PHYS2020

Electromagnetism and Relativity

Session 2, In person-scheduled-weekday, North Ryde 2024

School of Mathematical and Physical Sciences

Contents

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General Information

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Credit points
10

Prerequisites
(PHYS201 or PHYS2010) and (MATH235 or MATH2010 or MATH2055)

Corequisites
MATH236 or MATH232 or MATH2020 or MATH2110

Co-badged status

Unit description
The first half of the unit introduces the principles, theory and application of classical electromagnetism, which describes the properties and behaviour of electric and magnetic fields and their interaction with charged matter. Maxwell's four laws of electromagnetism are revisited, in the powerful language of vector calculus. We apply these laws to understand a range of phenomena in electrostatics, magnetostatics and electrodynamics. In the second half of the unit, we introduce the postulates of special relativity and explore their implications for the nature of spacetime. We determine how to refine Newtonian mechanics to be correct in the relativistic limit and show the deep connection between the geometry of spacetime and electromagnetism. Advanced techniques of experimental physics including indirect measurement of microscopic quantities are covered in guided laboratory sessions, as are data analysis techniques and report writing.

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: use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.

ULO2: apply differential and integral calculus to scalar and vector fields in cartesian, spherical, and cylindrical coordinates.

ULO3: solve electromagnetism problems involving constant as well as time dependent electric and magnetic fields.

ULO4: understand the origin of the transformation laws in special relativity from Einstein’s postulates, and discuss and numerically analyse simple relativistic problems.

ULO5: safely use experimental equipment to perform specified measurements, and analyse and interpret the results in the context of discipline knowledge.

General Assessment Information

Hurdle requirements This unit has hurdle requirements, specifying a minimum standard that must be attained in the final exam and laboratory assessments as well as a requirement that you sit a minimum number of the SGTA quizzes. To pass this unit you must obtain a mark of at least:

- 50% in the unit overall, as well as

- 40% in the final examination, and

- 40% in each individual laboratory activity.

In addition, you must also submit a minimum of 8 of the 12 SGTA (Small Group Teaching Activity quizzes.

Final Exam Important information regarding the final exam:

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 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 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.

Laboratory assessments: if your mark on an assessment task is less than the 40% hurdle requirement, you will be offered an opportunity to repeat and resubmit the task.

SGTA quizzes: Quizzes will be held during the SGTA sessions in Weeks 2-13, covering the previous week's lecture material. There is a hurdle requirement that you sit at least 8 of the 12 quizzes; your best 8 scores will be used to compute the quiz component of your final grade. This requirement aims to engage you with each week's lecture material so that you do not get left behind.

Penalties for late assessments.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at **11:55 pm**. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions for Lab reports will be accepted, with the Standard Late Penalty applied.

Assessment Tasks

Name	Weighting	Hurdle	Due
Readings and peer-discussions	15%	No	Weekly
Regular quizzes	25%	Yes	Weekly
Lab reports	20%	Yes	See iLearn
Final exam	40%	Yes	Examination period

Readings and peer-discussions

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 18 hours
Due: **Weekly**
Weighting: **15%**

Preclass reading, annotation, and peer discussion using the Perusall tool

On successful completion you will be able to:

- use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.
- apply differential and integral calculus to scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- solve electromagnetism problems involving constant as well as time dependent electric and magnetic fields.
- understand the origin of the transformation laws in special relativity from Einstein's postulates, and discuss and numerically analyse simple relativistic problems.

Regular quizzes

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 0 hours
Due: **Weekly**
Weighting: **25%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Short- and long-form problem solving questions, taken in SGTA sessions

On successful completion you will be able to:

- use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.
- apply differential and integral calculus to scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- solve electromagnetism problems involving constant as well as time dependent electric and magnetic fields.
- understand the origin of the transformation laws in special relativity from Einstein's postulates, and discuss and numerically analyse simple relativistic problems.

Lab reports

Assessment Type [1]: Lab report
Indicative Time on Task [2]: 24 hours
Due: **See iLearn**
Weighting: **20%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Laboratory-related tasks, analysis, and reporting

On successful completion you will be able to:

- safely use experimental equipment to perform specified measurements, and analyse and interpret the results in the context of discipline knowledge.

Final exam

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)

Final exam in the University Examination period.

On successful completion you will be able to:

- use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.
- apply differential and integral calculus to scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- solve electromagnetism problems involving constant as well as time dependent electric and magnetic fields.
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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 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

All activities -- lectures, SGTAs, and laboratories will be delivered in-person, on campus.

The unit will use the Perusall website, which allows us to set prereading tasks. Check iLearn in week 1 to connect to the unit's Perusall page, and start work on your first reading due in week 2. Lectures will add depth and detail to the prereading, and SGTAs will be used for active-learning problem solving with your peers.

The laboratory program will continue to develop your practical skills, python, teamwork, and writing.

The main text for the unit is Griffiths, "Introduction to Electrodynamics".

Unit Schedule

The first half of this unit is electromagnetism, and the second half is special relativity.

Lectures and SGTAs start in week 1, and labs start in week 2.

Full details of the lab program will be provided in iLearn. Please check in week 1 for details of any preparation required for your week 2 lab session.

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 connect.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 the Service Connect Portal, 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.

Unit information based on version 2024.02 of the Handbook