



# PHYS1020

## Electric and Magnetic Interactions

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

*School of Mathematical and Physical Sciences*

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#### Disclaimer

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## General Information

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Credit points

10

Prerequisites

PHYS1010 or PHYS107

Corequisites

MATH132 or MATH135 or MATH1010 or MATH1015

Co-badged status

Unit description

This unit, following on from PHYS1010, provides an overview of physics primarily for students intending to study physics and astronomy beyond first year, but also suitable for those specialising in any of the sciences. 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. PHYS1020 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:

**ULO1:** demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.

**ULO2:** interpret and make predictions about physical situations in terms of electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.

**ULO3:** use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.

**ULO4:** interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

**ULO5:** perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.

**ULO6:** identify, record and explain sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis.

## General Assessment Information

All assessment tasks in this unit are at scheduled times, and no late submission is accepted. If you miss an assessment task, please submit a request for Special Consideration.

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

- participation in at least 8 of the 12 marked quizzes.

### FINAL EXAMINATION

You must score at least 40% in the final examination to be able to pass the unit. If you score between 30% and 39% in the final examination you may be given a second chance to reach the hurdle threshold. The mark from the second chance exam will be capped at 40%, and the

second chance is only offered 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 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 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.

## **WEEKLY QUIZZES**

Weekly quizzes will be completed in iLearn, and will be associated with that week's SGTA. Participation in the SGTA (either on-campus or online) will be a prerequisite for taking the quiz. Details will be provided in iLearn.

There will be 12 quizzes, starting in week 2. To pass the unit, you must attempt at least 8 of the 12 quizzes. Your final mark will be made up of the best 8 individual marks.

## **LABORATORY ASSESSMENT**

Satisfactory completion of laboratories is a hurdle requirement. You must attend all laboratory sessions. There is an online induction module and safety quiz that needs to be **completed in Week 1** and includes work health and safety information. Students will also need to enrol in groups on iLearn so as to know which experiment to prepare for and complete in week 2. It needs to be completed by all students regardless of whether this is their first Physics unit or not. You can't do subsequent lab sessions if you don't complete the introduction. The next nine 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 2-9. 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. See iLearn 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 the catch-up class you are booked into, then that will count as another missed lab.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Weekly quiz</a>	30%	Yes	Weekly
<a href="#">Laboratory record</a>	30%	Yes	Weekly
<a href="#">Final examination</a>	40%	Yes	Examination period

### Weekly quiz

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 0 hours

Due: **Weekly**

Weighting: **30%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

A series of short tests, taken in SGTAs.

On successful completion you will be able to:

- demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- interpret and make predictions about physical situations in terms of electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
- use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
- interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

### Laboratory record

Assessment Type <sup>1</sup>: Lab book

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **Weekly**

Weighting: **30%**

**This is a hurdle assessment task (see [assessment policy](#) for more information on hurdle assessment tasks)**

Assessment of lab record made during each experimental activity, as well as any prelab preparation.

On successful completion you will be able to:

- perform physical measurements, record experimental data, display data graphically, analyse data, and draw written conclusions in a clear, concise, and systematic manner.
- identify, record and explain sources of uncertainty in physical measurements; and to undertake appropriate uncertainty analysis of results, including statistical analysis.

## Final examination

Assessment Type <sup>1</sup>: Examination

Indicative Time on Task <sup>2</sup>: 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 Examination period, covering the entire unit content.

On successful completion you will be able to:

- demonstrate an understanding of the basic concepts of electricity and magnetism including charge, current, Coulomb's law, the Lorentz force law and Maxwell's equations.
- interpret and make predictions about physical situations in terms of electric and magnetic fields, electric potential, electric and magnetic flux, electromotive force and electrical circuit properties such as voltage and current.
- use the laws of electromagnetism to solve a variety of quantitative problems in electrostatics, magnetostatics, circuit theory, induction and electromagnetic waves.
- interpret mathematically the basic properties of waves and describe the concept of wave-particle duality.

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<sup>1</sup> 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.

<sup>2</sup> 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

### 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 PHYS1010 in semester 1.

#### Web Resources

More information on the required text as well as additional resource 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](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, SGTA (Small Group Teaching Activity) questions and answers, weekly exercises, and other resources will be posted on the PHYS1020 iLearn site.

#### Learning and Teaching Strategy

This unit is taught through lectures and SGTA (Small Group Teaching Activities) 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 SGTA (Small Group Teaching Activity) problems and exercises. Attempting SGTA (Small Group Teaching Activity) 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, SGTA (Small Group Teaching Activity), 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

### **SGTAs**

You should attend the timetabled SGTA (Small Group Teaching Activity) each week.

### **Labs**

Refer to the Laboratory Practical section.

## **Policies and Procedures**

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](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 \(https://students.mq.edu.au/support/study/policies\)](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 \(https://policies.mq.edu.au\)](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](https://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto: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/](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

No changes from previous offering.

## Laboratory practicals

### Laboratory Sessions

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 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:** There are two laboratories used for 1st year physics they are both in 14 SCO (formerly E7B):

Room 114 (Ground floor at the North-East corner of building)

Room 254 (First floor, north-facing side of the atrium)

Please check iLearn to see where your lab class will take place.

**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.

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Unit information based on version 2024.02 of the [Handbook](#)