PHYS106

Electric and Magnetic Interactions

S2 Day 2019

Dept of Physics and Astronomy

Contents

General Information

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Credit points 3
Prerequisites PHYS107
Corequisites MATH132 or MATH135

Co-badged status
Unit description This unit, following on from PHYS107, provides an overview of physics both for students primarily intending to study physics and astronomy beyond first year, and for engineering students who wish to explore physics at a greater depth. As well as broadening their experience in classical Newtonian physics of matter and waves, and Maxwell's theory of electromagnetism, students are introduced to the main theories underlying modern physics: quantum mechanics, thermal physics, and Einstein's theory of relativity, with an emphasis on understanding the interrelationship between these fundamental ideas. PHYS106 deals with electromagnetism, circuit theory, waves and diffraction, and the effects of special relativity. Fundamentals of experimental method and data analysis are taught in well-equipped laboratories using examples which support and complement the lecture course.

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:

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- Understand and be able to describe the distinction between electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
- Demonstrate the understanding and use of key vector concepts including dot products, vector products, surface integrals over simple surfaces and electric and magnetic flux.
- Use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
- Understand and be able to mathematically interpret the basic properties of waves and show an understanding of the concept of wave-particle duality.
- Investigate real-world problems and interpret how numerical data and predictions relate to the physical world.

General Assessment Information

This unit has hurdle requirements, specifying a minimum standard that must be attained in aspects of the unit. 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

- 40% in each of the laboratory activities

- a nonzero mark in at least 10 of the 13 tutorial quizzes

Assessment Tasks

Name	Weighting	Hurdle	Due
Lab work	30%	Yes	Throughout the session
Final exam	40%	Yes	Exam period
Tutorials	30%	Yes	Week 1 - Week 13

Lab work

Due: **Throughout the session**
Weighting: **30%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Satisfactory completion of laboratories is a **hurdle requirement.** You **must** attend **all ten** laboratory sessions. The **first lab session is in week 1** and includes work health and safety information. Students may also be assigned to lab groups and computer access will be checked. It needs to be attended by all students regardless of whether this is their first Physics unit or not. It will be a little bit shorter than the other sessions, but attendance is absolutely mandatory – you can't do subsequent lab sessions if they don't attend the introductory one. The **next 9 lab sessions** involve experimental work and will be assessed. **You must obtain a mark of at least 40% for each of the laboratory sessions in order to pass the unit.**

Preparation is required for each of the lab sessions 2-10. You will find the **Prelab activities** in the Laboratory Resources section of iLearn. Your prelab work will account for some of the marks for each laboratory session.

If you miss a session or fail to achieve at least 40% for any lab session, you must complete a **"Request to schedule a Catch-up laboratory session"** form, which can be found on iLearn. Read the sections below for full details about catch up classes and when they are scheduled. **No more than 3 catch ups are allowed for missed labs/lab hurdles**, except where Special Consideration has been approved. If you fail to attend a catch-up class, then that will count as another missed lab.

Laboratory catch-up classes will be held during the mid-semester break and in week 12. The dates and times of the catch up classes will be available on the "Request a catch up lab" form

On successful completion you will be able to:

- Investigate real-world problems and interpret how numerical data and predictions relate to the physical world.

Final exam

Due: **Exam period**
Weighting: **40%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The final exam will be in the normal exam period, and will cover material from the entire course.

You are expected to present yourself for the final examination at the time and place designated in the University examination timetable (http://www.timetables.mq.edu.au/exam/). The timetable will be available in draft form approximately eight weeks before the commencement of examinations and in final form approximately four weeks before the commencement of examinations.

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 after results are released. Please see FSE101 in iLearn for dates. 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. Second chance exams for hurdle assessments will also be scheduled in this period.

On successful completion you will be able to:

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- Demonstrate the understanding and use of key vector concepts including dot products, vector products, surface integrals over simple surfaces and electric and magnetic flux.
- Use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.

- Understand and be able to mathematically interpret the basic properties of waves and show an understanding of the concept of wave-particle duality.

Tutorials

Due: **Week 1 - Week 13**
Weighting: **30%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Tutorials start in Week 1, and are 1 hour 50 minutes long each week. Tutorial attendance and engagement is compulsory.

Each week, through the online iLearn system, a number of problems will be set to be worked through in the tutorials. You are **strongly** encouraged to study the physics from the previous lectures, including study of the appropriate sections of the textbook, and to try the set problems before each tutorial, so that you can follow through the exposition by the tutor and contribute to problem solving discussions and write-up.

In addition to working on these problems, you will take a quiz, normally of 10-15 minutes long. There will be a quiz every week; all 13 quizzes will be graded, and we will take the best 10 scores to contribute to your overall tutorial grade.

It is a hurdle requirement to attend and participate in at least 10 out of 13 tutorials. This includes obtaining a non-zero mark for the quiz. Full attendance is strongly encouraged. Satisfactory attendance and participation in tutorials is a hurdle requirement. We require effective participation in tutorials, entailing a focused work effort and attendance for the full session. If you do not participate effectively in a given week, for example leaving the tutorial early without extenuating circumstances, it will be grounds for receiving a score of zero for that week's quiz, and that quiz will then not count towards passing the hurdle requirement. You must obtain a recorded, non-zero mark in at least 10 out of the 13 scheduled quizzes to have the potential to pass the unit. No additional quizzes will be offered for those who fail to meet this requirement.

On successful completion you will be able to:

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
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Delivery and Resources

Required and Recommended Texts and/or Materials

Textbook

Matter and Interactions by Ruth Chabay and Bruce Sherwood.

Either Volume 2 (Paperback) or the combined Volume (hardbound). Note that Volume 1 is the required text for PHYS107 in semester 1.

Web Resources

More information on the required text as well as additional ressource material can be found at http://www.matterandinteractions.org/

There are also other high quality learning resources on the web which we would recommend to you to use in your studies. The HyperPhysics site hosted by the Department of Physics and Astronomy at Georgia State University is widely acclaimed and used. The site also has mathematics learning resources on the maths used in physics.

http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html (Mechanics, and, Electricity & Magnetism).

Increasingly there are excellent web-based interactive simulations available – some are in the on-line resources that support the textbook. We encourage you to conduct your own web searches for others, and to develop your own critical judgment of which sites provide high quality resources that assist your learning. Two that we recommend to you are:

• http://www.explorelearning.com/ The Explorelearning Gizmos: follow links to Grade 9-12, Physics, Motion and Force; and Electricity & Magnetism. You will have to register to use this site.

• http://phet.colorado.edu/simulations/index.php?cat=Featured_Sims The University of Colorado, Boulder, Physics Education Technology (PhET) Simulations: follow the links to Motion; Energy, Work & Power; and Electricity, Magnets and Circuits. This site also contains maths resources, for example vector addition.

Technology Used and Required

Lecture notes, tutorial questions and answers, weekly exercises, and other resources will be posted on the PHYS106 iLearn site.

Learning and Teaching 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 and lecturers.

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.

You should aim to spend an average of 3 hours per week understanding the material and working on the tutorial problems and exercises. Attempting tutorial questions and weekly exercises is one of the key learning activities for this unit. 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.

As mentioned, there are many useful web resources on this material and we encourage you to seek out youtube videos on electromagnetism and other resources. However, while reading over the lecture notes and reading the textbook are very important, reading notes and watching physics videos are *passive* learning activities. It is critical that a substantial portion of your study time in physics is devoted to *active* learning strategies by attempting numerous problems from the text, tutorials, assignments and past exams. It is simply impossible to become adept in this subject by *watching* physics problems, you must *do* physics problems.

Unit Schedule

Lectures:

There are two lectures per week, as timetabled. Lectures follow the chapters from Volume II of the textbook Matter and Interactions.

Week 1: The electric field

Week 2: Electric fields in matter

Week 3: Electric fields of distributed charges

Week 4: Electric potential

Week 5: Electric field and circuits

Week 6: Circuit elements

Week 7: Magnetic field

Week 8: Magnetic force

Week 9: Patterns of field in space

Week 10: Faraday's law

Week 11: Electromagnetic radiation

Week 12: Waves and particles

Week 13: Revision

Tutorials

You should attend the timetabled tutorial each week.

Laboratory work

Lab experiments start in week 1. See the section on Laboratory Practicals.

Learning and Teaching Activities

Lectures

There will be two one hour lectures per week. During these the content of the unit will be explained, example problems will be solved and physics principles demonstrated.

Exercises

Each week we will release a set of short worked exercises. These will cover the main basic skills from lectures that week, and will be of a similar length and difficulty to the in-tutorial quizzes. Quizzes will not be closely based on any single exercise.

Tutorials

You must attend the tutorial each week. During this time students will work through problems related to the previous week's lecture content. Questions will be released in advance, and it is strongly recommended that you attempt the questions yourself before each tutorial.

Laboratory practicals

See the Laboratory Practical section below.

In-tutorial quizes

There will be a tutorial quiz of 10-15 minutes duration in each tutorial. These short quizzes are designed to test a key concept from the two previous lectures. Quiz answers from each of the tutorials will be released, forming a set of basic revision questions.

Suggested book questions

We will each week publish a list of problems from the textbook. We recommend that you attempt these key problems to help you master the basic concepts covered in that week.

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). 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.)*

Undergraduate students seeking more policy resources can visit the 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).

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 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

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.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- Understand and be able to describe the distinction between electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
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- Investigate real-world problems and interpret how numerical data and predictions relate to the physical world.

Assessment tasks

- Lab work
- Final exam
- Tutorials

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
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Assessment tasks

- Lab work
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- Tutorials

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

- Lab work

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

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
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- Final exam
- Tutorials

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

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
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electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
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Assessment tasks

- Lab work
- Final exam
- Tutorials

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.

This graduate capability is supported by:

Learning outcomes

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
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Assessment tasks

- Lab work
- Final exam
- Tutorials

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

- Demonstrate familiarity with the concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- Understand and be able to describe the distinction between electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
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Assessment tasks

- Lab work
- Final exam
- Tutorials

Changes from Previous Offering

This year, there is no midsession exam; instead the weighting of the quizzes and the labs have been increased.

We will hold a 50 minute mock-exam in the week 7 tutorial, and then go over that material straight after. This will be of similar difficulty to the final exam, and will give you a idea of how well you are progressing. There are no marks associated with this mock exam, but you are strongly encouraged to treat it seriously to get the most benefit from the task. There **will** be a marked quiz as normal in this tute!

Laboratory Practicals

Ten three-hour laboratory classes will be held during the semester. The first is an introductory session. It is held in Week 1, and no prelab work is required. Students will be given a lab book, computer access will be confirmed and important safety information and therefore attendance is mandatory. **Students cannot undertake any experiments until they have completed the introduction and safety session.** During the remaining laboratory sessions students will engage in practical exercises to develop their experimental skills and to further their understanding of the physics concepts.

The laboratory component is an essential component of your studies and so counts for an appreciable fraction of your final assessment. You will be introduced to some of the basic skills and techniques required of practicing physicists, scientists and engineers. **You will be issued with a Laboratory Notebook,** provided with instructional material in the form of **Laboratory Notes** which can be found in the Laboratory Resources section of iLearn, and assisted in the laboratory by a team of demonstrators. For each laboratory session, except in week 1, you are required to complete some preparatory work (**Pre-Lab**) before attending your nominated Lab session. To figure out which Prelab to do, please consult the **Laboratory Schedule** on iLearn.

Location: **14 SCO (formerly E7B), Room 114** (Ground floor at the North-East corner of building)

Laboratory Safety: You are required to follow all safety guidelines given in the first Lab session, your lab notes, and the lab staff. Food and drink cannot be consumed in the lab, and students without suitable covered footwear will be refused admission.