PHYS202

Electricity and Magnetism

S2 Day 2015

Dept of Physics and Astronomy

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General Information

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Credit points 3
Prerequisites MATH136 and [(PHYS140 and PHYS143) or (PHYS106 and PHYS107)]
Corequisites MATH235
Co-badged status

Unit description

The theory of electromagnetism, one of the most successful and most widely applied theories of modern physics, describes the properties and behaviour of electric and magnetic fields and their interaction with charged matter. This theory underlies all of modern optics, telecommunication and electrical engineering, and has played an important role in furthering our understanding of the fundamental forces of nature.

The basic laws of electromagnetism are introduced in this unit, and their important consequences and applications in electrostatics, magnetostatics and electrodynamics are studied. It is also shown how these laws can be re-expressed in terms of the more powerful mathematical language of vector calculus, which leads to the development of Maxwell's equations. These equations give a fully unified description of electromagnetism in both static and dynamic situations. The overwhelming success of these equations in describing electromagnetic phenomena is illustrated by studying electric and magnetic fields in matter, and electromagnetic waves. More advanced techniques of experimental physics including indirect measurement of microscopic quantities are covered in weekly guided laboratory sessions, as are further data analysis techniques and regular 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:

- Understanding and skill in differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Ability to use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment Tasks

Name	Weighting	Due
Assignments (6)	20%	Week

Name	Weighting	Due
Final	60%	University Examination Period
Laboratory reports	20%	Week

Assignments (6)

Due: **Week**
Weighting: **20%**

Homework is an essential component to build skills for this course. Problem sets range from around 4-8 questions each and are assigned approximately every two weeks. The problems are closely related to material given in the lectures and expounded on in the textbook "Introduction to Electrodynamics," by D.J. Griffiths. Students are encouraged to attempt homework problems before tutorial sessions where solutions to similar problems will be discussed in detail.

Extensions: Late assignments may be accepted with persmission from the lecturer. Marks may be deducted for late submissions in the absence of an approved extension.

The University Examination period for Second Half Year 2013 is from Monday 11 November to Friday 29 November 2013. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in draft form approximately eight weeks before the commencement of the examinations and in final form approximately four weeks before the commencement of the examinations. Exam timetables are available at http://www.timetables.mq.edu.au/exam.

The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for Special Consideration. If a Supplementary Examination is granted as a result of the Special Consideration process the examination will be scheduled after the conclusion of the official examination period.

Return: To the extent that it is possible, marked assignments will be returned no later than two weeks after they have been handed in by the students.

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period.

On successful completion you will be able to:

- Understanding and skill in differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
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- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Ability to use symmetry arguments to derive electric and magnetic fields from various configurations of charges and currents.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Final

Due: **University Examination Period**
Weighting: **60%**

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Laboratory reports

Due: **Week**
Weighting: **20%**

Laboratory work will begin in week 1 for the Friday class and in week 2 for the Monday class. Each experiment is allotted two weeks for completion and you are expected to complete 5 experiments.

You must keep a laboratory log book, in which you keep a record of all activities. In addition you will be required to write a full report on one experiment of your choice. Some notes about laboratory log books and report writing are included in an appendix at the end of this outline.

The purpose of the laboratory work is to expose you to a range of physical concepts and experimental techniques which spread beyond the coverage of the lectures. In addition we hope that your ability to maintain a written record of your laboratory work and to write reports on your work will develop further. To this end, the laboratory will be assessed in the following way:

(i) Your laboratory log book will be marked each fortnight. If it is less than satisfactory, it will be returned to you for correcting, and then re-marked. All relevant calculations must be done, the appropriate graphs drawn, and uncertainties assessed where appropriate.

(ii) You are required to submit a full report on one two-week experiment of your choosing from the first three experiments that you have completed. This report will be submitted in draft form initially. It will be marked and returned to you with comments for its improvement. When the report is resubmitted, your first attempt should also be handed in for comparison. The mark awarded for the report will be that obtained in the second marking. (However, if you obtain more than 7 out of 10 for the initial submission, then handing in the final version is optional.) This strategy gives you the opportunity to use the feedback from staff to help you develop professional report-writing skills before your work is finally graded.

The draft report is to be submitted by the end of week 10 with the final version by the end of week 13.

Permission may be granted for late submission of laboratory reports if the request for consideration is made prior to the due date. Reports submitted late may be subject to a marking penalty of one-half mark (out of ten marks) for each working day that the report is late, unless a valid, extraordinary, substantiated reason for late submission is presented to the Unit Convenor.

An increasing number of students are choosing to submit laboratory reports in word-processed form. This is a good procedure, however there are some points which need to be kept in mind. If you are not accustomed to using a word processor, the process can take much longer than writing a report by hand. In addition, problems with hardware can arise which cause delays and frustration. As a general rule we are not sympathetic to late reports caused by computer faults.

If you are planning to word-process your report it may also be advisable to bring a memory stick to the lab sessions. Some experiments have data recorded on PCs which can be saved direct to your memory stick, then included in your report.

The relative weighting of the components of the laboratory assessment will be

Laboratory log book 14%

Report 6%

TOTAL 20%

On successful completion you will be able to:

- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Delivery and Resources

Classes

Lectures

Tutorials will commence in the second week of semester

Laboratory

Required and Recommended Texts and/or Materials

Required Text

David J Griffiths, *Introduction to Electrodynamics, 3rd or 4th edition* (Prentice Hall, Englewood Cliffs, N J).

Recommended Readings

- John R Reitz, Frederick J Milford and Robert W Christy, *Foundations of Electromagnetic Field Theory, 4th ed* (Addison-Wesley, Reading, MA, 1993)
- Paul Lorrain, Dale R Corson and Francois Lorrain, *Electromagnetic Fields and Waves, 3rd ed* (W H Freeman, New York, 1988)
- David K Cheng, *Field and Wave Electromagnetics, 2nd Ed* (Addison Wesley, New York, 1989)
- John D Kraus, *Electromagnetics 4th Ed* (McGraw-Hill, New York, 1991)
- Les Kirkup, *Experimental Methods* (Wiley, Brisbane, 1994), chapter 7; QC371557
- Pamela Peters, *Strategies for Student Writers: a Guide to Writing* (Wiley, Milton, Queensland, 1985); PE1471P42

Technology Used and Required

Unit Web Page

The web page for this unit can be found at:

http://physics.mq.edu.au/current/undergraduate/units/PHYS202/index.html

Teaching and Learning Strategy

PHYS202 is primarily about electromagnetism. Although we will be following the text by Griffiths, this material is fairly standard and many texts cover it. The actual physics will not be new to you; it has been covered in previous physics units. What will be new are the mathematical methods used to describe it - in particular vector calculus.

In the text, chapter 1 gives an outline of vector calculus. This unit will cover a large part of the material in chapters 2, 4, 5, 6, 7 and 9 of the text.

To succeed in this course you will need to do many practice exercises from the text, in the homework, and during tutorials. This will help build intuition for the physical concepts and skill in the mathematics involved. If you are comfortable with solving the homework problems independently then you should perform well in the final exam.

Unit Schedule

First half:

- (Week 1) Differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- (Week 2,3) Electric fields, the electric potential, work and energy, and conductors. Multipole expansions.
- (Week 4,5) The Lorentz force law, the Biot-Savart Law, and the divergence and curl of the magnetic field. Magnetic vector potential.
- (Weeks 6,7) Electric motive force, electromagnetic induction, the displacement current. Overview of Maxwell's equations.

Second half:

- (Weeks 8,9) Polarisation, the field or a polarized object, electric displacement, and linear dielectrics.
- (Weeks 10,11) Magnetization, the field of a magnetized object, the auxiliary field, and linear and nonlinear media.
- (Weeks 12,13) Time dependent electric and mangetic fields. EM waves in vacuum, absorption and dispersion (taught at the discretion of lecturer).

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/

Results

Results shown in *iLearn*, 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.

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

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use 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

- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment tasks

- Assignments (6)
- Final
- Laboratory reports

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:

Assessment task

- Final

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 tasks

- Assignments (6)
- Final
- Laboratory reports

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

- Understanding and skill in differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
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- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment tasks

- Assignments (6)
- Final
- Laboratory reports

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

- Understanding and skill in differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
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- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment tasks

- Assignments (6)
- Final
- Laboratory reports

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

- Understanding and skill in differential and integral calculus with scalar and vector fields in cartesian, spherical, and cylindrical coordinates.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment tasks

- Assignments (6)
- Final
- Laboratory reports

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

- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving electric fields in the vacuum and in matter.
- Understanding of and a facility for solving problems involving time dependent electric and magnetic fields.

Assessment task

- Laboratory reports

Changes from Previous Offering

None

BEMA assesment

A BEMA test will be held at the beginning of the course. It does not form part of the unit assessment and it does not contribute to any marks.