics to experimental scenarios.

Final examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Examination period**
Weighting: **40%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Examination in the university exam period covering all content from the unit.

On successful completion you will be able to:

- derive and apply mathematical formalisms to explain fundamental concepts and phenomena in electromagnetism.
- explain how the underlying theory of electromagnetism is linked to everyday phenomena, as well as scientific and engineering applications.
- apply theoretical concepts underpinning central topics in optics to experimental scenarios.

Lab reports

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 12 hours
Due: **See iLearn schedule**
Weighting: **20%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Formal reports for two experimental investigations.

On successful completion you will be able to:

- carry out multi-part experimental investigations of physical phenomena using complex control and measurement equipment, recording your results accurately in a lab book.
- compare experimental and theoretical results, and compile your findings in professional reports.

Assignments

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 20 hours
Due: **Monday Wk 5, 8, 11, 13**
Weighting: **20%**

A series of problem-solving assignments throughout the session.

On successful completion you will be able to:

- derive and apply mathematical formalisms to explain fundamental concepts and phenomena in electromagnetism.
- explain how the underlying theory of electromagnetism is linked to everyday phenomena, as well as scientific and engineering applications.
- apply theoretical concepts underpinning central topics in optics to experimental scenarios.

Lab record

Assessment Type [1]: Lab book
Indicative Time on Task [2]: 0 hours
Due: **see iLearn schedule**
Weighting: **10%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Assessment of your in-lab record for two experimental investigations.

On successful completion you will be able to:

- carry out multi-part experimental investigations of physical phenomena using complex control and measurement equipment, recording your results accurately in a lab book.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Learning Skills Unit for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Classes

There are two online lectures per week, and one on-campus SGTA.

The timetable for classes can be found on the University web site at: https://timetables.mq.edu.au/2021/

Labs are on-campus.Schedule for labs with be on iLearn

Required and Recommended Texts and/or Materials

Required Text

Electromagnetism: Introduction to Electrodynamics, DJ Griffiths, 3rd or 4th edition (Prentice Hall, Englewood Cliffs, N J). Sections of this text will be made available on Perusall.

Recommended Readings

The Feynman Lectures on Physics, Vol II, Addison Wesley

Technology Used and Required

Unit Web Page

This unit will be administered through iLearn. Please check this site regularly for lecture and extension material available for downloading and look out for announcements. We will run one or more discussion fora through the iLearn page for both technical physics and administrative issues. Staff will ignore emails and discussion questions about issues which are already explained in this document or which have been covered in the announcements and discussion features of the iLearn page.

Teaching and Learning Strategy

The theoretical aspects of this unit are taught in lectures and tutorials with fortnightly assignments to strengthen the understanding of the material. The theoretical material is heavily mathematical in nature, and often abstract, and true understanding can only be achieved through testing and refining understanding through problem solving.

The experimental aspects of the unit require students to attend laboratories where they will be expected to set up experiments, take data, analyse the data within the context of the physical phenomena that are being studied, maintain a laboratory log-book, and report on their findings in clearly written laboratory reports.

Schedule of topics

· Review of Maxwell's Equations of electro and magneto statics in vacuum

· Electrodynamics in vacuum

· Dipole radiation, plane wave solutions

· Properties of electromagnetic waves in homogenous regions and at interfaces between different materials

· Gaussian beams

· Descriptions of polarisation states and control

· Interference

· Fabry-Perot interferometer

· Fourier theory

· Fourier optics

· Fraunhofer (far-field) diffraction

· Fresnel (near-field) diffraction

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.e

du.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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 Enquiry Service

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

Equity 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.

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 from Previous Offering

The unit content has changed this session: relativity is removed from the second half, and replaced with optics.