



PHYS3010

Classical Electrodynamics

Session 1, Weekday attendance, North Ryde 2020

Department of Physics and Astronomy

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General Information

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Credit points

10

Prerequisites

(PHYS201 or PHYS2010) and (PHYS202 or PHYS2020) and (MATH235 or MATH2010)

Corequisites

Co-badged status

Unit description

This course extends 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 build on the differential Maxwell equations introduced in PHYS2020 and its focus on statics to formulate the full dynamical description of electromagnetism in free space and in materials. The techniques developed in this unit provide tools for solving practical problems in power generation and transmission, circuits, radiation and optics, and is essential training for more advanced courses in physics. Topics include electromagnetic waves in vacuum and lossy dielectrics; energy and momentum in electromagnetism; the potential formulation of Maxwell's equations and gauge transformations; phase and group velocities and dispersion; complex field representations and Fourier transforms; causality and Kramers-Kronig relations; special relativity, Lorentz transformations, and the Lorentz invariance of the Maxwell equations. An advanced laboratory program provides the opportunity for students to develop skills in self-directed experimental physics using a wide variety of measurement techniques and equipment.

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: derive the foundational equations in special relativity from postulates, and discuss and numerically analyse simple relativistic problems.

ULO4: carry out multi-part experimental investigations of physical phenomena, using complex control and measurement equipment, while keeping a contemporary labbook record.

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

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

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 electromagnetism and special relativity. 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**.

If for any reason a student is unable to submit an assignment by the due date, the student should contact the relevant staff member as soon as possible, explain the situation, and request an extension. If such contact is not made, then the student will be penalised 20% for each working day that the assignment is late (i.e. an assignment due on a Friday and handed in on a Monday is penalised as if it is one day late). As complete solutions for an assignment are usually handed out to the class a week after the assignment is due, an extension beyond a week is generally not possible, and in any case would receive a grade of zero.

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)

Labs start in the second week of term. During the session, you are required to carry out four experiments, each taking no more than two weeks to complete.

You will submit one draft report, and two final reports according to the lab timetable (see 'Unit Schedule' in this Guide). 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 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.

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

Mixed Lecture and Tutorial/discussion

The timetable for classes can be found on the University web site at: <https://timetables.mq.edu.au/2020/>

Laboratories will commence in the second week of semester.

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

Electro and magneto-statics in media

Electrodynamics in vacuum

Properties of electromagnetic waves

Electromagnetic waves in matter

Propagation and dispersion

Dipole radiation

Introduction to special relativity

The structure of space-time

Relativistic Kinematics

Relativistic Dynamics

Electromagnetism and relativity

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

Assignments

There will be four assignments. Dates available and due dates will be given during the course.

Laboratory Schedule

You are required to carry out four different experiments and each should take not more than two weeks to complete. You will be submitting two full lab reports and two experiments will be assessed based on your log book. Due dates are shown below. These dates are not negotiable except in cases of serious illness or misadventure. A late penalty may otherwise be imposed.

Regular labs run from week 2 to week 11. There are no labs scheduled in weeks 4 and 7; you should use this time wisely to work on your reports.

Week 1: No lab

Week 2: Experiment 1

Week 3: Experiment 1

Week 4: Free week to write draft report for Experiment 1, due **Monday of week 5**.

Week 5: Experiment 2

Week 6: Experiment 2

Week 7: Free week to work on your reports.

Mid-session break

Week 8: Experiment 3. Final report for experiment 1 **due Monday of week 8**.

Week 9: Experiment 3

Week 10: Experiment 4.

Week 11: Experiment 4. Final report for experiment 2 or 3 **due Monday of week 11.**

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) (<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) (<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) (<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 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 from Previous Offering

Perusall will be used for the first time in this unit to encourage engagement with the text bok.