Fall 2024

PHYS 432 - 001: Electromagnetism I

Gareth Perry

Course Outline
Physics 432-001: Electromagnetism I
Fall 2024

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Lectures: Mondays and Thursdays, 2:30 – 3:50 pm, FMH 409.

Office Hours: Mondays 10:00 – 11:00 am; Thursdays 12:00 – 1:00 pm; or by appointment.

Course Website: The course's Canvas page will be the main source of information and communication outside of the classroom.

Textbook: *Introduction To Electrodynamics*, 5th Edition, David J. Griffiths, Cambridge. University Press, ISBN-13: 978-1-00-939775-9. The textbook has many problems to help you understand the material. Some of these problems are more difficult than others; Griffiths use notation to distinguish the *very* difficult problem. I recommend that you do as many of these problems as you can.

Prerequisites: Physics 234 or Physics 234H or Physics 231H
and Math 222 or Math 222H and Math 328 or Math 335, all with grade of C or better.

Course Description: This course focuses on the electromagnetic force and builds upon previous courses including Physics 121/122 and those courses listed in the prerequisites. This course employs mathematical treatments including differential, integral, and vector calculus to explore a variety of topics including electrostatics, magnetostatics, electric fields in matter, and magnetic fields in matter.

Course Objectives: Upon completion of this course, students will be able to:

- carry-out various mathematical operations including the derivative, integral (line, surface, and volume), gradient, and curl;
- relate the electrostatic field to charge distribution and electric potential, and correctly apply Coulomb's Law and Gauss's Law;
- identify and correctly apply Laplace's Equation and calculate electric potential using the method of images;
- understand both quantitively and qualitatively electric polarization;
- understand the interconnection between dielectrics and electric fields both quantitatively and qualitatively;

- correctly apply the Lorentz Force Law;
- correctly use the Bio-Savart Law and Ampere's Law to calculate the magnetic field associated with moving charge;
- correctly use multipole expansion technique to calculate static magnetic fields;
- understand the interconnection between current, vector potential, and magnetic field;
- understand the differences and similarities between diamagnets, paramagnets, and ferromagnets; and,
- understand both quantitatively and qualitatively the interrelationship between magnetic fields, and magnetic susceptibility and permeability;

Course Expectations: You, the students, can expect me to:

- treat each student with dignity and respect;
- promote and support a safe and nurturing learning environment;
- be punctual and use class time effectively;
- work to make each lecture effective and impactful;
- be available to student inquiries, comments, and concerns during office hours; and,
- be available, as much as possible, for ad hoc appointments for students outside of normal office hours.

Academic Integrity: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing, or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Honor Code Violations or Disruptive Behavior: NJIT has a zero-tolerance policy for cheating of any kind and for disruptive student behavior. Violations will be reported to and judged by the Dean of Students. The penalties range from failure in the course plus disciplinary probation up to expulsion from NJIT. Avoid situations where your own behavior could be misinterpreted as dishonorable.

- Students are required to agree to the NJIT Honor Code on each quiz and exam.
- Turn off all phones, wireless devices, laptops, and messaging devices, etc.., during quizzes and exams unless instructed otherwise.
- Please refrain from eating and drinking during lecture or create noise in class that interferes with the work of other students or instructors.
- Do not contact any "tutoring services" for help during an exam. This is strictly forbidden.

Attendance: You will not be required to attend class; I will not be taking attendance. However, it is highly recommended that you attend class as much as possible. *If you are sick or feeling unwell, please do not attend class.*

Missed Quizzes and Exams: The general policy is that students who miss an exam will receive a score of zero for that exam. That score will be included in the calculation of their final grade. Students who anticipate an absence from a common exam should discuss their situation with the Dean of Students and their Instructor prior to their absence. To receive an "excused absence" for the exam (a very rare occurrence), the student must present documentation to the Dean of Students and/or their Instructor justifying their absence. The Instructor and the Dean of Students must concur in permitting an "excused absence" for the exam.

Withdrawal: If you must withdraw from the course, do it officially through the Registrar before the last withdrawal date. If you simply stop attending and taking exams your instructor will have to assign a failing grade in the course.

Homework Assignments: There will be regular homework assignments, based on the textbook's suggested problems. Independent and original solutions to the assigned problems are to be submitted to the instructor either physically or electronically by the assignment's due date.

Lecture Quizzes: We will have regular quizzes during the course. A quiz will cover the previous week's material and will take place during the final 15-20 minutes of lecture. Quiz problems will be open-ended. Quizzes will be "open book", but you will not be allowed to use your notes. For this reason, I would recommend not purchasing an electronic copy of the textbook as you will not be allowed to use your laptop/tablet/etc... during quizzes.

Midterm: We will have one midterm exam, tentatively scheduled for October 24 2024, during the regular lecture period, covering Chapters 1 – 4 (inclusive), which may be adjusted depending on how quickly we move through the material. Exam questions will be open-ended.

Grading: Homework Assignments: 20%; Lecture Quizzes: 20%; Midterm Exam: 30%; Final Exam: 30%

Letter grade cutoffs:

≥85%	A
≥80%	B+
≥70%	B
≥65%	C+
≥50%	C
≥40%	D
<40%	F

Course Schedule: We will try our very best to stick to the following course schedule. Please note that some lectures will likely be virtual to accommodate traveling during the semester. Lectures which are tentatively scheduled to be virtual are noted with a **(V)** symbol. The students will be given adequate notice if any other virtual lectures are required during the semester.

Lecture	Topic	Textbook Chapter Material
1. Thursday 09/05	Vector Analysis	1.1 – 1.2
2. Monday 09/09	Vector Analysis	1.3 – 1.4
3. Thursday 09/12	Vector Analysis	1.5 – 1.6
4. Monday 09/16	Electrostatics	2.1
5. Thursday 09/19	Electrostatics	2.2
6. Monday 09/23	Electrostatics	2.3
7. Thursday 09/26	Electrostatics	2.4 – 2.5
8. Monday 09/30	Potentials	3.1
9. Thursday 10/03	Potentials	3.2
10. Monday 10/07	Potentials	3.3
11. Thursday 10/10	Potentials	3.4
12. Monday 10/14	Potentials	Cleanup
13. Thursday 10/17 **(V)**	Electric Fields in Matter	4.1
14. Monday 10/21	Electric Fields in Matter	4.2
Thursday 10/24 **Midterm covering Chapters 1 – 3 (inclusive)**		
15. Monday 10/28	Electric Fields in Matter	4.3
16. Thursday 10/31	Electric Fields in Matter	4.4
17. Monday 11/04	Electric Fields in Matter	Cleanup
18. Thursday 11/07	Magnetostatics	5.1
19. Monday 11/11	Magnetostatics	5.2
Monday 11/11 **Last Day to Withdraw from Classes**		
20. Thursday 11/14 **(V)**	Magnetostatics	5.3

21. Monday 11/18	Magnetostatics	5.4
22. Thursday 11/21 **(V)**	Magnetostatics	5.4
23. Monday 11/25	Magnetostatics	Cleanup
24. Tuesday 11/26 (Thursday classes meet)	Magnetic Fields in Matter	6.1
25. Monday 12/02	Magnetic Fields in Matter	6.2
26. Thursday 12/05	Magnetic Fields in Matter	6.3 – 6.4
27. Monday 12/09	Magnetic Fields in Matter	Cleanup