PHY 301: Electromagnetic Theory I, Fall 2025

Date of this version of the Syllabus: 08/15/2025

Course Description:

The application of Maxwell's equations to solve time-independent boundary-value problems and to study the interactions of electric and magnetic fields with bulk matter.

Prerequisite: PHY 251 and PHY 277 or permission of department; MAT 203 or MAT 205 or AMS 261 or MAT 307
Advisory Corequisite: MAT 341

3 credits

Class Meeting Times: Monday/Wednesday 8:00-9:20 AM in Staller Center, M0113

Course Instructor: Navid Vafaei-Najafabadi,
e-mail (For private communication, Reply in 24-48 hours):
navid.vafaei-najafabadi@stonybrook.edu
Office: Physics D101
Office hours (preferred method of contact): Monday 9:30-11 am (after class), Thursdays 11:00 am – 1 pm

TA: Evan Trommer
e-mail: evan.trommer@stonybrook.edu
Office: Physics D103
Office Hours: Fridays* 11 am – 12:30 pm
* will be away Sep. 19

Course Material:

1. Required Text:

Introduction to Electrodynamics, D. J. Griffiths
This book is the primary text for the course. For this course, we will primarily follow the material in chapters 1-7 of this book

2. Recommended Text:

Multivariable Calculus, R. Larson
This book was recommended as a reference. Electrodynamics heavily relies on the knowledge of multi-variable calculus, for which this book is an excellent reference

Topics & Approximate Timeline:

The focus of the class will be on topics covered in Ch. 1-7 of the Introduction to Electrodynamics by Griffiths. These topics and the approximate time devoted to each during the semester is as follows:

1. Introduction to Maxwell's equations and a brief review of vector calculus (1.5 week)
2. Electrostatics: charge, field and potential (3 weeks)
3. Special techniques in electrostatics (2 weeks)
5. Magnetostatics: current, field and vector potential (2.5 weeks)
7. Electrodynamics and Maxwell equations (2 weeks)
4. Eclectic field in dielectrics: polarization (1 weeks)
6. Atoms and solids in magnetic field: magnetization (1 weeks)

Learning Objectives:

Upon completing this course, students will be able to

- Recognize Maxwell's equation and identify the sources and the fields
- Solve mathematical problems involving vector calculus, including those that involve divergence and Stokes theorems
- Calculate time independent electric field as a result of a given charge distribution
- Use separation of variables, method of images, and multipole expansion to solve for electric potential and fields
- Calculate magnetic field resulting from time invariant currents
- Calculate the vector potential and the corresponding magnetic field vectors from time invariant current densities
- Apply Maxwell's equation to relate time varying electric and magnetic fields
- Analyze the electric field resulting from bound and free charges to calculate the electric field in matter
- Analyze the magnetic field resulting from bound and free currents to calculate the magnetic field in matter

Grade Breakdown:

Homework: 15%

Homework will contain problem sets that will be posted on Monday and due the next Monday in class. Paper submission preferred, but Brightspace submission is also accepted.

Midterm 1: 25%

The first midterm will be **on September 29th in class**.

Midterm 2: 30 %

The second midterm will be **on November 10th in class**.

This midterm covers only the topics discussed after Oct. 1st (i.e. not cumulative)

Final: 30 %

Currently scheduled on **Wednesday, December 17th** at 8-10:45 am, Location Staller Center, M0113 (same location as class)

Final exam will be cumulative, and will include all topics covered in class

Extra Credit:5%

The prepared notes for this course are a mix of handwritten content, typed text, and embedded images. As part of Stony Brook's ongoing efforts to enhance accessibility for all students, I'm offering an extra credit opportunity to help convert class notes into a format accessible to screen readers.

Your mission, should you choose to accept it, will be to convert the class notes into **machine-readable LaTeX** documents. To do so, the TeX file should be compiled to a MathML document. Each set of notes will be prepared by a pair of students. The two students will divide the section between them, with each acting as the "scribe" for one part and the "proofreader" for the other. Both students will receive 5% extra credit toward their final course grade.

Guidelines:

- A Google Sheet will be distributed in the first week. Please use it to sign up for one of the available spots.
- Transcribe all handwritten material into LaTeX; test using the instructions below
- Clearly typeset any mathematical expressions.
- Include image descriptions (alt text) where appropriate.
- Maintain a clean and readable structure, using LaTeX section headers, bullet points, and equations where applicable.
- If an image contains meaningful content (e.g. a diagram or graph), describe it in words or include a labeled sketch using LaTeX (e.g., with tikz or a captioned placeholder).
- If a part of the handwriting is unclear or illegible, make a note using a LaTeX comment (e.g., % unclear – needs review).

There are several methods to create a MathML document. Instructions for one common method, where TeX file is converted to MathML is provided in the following link. Make sure to test your files open properly in Mozilla.

https://www.csun.edu/~hcmth008/mathml/acc_tutorial.html

Letter Grades:

Final grades assigned for this course will be based on the percentage of total points earned and are assigned as follows:

Grade	%
A (Superior Work)	90+
A-	80-90

B+	72-80
B (Good Work)	65-72
B-	60-65
C+	55-60
C (Satisfactory)	45-55
C-	40-45
F	<40

- Additional information
  - Undergraduate Grading System
  - Graduate Grading System

Attendance Policy:

While attendance is strongly encouraged, no class assessment depends on it. Please don't risk the health of your fellow classmates by coming to the class ill.

How to Succeed in this Course:

- Complete all assigned work in the course
- Attend office hours with questions and topics of discussion (or even without!)
- Speak up in class if you have difficulty following the lecture
- Use the available academic resources (see below)

You are responsible for ensuring that you can attend all exams at the scheduled days and times. An important part of your responsibility at the beginning of the semester is to make sure your schedule will allow for an orderly adherence to the class and exam calendars. If you miss an exam without a valid excuse that must be **documented in writing**, you will NOT be allowed to make up that missed exam. Your grade on it will be zero.

Homework Policies:

Every Monday five to ten homework problems from each chapter will be posted on Brightspace. The graded problems should be handed in on the following Monday in class (or Wednesday if Monday is a holiday). Homework represents the primary avenue of practice for the course material. Don't wait until the last minute to work on them!

Homework 0 (Multivariable calculus homework): In the last few years that I have taught this class, lack of preparation in the topic of multivariable calculus has been the primary area of weakness in students who didn't do well. An initial homework is already assigned in Brightspace and is due on

Wednesday (**September 3rd**) to help you review and practice this topic, which is a critical skill for success in this class.

Rules Regarding Homework:

- Handwritten homework delivered on paper is preferred (think of it as practice for exams), but submissions on Brightspace are also accepted. If submitting on Brightspace, please ensure that the file is high quality and all content is clearly legible. e.g. use a phone "scanner" app rather than simply submitting a photo.
- You may collaborate with your classmates on the homework if you are contributing to the solution. You must personally write up the solution of all problems. Copying someone else's work—whether from another student, an online source, or a generative AI tool—is a violation of the academic integrity policy (see below) and undermines your own learning.
- You may (and are encouraged to) use the library and all available resources to help solve the problems. Use of Mathematica, other software tools and spreadsheets are encouraged.
- Late homework: Homework submitted by the end of due date is considered on time. Late homework will be accepted until the end of the class following the deadline, but will incur a 20% penalty per day that it is late.

Generative AI Policy:

I believe that generative AI is a wonderful tool (ChatGPT app is never closed on my own computer). That being said, in my experience, the most productive use of AI tools is to refresh your memory on facts or details you already know or to serve as an encouraging "homework buddy"— not as a reliable source of information. Always check what AI tells you!

You are allowed to use generative AI to *help guide* you in your homework but not *to do* your homework. Remember, you won't be allowed to bring ChatGPT to the exam!

Examples of helpful AI prompts:

- Remind me how to use differential area element in a [insert name] law application in cylindrical geometry
- I'm stuck in this problem. Give me a few options for how to approach this problem?
- Here's how I solved this integral, but it doesn't look right. Did I do it correctly?

Example of unhelpful AI prompt:

- Solve this problem

To help ensure genuine understanding and reduce the impact of improper use of AI tools, homework solutions submitted without written commentary will receive at most 50% of the possible points. For each problem, include a few sentences describing your approach—what you're trying to find, the key steps or reasoning you used, and how you arrived at your answer. These explanations don't need to be long or overly detailed, but should show that you understand what you're doing.

Course Delivery Mode and Structure

This is an ***in-person*** *course. The class meets* ***Mondays and Wednesdays from 8:00AM - 9:20AM*** *in* ***Staller Center, Room M0113***. All assignments and course material will be posted on Brightspace.

How We Will Communicate:

Office hours are the primary time intended for us to discuss course-related issues. If you cannot make the office hours, e-mail me for a separate appointment. For personal/private issues, email me directly. Make sure to include the course name and section when you send me an email. **Please allow between 24-48 hours for an email reply.** Your Stony Brook University email must be used for all University-related communications. You must have an active Stony Brook University email account and access to the Internet. All instructor correspondence will be sent to your SBU email account. **Plan on checking your SBU email account regularly for course-related messages.** To log in to Stony Brook Google Mail, go to http://www.stonybrook.edu/mycloud and sign in with your NetID and password.
Regular announcements will be sent from Brightspace. These will be posted in the course site and may or may not be sent by email.

Technical Requirements:

This course uses Brightspace for the facilitation of communications between faculty and students as well as posting of grades and feedback. The Brightspace course site can be accessed at https://mycourses.stonybrook.edu/d2l/login?utm_source=herobutton

If you are unsure of your NetID, visit https://it.stonybrook.edu/help/kb/finding-your-netid-and-password for more information. You are responsible for having a reliable computer and Internet connection throughout the term. **Caution!** You will be at a disadvantage if you attempt to complete all coursework on a smart phone or tablet. It may not be possible to submit the files required for your homework assignments.

Academic Resources:

If you find that you are struggling with the course material throughout the semester, consider taking advantage of resources provided by the university:

Student Success Resources:

A helpful resource is the *"For Students"* section linked from the Stony Brook homepage: http://www.stonybrook.edu/for-students as well as the Division of Undergraduate Education website: http://www.stonybrook.edu/commcms/due/index.html.

Academic Success and Tutoring Center:

This important program opened in September 2013. Information can be found at: http://www.stonybrook.edu/commcms/academic_success/.

Posting and Updating of This Syllabus:

This Syllabus will be posted on Brightspace. When, from time to time, it may be updated, all students will be notified by an Announcement posted in Brightspace and sent via email to your official University email address. All syllabus versions are dated and the latest syllabus is always posted on Brightspace, so when in doubt, check Brightspace! Changes from the original syllabus will appear in green font.

Academic and Major Advising (undergraduate only):

Have questions about choosing the right course? Contact an advisor today. Phone and emails vary-please see website for additional contact information; website: https://www.stonybrook.edu/for-students/academic-advising/

Ombuds Office:

The Stony Brook University Ombuds Office provides an alternative channel for confidential, impartial, independent and informal dispute resolution services for the entire University community. We provide a safe place to voice your concerns and explore options for productive conflict management and resolution. The Ombuds Office is a source of confidential advice and information about University policies and procedures and helps individuals and groups address university-related conflicts and concerns. http://www.stonybrook.edu/ombuds/

University Services

Bursar: For help with billing and payment. Phone: 631-632-9316; email: bursar@stonybrook.edu; website: http://www.stonybrook.edu/bursar/

Registrar: Having a registration issue? Let them know. Phone: 631-632-6175; email: registrar_office@stonybrook.edu; http://www.stonybrook.edu/registrar/

SBU Libraries: access to and help in using databases, ebooks, and other sources for your research.

- Research Guides and Tutorials: http://guides.library.stonybrook.edu/
- Getting Help: https://library.stonybrook.edu/research/ask-a-librarian/

Support for Online Learning: https://www.stonybrook.edu/online/

University Policies

Student Accessibility Support Center (SASC) Statement:

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Important Note: Any form of academic dishonesty, including cheating and plagiarism, will be reported to the Academic Judiciary.

Critical Incident Management Statement:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

Regarding Equivalent Opportunity/Religious Absences:

https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/equivopportunity_religiousabsences.php

Student Participation in University-Sponsored Activities:

By their participation in campus-related activities such as research conferences, dramatic or musical performances, intercollegiate athletic competitions, or leadership meetings, students make contributions to the University. In recognition of the students' commitment both to their regular academic programs and to related activities, the University makes every effort to accommodate unique situations.

Students are responsible for presenting a printed copy of semester obligations to all their professors at the beginning of the semester to alert them to activities that may present conflicts. Instructors are required to make arrangements for students to complete examinations, quizzes, or class assignments early or late if the student's participation in a University-related activity results in the student's absence from the class when such work is due. Some events occur only by invitation during the semester, and instructors should make accommodations for these students.

Minimal instructional and student responsibilities:

www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/

Understand When You May Drop This Course:

It is the student's responsibility to understand when they need to consider withdrawing from a course. Refer to the Stony Brook Academic Schedule for dates and deadlines for registration: http://www.stonybrook.edu/commcms/registrar/calendars/academic_calendars.

- Undergraduate Course Load and Course Withdrawal Policy
- Graduate Course Changes Policy

Incomplete Policy:

Under emergency/special circumstances, students may petition for an incomplete grade. Circumstances must be documented and significant enough to merit an incomplete. If you need to request an incomplete for this course, contact me for approval as far in advance as possible.

Course Materials and Copyright Statement:

Course material accessed from Brightspace, SB Connect, SB Capture or a Stony Brook Course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity.

Online Communication Guidelines and Learning Resources:

Maintain professional conduct both in the classroom and online. The classroom is a professional environment where academic debate and learning take place. I will make every effort to make this environment safe for you to share your opinions, ideas, and beliefs. In return, you are expected to respect the opinions, ideas, and beliefs of other students—both in the face-to-face classroom and online communication. Students have the right and privilege to learn in the class, free from harassment and disruption. The course follows the standards set in the Student Code of Conduct, and students are subject to disciplinary action for violation of that code. If your behavior does not follow the course etiquette standards stated below, the grade you receive for a posting may suffer. I reserve the right to remove any discussion messages that display inappropriate language or content.

Online Etiquette:

- Offensive language or rudeness will not be tolerated. Discuss ideas, not the person.
- Avoid cluttering your messages with excessive emphasis (stars, arrows, exclamations).
- If you are responding to a message, include the relevant part of the original message in your reply, or refer to the original post to avoid confusion;

- Be specific and clear, especially when asking questions.
- Use standard punctuation and capitalization. Using all UPPERCASE characters gives the appearance of shouting and makes the message less legible;
- Remember that not all readers have English as their native language, so make allowances for possible misunderstandings and unintended discourtesies.