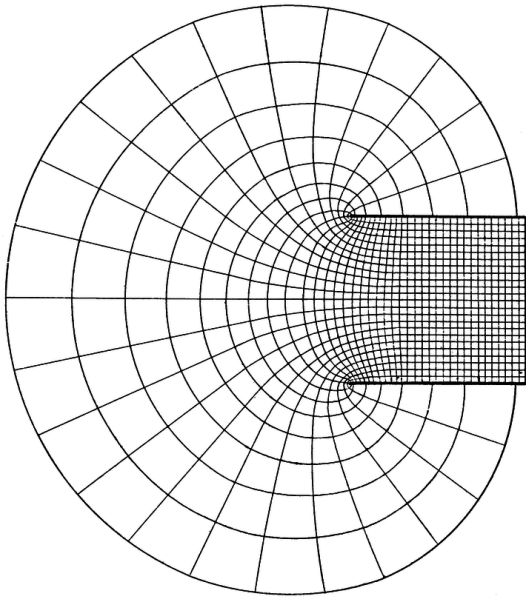
Electromagnetism: Statics

PHYS-3200 (Fall 2024)



Instructor:

Name:	Dr. Jeffrey G. Rau
Title:	Assistant Professor
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Office hours:

Days:	Tuesday and Thursday
Time:	11:30AM to 12:30PM or by appointment
Location:	Essex Hall 289-1

Lectures:

Days:	Tuesday and Thursday
Time:	10:00AM to 11:20AM
Location:	Essex Hall 287

Assessment:

40%	Assignments	(~ Weekly, lowest two grades dropped)
2 × 15%	Mid-term exams	(Thursday October 3rd, 2024 and Thursday November 7th, 2024)
30%	Final exam	(Cumulative, TBD)

Materials:

Required text:	*Introduction to Electrodynamics*, D. J. Griffiths	ISBN: 1108420419
At a similar level:	*Electricity and Magnetism*, E. Purcell & D. Morin	ISBN: 1107014026
More advanced:	*Modern Electrodynamics*, A. Zangwill	ISBN: 0521896975
	Classical Electrodynamics, J. D. Jackson	ISBN: 047130932X

Course information:

Website:	Brightspace (notes, discussions, assignments, . . .)
Prerequisites:	PHYS-2210, PHYS-2500, and MATH-3550 or PHYS-3610 (or consent of the instructor)
Description:	Classical electromagnetism focusing on stationary phenomena. Topics to be covered may include: electrostatics in vacuum, electric potential, conductors; magnetostatics in vacuum, currents, vector potential; electro- and magnetostatics in matter; techniques for Laplaces equation, multipole expansion; electromagnetic induction.

Course Outline

After a review of some topics in vector calculus, the course is structured to cover (mostly) stationary phenomena in electromagnetism, at the level presented in Chapters 1-7 of *Introduction to Electrodynamics* by D. J. Griffiths (though in a somewhat different order). The content of the course is, in the end, determined by what is covered in the lectures. A (tentative) course outline, with corresponding sections in Griffiths, is given below.

Electrostatics (Sections 2.1-2.5)

- Couloub's Law, Gauss' Law
- Electric potential
- Energy and work in electrostatics
- Conductors
  - Definition; induced charges
  - Capacitors

Magnetostatics (Sections 5.1-5.4)

- Lorentz force law; Steady currents
- Biot-Savart Law, Ampère's Law
- Magnetic vector potential

Electrostatics and magnetostatics in matter (Sections 4.1-4.4, 6.1-6.4)

- Electric fields in matter
  - Polarization; bound charges
  - Electric displacement
  - Linear dielectrics
- Magnetic fields in matter
  - Magnetization; bound currents
  - $\boldsymbol{H}$-field
  - Linear magnetic materials; paramagnets, diamagnets

Special Techniques (Sections 3.1-3.4)

- Boundary conditions; Uniqueness theorems
- Method of Images
- Separation of variables; Fourier Series
- Multipole expansion

Electrodynamics (Sections 7.1-7.3)

- Electromagnetic induction; Faraday's Law
- Maxwell's equations

Lectures

The main delivery method for the course material will be through **in person lectures** during our scheduled lecture times.

- There will be **two 80 minute sessions per week**, held during our scheduled class period (10:00AM-11:20AM, Tuesday and Thursday) in Essex Hall 287.
- During the week September 16th - 20th I will be away at a workshop and **recorded lectures will be posted** in lieu of in person delivery.

Assignments

Assignments to be done as homework will be given (approximately) every week. Deadlines will be typically be one week after the assignment is posted (the precise date and time will be listed on the assignment). **The lowest two assignment grades will be dropped.**

- Homework must be prepared in a professional and legible manner and must be turned in either as a *hard-copy* or *electronically* through Brightspace. If submitting electronically, handwritten pages must be scanned and uploaded as a *single* PDF file. If prepared electronically, the final output format must be a single PDF file.
- Feedback will be provided electronically for an electronic submission, and a marked PDF will be returned via Blackboard as an attachment in the “Feedback to Learner" section. For hard copies feedback will be written on the assignment and it will be returned in class.
- **No late homework will be accepted** – after the deadline it will be given a mark of zero.
- While discussing the problems with your peers is encouraged, homework is to be written and submitted *individually* and should represent *your own work*.
- Copying from other students or from *any other source* is *not allowed* (this includes websites and discussion boards). Plagiarism and academic dishonesty are serious offences and will be addressed using university guidelines and policies. The use of generative AI *is* permitted in this course as a tool to aid and enhance understanding, but not as a substitute for learning or as a substitute for producing original work. All submitted homework should reflect your own thoughts, ideas and reasoning and (if necessary) students may be held responsible for defending their solutions.

Mid-term exams

There will be two mid-term exams which will be written **in person** during our scheduled lecture time. It will be a conventional closed book and closed notes exam.

- *Dates*: **Thursday October 3rd, 2024** and **Thursday November 7th, 2024**
- The material covered will be from the start of the course up to the previous week.
- Exams will consist primarily of worked problems, similar to (but not identical to) the problems that have been assigned for the homework. A short-answer portion covering more conceptual questions may also be included at my discretion.

- There will be *no make up exams* for the mid-terms. If a mid-exam is missed, with acceptable medical (or equivalent compassionate) reasons, the weight of that exam will be transferred to the final exam, with the assignments reweighted to 50% of the course grade and the final exam to the remaining 50%.

Final exam

The final exam will be a three-hour written comprehensive exam drawn from *all* of the course, at similar level to the mid-terms and homework. The exam will take place over *three hours* on our scheduled exam day. The exam will be a conventional closed notes/book exam.

- *Date:* **To be determined** (Final exam period: December 7th - 18th, 2024)
- If your grade on the final exam is higher than your lowest mid-term exam grade, the final exam grade will replace it.
- A make-up examination for the final exam will only be administered with acceptable and verifiable medical (or equivalent compassionate) reasons, handled through the official University of Windsor channels and procedures.

Technical

- All email correspondence must be from your University of Windsor email address; email from other addresses will be ignored. Please include the course number (PHYS-3200) in the subject line any emails so I can get to it quickly.
- If you have a conflict with the posted office hours, you are also free to ask me questions at any time via email (though I will not guarantee a response rate, I will try my best). Alternatively, you can also arrange a scheduled time for a one on one (in person or virtual) discussion.
- Files submitted electronically should have a filename that indicates the course number (PHYS-3200), what is being submitted and your full name.
- If there are technical difficulties in submitting an assignment or an exam through Blackboard, you may email it directly to me (from your offical University email account).
- For scanning of hand-written pages there are many good smartphone applications that directly produce PDFs. Some examples include Office Lens (Android, iOS) and Adobe Scan (Android, iOS).

Miscellaneous

- *Voluntary withdrawal deadline*: **November 13th, 2024**
- *Reading week:* **October 12th, 2024 - October 20th, 2024**
- For a medical absences students should follow current policies, including use of the self-report of illness interface.
- As per senate rules, grades are percentages, reported as whole numbers.
- The content of the course is, in the end, determined by what is covered in the lectures and not by the outline provided in the syllabus.

- The Student Perceptions of Teaching (SPT) be administered in the final two weeks of the semester. Instructions are available here.
- Students in need of university-recognized accommodations (via student accessibility services) should make themselves known to the instructor at the beginning of the course and discuss what arrangements are needed and how they might be accommodated.
- University of Windsors student code of conduct provides that all students are expected to commit to a code of behavior based on dignity and individuality, and respect for the rights and property of others.
    - Anyone exhibiting disruptive behavior during lectures will be asked to leave. Disciplinary actions will be taken for failure to follow directions.
    - Plagiarism and academic dishonesty are serious offences and will be addressed using university guidelines and policies.
- For help addressing mental or physical health concerns, refer to Student Health, Counselling and Wellness Services for a full list of on-and off-campus resources available to students.