PHYS3010

Advanced Electromagnetism and Optics

Session 1, In person-scheduled-weekday, North Ryde 2023

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
Convener, lecturer, tutor, lab demonstrator
Alex Fuerbach
alex.fuerbach@mq.edu.au
Room 417, 12WW
By appointment

Lab manager
Gina Dunford
regina.dunford@mq.edu.au

Credit points
10

Prerequisites
(PHYS201 or PHYS2010) and (PHYS202 or PHYS2020) and (MATH235 or MATH2010 or MATH2055) 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://www.mq.edu.au/study/calendar-of-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.

Late submission will be permitted in line with the FSE policy below.

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.

Late submission will be permitted in line with the FSE policy below.

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, each taking two weeks.

You will two full reports according to the lab timetable provided on iLearn. The first report is worth 7% of the unit total, and the second worth 13%.

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, the 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.

Late submission will be permitted in line with the FSE policy below.

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.

General Faculty Policy on assessment submission deadlines and late submissions:

Online quizzes, in-class activities, scheduled tests and exams must be undertaken at the time indicated in the unit guide. Should these activities be missed due to illness or misadventure, students may apply for Special Consideration.

All other assessments must be submitted by 5:00 pm on their due date.

Should these assessments be missed due to illness or misadventure, students should apply for Special Consideration.

Assessments not submitted by the due date will receive a mark of zero unless late submissions are specifically allowed as indicated in the unit guide or on iLearn.

If late submissions are permitted as indicated in the unit guide or on iLearn a consistent penalty will be applied for late submissions as follows:

A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark: 12 to 24 hours late = 10% deduction; for each day thereafter, an additional 10% per day or part thereof will be applied until five days beyond the due date. After this time, a mark of zero (0) will be given. For example, an assessment worth 20% is due 5 pm on 1 January. Student A submits the assessment at 1 pm, 3 January. The assessment received a mark of 15/20. A 20% deduction is then applied to the mark of 15, resulting in the loss of three (3) marks. Student A is then awarded a final mark of 12/20.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignments	20%	No	Weeks 4, 7, 10 and 13
Final examination	40%	Yes	Formal Examination period
Lab reports	20%	Yes	As per lab schedule
Pre-class reading	10%	Yes	Weeks 2 - 11
Lab record	10%	Yes	As per lab schedule

Assignments

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 20 hours
Due: **Weeks 4, 7, 10 and 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.

Final examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **Formal 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: **As per lab 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.

Pre-class reading

Assessment Type [1]: Participatory task
Indicative Time on Task [2]: 24 hours
Due: **Weeks 2 - 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.

Lab record

Assessment Type [1]: Lab book
Indicative Time on Task [2]: 0 hours
Due: **As per lab 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.

---

[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 Writing Centre 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

All classes are on campus. There is a two hour lecture each week and a one hour SGTA. **Both sessions will be mixed use, comprising lectures, worked examples, and active problem solving with your peers.** We will make a best effort to record the lecture components of both sessions, but in-person attendance will be far superior.

The timetable for classes can be found on the University web site at: https://timetables.mq.edu.au/2023/

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 SGTAs with periodic 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

· Diffraction

- Laser rate equations

- Nonlinear optics

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
- Assessment Procedure

- Complaints Resolution 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.edu.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

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

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

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the 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

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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

We will use both weekly classes in a mixed mode, attempting to reduce the reliance on lectured content and allowing more time for active learning.