Special Problems Course

Course Information

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Course Prefix and Number: PHYS 2212
Term: Fall 2026

Course Description

This course deals with electric and magnetic interactions, which are central to the structure of matter, to chemical and biological phenomena, and to the design and operation of most modern technology. The main goal of this course is to have you engage in a process central to science: the attempt to model a broad range of physical phenomena using a small set of powerful fundamental principles. The specific focus is an introduction to field theory, in terms of the classical theory of electricity and magnetism. To aid in this goal, you will develop computational models to visualize these fields and the interaction of charged particles. These models will be made using the Visual Python programming language. The course also emphasizes the atomic structure of matter, especially the role of electrons and protons in matter. This is a calculus-based course.

Course Learning Outcomes

By enrolling in this course, students will

1. Analyze physical systems by applying the fundamental principles of electricity and magnetism (e.g., Coulomb's Law, Gauss's Law, Ampere's Law, and Faraday's Law).
2. Calculate electric and magnetic fields, forces, potentials, and energies for various charges and current distributions.
3. Develop and interpret 3D computational models of electromagnetic phenomena using Python.
4. Explain the behavior of electric circuits containing resistors, capacitors, and inductors from both a microscopic and macroscopic perspective.
5. Describe the production and properties of electromagnetic radiation.
6. Model complex physical systems by making appropriate idealizations and approximations.
7. Communicate scientific reasoning and results effectively through laboratory activities.

Topics Covered

1. The Electric Field: Coulomb's Law, fields of point and distributed charges, polarization, and physical integrals.

2. Electric Potential: Potential difference, potential energy, and the relationship to the electric field.
3. Electric Circuits: Microscopic models of current, resistance, capacitance, inductance, batteries, and DC circuits.
4. Magnetic Field: Magnetic forces, sources of magnetic fields (Ampere's Law), and atomic models of magnetism.
5. Electromagnetism: Patterns of fields (Gauss's Law), Motional EMF, and Faraday's Law of Induction.
6. Electromagnetic Radiation: The properties of electromagnetic waves and their production by accelerating charges.

Required Course Materials

This course will roughly follow the Matter & Interactions Curriculum Links to an external site. Vol. 2: Modern Mechanics, 4th Edition by R. Chabay & B. Sherwood (John Wiley & Sons 2015). Students who wish to earn optional bucket points by completing reading assignments will need to purchase the book through Perusall (details below)

Course Modality

We will use in-class lecture time to engage in active learning activities (e.g. problem-solving, discussion, etc). Important concepts will be introduced via the Weekly Preview assignments. During class, please come prepared to use what you have learned by putting larger conceptual ideas together. This approach is a lot more fun than sitting passively listening to a lecture! More importantly, this modality provides many opportunities in class to work through concepts that are giving you trouble. For this to work, you will need to make sure you come to class prepared to be an active learner. An abundance of research demonstrates that this method of learning is more effective than a traditional lecture-only based class.

Prepare for class by following these steps:

1. Complete the Weekly Preview assignments before class
2. Identify the concepts that you are having difficulty with so that we can work through these concepts together with clickers and in-class group work.
3. Please remember that we are here to make sure you succeed and if you are having trouble, seek help!

What to bring to class

- A laptop or notebook for note taking (research shows that students learn more by utilizing handwritten notes)
- A laptop or smartphone for accessing the internet.

Lab Meetings will take place in Clough and be in person

Tests will take place in person and on campus and be completed on paper, scanned with a smartphone, and uploaded to Gradescope during the testing period.

Grading Policy

Numerical ranges for final grades are as follows: 90-100 points = A, 80-89 points = B, 70-79 points = C, 60-69 points = D, 0-59 points = F. Final grades will not be curved and rounding is at the discretion of the individual instructors.

We will be using the Canvas Grades to keep track of your progress in this course. However, please note that the Canvas grade book cannot accommodate our test weighing scheme or the bucket points. This causes a small but sometimes significant error in the overall grade that Canvas reports to students.

To accurately compute a final grade, students will need to manually calculate a weighted average using the guidelines below or utilize the spreadsheet found under Files > Documents

The Core Points

- All students must participate in these activities or receive a zero for the assignment. Please contact the course coordinator to be excused from these activities or to schedule makeup.

40pts - Tests

- There are three evening tests weighted depending on the grade the student receives in them
    - Lowest score 5pts, middle score 15pts, highest score 20pts
- The tests and the final exam will follow the same general exam grading rubric
- Regrades must be submitted through Gradescope within 7 days of the time grades are returned
- Students who show up more than 15 minutes late for the test/exam will not be permitted to take the exam.
- Students with ODS exam accommodations should contact the course coordinator

25pts - Final Exam

- Our final exam is common (i.e., all PHYS 2212 classes have the final exam at the same time)
- Students who show up more than 15 minutes late for the test/exam will not be permitted to take the exam.
- Graded final exams are not returned to students but can be reviewed by appointment

25pts - Laboratory

- **15pts** will be earned for the six individual lab experiments, which have peer-graded video lab reports

    - You must successfully complete the majority of the lab experiments to pass this class. If you fail to meet this threshold, you will earn an F in the course.
    - Labs are submitted through Perusall where you grade is determined based on the following scoring criteria with a maximum possible score of 100
        - 10% for submitting a document
        - 30% for submitting 1 high-quality comment on each assigned submission
        - 10% for submitting peer score for assigned submissions
        - 50% based on the average of scores received from peers
    - 20% for submitting 1 high-quality comment in reply to each received comment
    - Make sure to read this page for the full details: Working on Lab Experiments
- **10pts** will be earned for actively participating during the lab meeting
    - These will take place in Clough during the scheduled lab meeting time
    - Working as a group, students collect data from an experiment
    - Working as a group students complete Group Problem Sets (GPS) on the whiteboard
    - Students submit a picture of their work in a weekly assignment
    - Graded by their TAs
    - Read this page for more details: What to expect during Lab Meetings

The Bucket Points

- Students can earn up to 10 points toward their final grade through any combination of the following activities.
- These cannot be excused or made up; missing points are earned by completing additional bucket activities
- You can earn partial credit in all the bucket categories
- Students cannot earn extra credit by completing more than 10 bucket points
- These activities are intended to support student learning and give students flexibility
- Pick and choose from as many different types of assignments as needed
- General due dates for these assignments are on Sunday evenings at 11:59pm.

4pts - Weekly Homework

- Online, completed through WebWork
    - Due weekly on Sundays at 11:59pm
    - 1 week extension with no penalty
- Includes the Reviewing the Syllabus assignment

6pts - Class Participation

- Monitored through a series of in-class polling-type questions (clickers)
- Each student will need to download and use the PointSolutions App (free)

- You are not penalized for wrong answers during lecture, but you must complete at least 50% of the questions in each lecture to earn participation credit for that lecture
- Instructors do not manage missing data or connection issues for individual students
- Quick summary of how to calculate your class participation grade:
- Answer at least half of the clicker questions in each lecture to earn one point for that lecture
- There are X lectures with clicker questions during the semester (e.g. X=30). If you earn the participation point in each lecture, then you have X points. If you miss a lecture or don't answer enough clicker questions you miss points (for example, you finish the semester with 28 clicker points)
- Your clicker score is the percentage of lectures in which you earned points (in this example, 28/30 = 93.33%)
- Multiply your percentage by 0.05 to know how many points you earn for class participation (in this example, it's 4.67)

2pts - aiPlato Test Reviews

- Interactive (AI Tutor) review assignments for each test and the final exam

1pts - Weekly Previews

- Interactive assignments delivered through Perusall
- Requires purchase of the M&I textbook through Perusall
- Accessed by clicking on a Weekly Preview Assignment from Canvas>Modules
- More details: How do the Weekly Preview assignments work?

1pt - Extra Problems

- Online, completed through WebWork
- A massive assignment due at the end of the semester with many extra homework type problems for practice leading up to the final exam

1pt - Test Wrappers

- These reflection exercises help you focus on common errors and time management
- Available after each test, and must be completed before the start of the next test

1pt - Wiki Resource

- Make a substantial improvement to an assigned topic on our class wiki resource
- Part of your your score will be determined by peer review

1pt - Public Lecture Reviews

- Attend evening lecture(s), in person, by visiting scientists
- Part of your score will be determined by peer review

Extra Credit

You have the opportunity to earn up to 1pt of extra credit to be added to your final course grade. This can be earned by completing the Physics Pre-Test and the Physics Post-Test. In addition to the pre/post tests, individual instructors have the discretion to provide small amounts of extra credit to their lecture section.

- If you do the pre-test (only available for the first week of the semester), you earn 0.5pt of extra credit.
- If you do the post-test (only available for the last two weeks of the semester), you can earn up to 0.5pt of extra credit, depending on your score in the post-test. Example: if you scored 80% in the post-test, then you earned 80% of 0.5pt, which is 0.4pt.
- You can do the pre-test only, or the post-test only, or both, or neither, up to you.

Attendance Policy

Lectures: Attendance to lectures is required. Class participation will be monitored through a series of in-class polling-type questions (clickers). Students must complete at least 50% of the questions in each lecture to earn the participation point for that lecture. Class participation is in the "Bucket" category of assignments, so any missed points can be made up by completing other Bucket assignments.

Lab Meetings: Attendance to the lab meetings (where students work on GPS and Lab Experiments) is mandatory. Students who need to miss a lab meeting must complete the GPS Excused Absence form to be excused from the GPS. Since Lab Experiments follow two-week cycles, missing one lab meeting does not excuse a student from completing the lab experiment.

Excused Absences: All coursework that is part of the bucket (clickers, homework, etc.) can automatically be made up without approval by completing additional bucket activities. Receiving an excused absence from the remaining core coursework (Tests, Labs, and the Final Exam) requires approval of the course coordinator. Any missing coursework that is not excused will automatically receive a zero. In general, we follow the GT policies on absences as outlined in the catalog https://catalog.gatech.edu/rules/4/Links to an external site.

What constitutes a valid excuse?

A medical emergency or an illness that is severe enough to require medical attention (a visit to STAMPS or any other physician)

Students are responsible for contacting the Office of the Dean of Students as soon as possible to report on the medical issue or emergency, providing dated documentation from a medical

professional and requesting assistance in notifying their instructors. The medical documentation will be handled confidentially within the Office of the Dean of Students.

- https://studentlife.gatech.edu/request-assistanceLinks to an external site.
- Participation in approved Institute activities (such as field trips, professional conferences, and athletic events)
- Approval of such activities will be granted by the Student Academic and Financial Affairs Committee of the Academic Senate, and statements of the approved absence may be obtained from the Office of the Registrar.
- https://registrar.gatech.edu/info/institute-approved-absence-form-for-studentsLinks to an external site.
- Participation in a particular religious observance

Students must inform the course instructor of the upcoming absence, in writing, within the first two weeks of class. How are valid excuses handled?

Once you have documentation from the Registrar, or Dean of Students, please complete this form (external link). Your lab meeting participation will be excused with no makeup required. The first missed test is replaced with the final exam. Subsequent tests will require a scheduled makeup test coordinated by the course coordinator. The final exam must be rescheduled by the course coordinator

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the Student Code of Conduct and the Academic Honor Code.

The policy on academic honesty as stated in the Honor Code will be fully enforced during this course for both the instructor and student. All Honor code violations will be referred to the Dean of Students' office.

- Collaboration with other students in this course on homework assignments, lab assignments, and in-class activities is permitted and encouraged.
- Study groups can be facilitated through private channels on Edstem ("Ed Discussion", our class forum)
- Video lab reports submitted for Lab Exercises must only be the work of the student submitting the report.
- Collaboration is not permitted during tests or the final exam

These activities are closed internet, books, and notes with the following exceptions:

- Students are allowed a copy of the formula sheet found on Canvas
- No laptops or cell phones may be present until the time is called, and students are asked to scan and upload their work

- Students must work on the test individually and receive no assistance from any other person or resource
- Students who continue to work on tests or exams after time is called will receive a zero on the assignment
- Students may not submit responses to in-class polling questions (clickers) without being present in the lecture

AI usage

Physics is a performance skill, much like playing an instrument or a sport. You cannot learn to play the piano by watching a robot play the piano, and you cannot learn physics by watching an AI solve a homework problem. The danger of unregulated use of Generative AI in this course is that it provides an illusion of competence. The AI can show you a solution that makes sense when you read it, but it prevents you from struggling through the mental steps necessary to learn the material.

Using Generic AI (ChatGPT, Gemini, etc.) as an Academic Coach

We encourage you to use AI tools to deepen your understanding, provided you do the work yourself. Here is how we recommend using AI effectively in this course

- **Lecture Synthesis:** "I didn't quite catch the derivation of the electric field of a ring. Can you summarize the key steps and explain why the horizontal components cancel out?"
- **Self-Quizzing:** "I have a test on Gauss's Law coming up. Please generate 5 conceptual multiple-choice questions to test my understanding of flux."
- **Code Debugging:** "My GlowScript code has a syntax error on line 12. Can you help me find the typo"
- Do not ask it to write the physics logic for you
- **Exam Review (aiPlato):** We have partnered with aiPlato.ai to provide specialized Exam Review Assignments created by your instructors and validated by aiPlato
- Unlike generic chatbots, this tool is specifically tuned for physics education
- Students can earn bucket points for completing assignments on aiPlato

The Trust but Verify Rule

AI models are often confident but wrong when working through math or physics

- The Strategy: If an AI gives you an explanation that conflicts with your notes, or if you feel like you "sort of" get it but not fully, please come to Office Hours.
- Bring the Receipt: Show your instructor what the AI told you. We can help you identify if the AI made a subtle physics error (which is common) or if there is a gap in your own understanding. Using AI should increase, not decrease, your engagement with faculty!

Some Prohibited Uses

- The "Solver" Trap: Do not input homework or exam review problems prompts to copy+paste an answer.
- This creates an "illusion of competence" that will evaporate during the exam.
- Lab Reports: You may not use AI to generate the script, voiceover, or avatar for your video lab reports.
- The presentation must feature your voice and your logic.
- Exams: The use of any AI tools during exams is strictly prohibited

Allegations of scientific or scholarly misconduct are handled in accordance with the procedures outlined by the Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct.

Core IMPACTS

This is a Core IMPACTS course that is part of the Technology, Mathematics & Sciences area. Core IMPACTS refers to the core curriculum, which provides students with essential knowledge in foundational academic areas. This course will help master course content, and support students' broad academic and career goals. This course should direct students toward a broad Orienting Question:

- How do I ask scientific questions or use data, mathematics, or technology to understand the universe?

Completion of this course should enable students to meet the following Learning Outcome

- Students will use scientific methods and laboratory procedures or mathematical and computational methods to analyze data, solve problems, and explain natural phenomena.

Course content, activities and exercises in this course should help students develop the following Career-Ready Competencies

- Inquiry and Analysis
- Problem-Solving
- Teamwork

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulates some basic expectations that you can have of me and that I have of you. Additional information for research-related work is given in The Expectations of Advisors and Advisees. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.