Spring 2024

PHYS 122 - 002: Electricity & Magnetism ECE Appl.

Lindsay Goodwin

Syllabus for PHYS 122 - Section 002 + 004
Electricity and Magnetism for ECE Applications

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Office Hours:
Tiernan 101 Monday 2:30 - 3:30 PM, Tuesday 3:30 - 4:30 PM (other times by appointment)

Lecture:
Sections 002/004 - Central King Building 303 Tuesday 10:00 - 11:20 AM

Recitation:
Section 004 - Kupfrian Hall 209 Thursday 11:30 AM - 12:50 PM
Section 002 - Kupfrian Hall 106 Thursday 2:30 - 3:50 PM

Course Description

This course is the second of the **calculus-based** introductory Physics (PHYS) series, covering topics in Electricity and Magnetism (EM, or E&M) at the introductory level. The principal **Learning Outcomes** are to demonstrate understanding and mastery of classical electricity and magnetism up to AC circuits, including Maxwell's Equations. The subject areas you will be assessed on include electric charge, electric and magnetic fields, forces on stationary and moving charges and currents due to electrostatic and magnetic fields, electrostatic potential and potential energy, Gauss' Law, capacitance, current, resistance, the Biot-Savart Law, Ampere's Law (with Maxwell's correction), Faraday's Law, inductance, DC, RC, LR, LCR, and AC circuits, including phasor diagrams and resonant oscillations if time permits.

In the subject areas noted above, you should be able to:

1. Recall and use the conceptual and mathematical definitions and be able to explain them.
2. Explain the conceptual and mathematical relationships between quantities used.
3. Use symmetry arguments, sketches and diagrams, graphs, field maps, algebra, trigonometry, and basic integral and differential calculus methods in interpreting material using reasoned arguments and also in interpreting and setting up textbook-level problems.
4. Explain and manipulate equations and techniques developed in the text, lectures, problem examples, and in the course of working problems.

5. Apply the skills above to successfully solve textbook-level problems with numeric, symbolic, or conceptual answers.
6. Critically evaluate the soundness and precision of your own answers, explain and interpret your solutions to problems in a way that shows understanding, and identify and appraise the range of applicability of your results, and their limitations.
7. Apply conceptual and mathematical definitions including flux of vector fields, scalar potentials, and relevant line, surface and volume integral relationships to vector fields.
8. Utilize dimensional arguments, scaling arguments and, limits to determine the validity of calculations.
9. Solve symbolically labeled DC circuits with up to three independent currents.
10. Be able to carry out algebraic manipulations with complex numbers applied to multiple loop AC circuits.
11. Determine the solutions for first-order ordinary differential equations using integration.
12. Solve problems with nontrivial current or charge distributions by integration.
13. Determine approximate solutions for E and B for limiting cases by truncating a series expansion.
14. Solve problems with numeric, symbolic, or conceptual answers. Emphasis placed on symbolic solutions.

Required Materials

- **Textbook: "University Physics", 15th Edition, authors Young & Freedman (Pearson, 2020).** We use Chapters 21 to 31 in Volume 2. Most students now buy the e-text, which is bundled with the Modified Mastering Physics homework system. The ISBN is **9780135206348**. Students may also use the old 13th and 14th editions of the same text for reading assignments, as the section materials generally match. However, the end-of-chapter problems are numbered differently.

- **Mastering Physics Online Homework System**: Each student must obtain an access code kit that allows use of the online homework system. In addition to using the access code, each student must enroll in the Mastering Physics course.

- **Canvas**: The syllabus and lecture material is on Canvas. However, the solutions to recitation and lecture problems are worked out in-person.

Physics 121/122 Tutoring:

Central King Building, Room G12, https://physics.njit.edu/physics-tutoring-sign-sheet

Prerequisites/Corequisites

Prerequisites (all with C grade or better): Physics 111 (111H) and Math 111 (111H)
Co-requisites: Physics 121A (the lab course) and Math 112 (Calculus-II)
[Note: PHYS 121A Laboratory SHOULD be taken along with PHYS 122 unless you passed it previously or have an approved exemption. It is recommended that you take the PHYS 121A

laboratory at the same time as the course since the laboratory reinforces the concepts learned in the course. The Lab is otherwise a totally separate course from PHYS 122 in that the lab instructors set the requirements and grades.]

Grading Policy

Grades will be based on a term average for the semester's work that includes the common exam score, the final exam, in-class quizzes, and the term's homework score. The approximate weights to be used for calculating the term average score:

- **15%** for Exam 1 (1.5 hours, proctored in person, closed book/notes, no calculator needed)
  - February 12, 2024, 4:15 - 5:45 PM
- **15%** for Exam 2 (1.5 hours, proctored in person, closed book/notes, no calculator needed)
  - March 25, 2024, 4:15 - 5:45 PM
- **15%** for Exam 3 (1.5 hours, proctored in person, closed book/notes, no calculator needed)
  - April 15, 2024, 4:15 - 5:45 PM
- **25%** for the Comprehensive Final Exam (2.5 hours, proctored in person, closed book/notes, no calculator needed)
  - During Finals Week, 2.5 hours long
- **15%** for homework performed in Mastering Physics
- **15%** for weekly class quizzes during recitation

The term average values used as cutoffs for various letter grades will be in the approximate range of: 85% for A, 80% for B+, 70% for B, 65% for C+, 55% for C, and 50% for D and $< 50\%$ for F

In-class quizzes covering preceding or current work are given weekly in recitation, and the grades will count toward your final course grade. There will be no make-up quizzes and normally no make-up common exams. Students who miss an exam usually receive a score of zero for that exam. Students who expect to be absent from an exam should discuss their situation with their instructor PRIOR TO their absence. In order to qualify for a (rare) "make-up" exam, a student needs to document the reason for not being able to take the test as scheduled. Under NJIT standard policy, the documentation should be presented to the student's PHYS 122 instructor AND to the Dean of Students. BOTH the PHYS 122 instructor and the Dean of Students must concur in permitting a "make-up" Exam. Students who miss exams and do not contact and present documentation to their instructor within 7 days of the Exam will receive a score of zero for the Exam.

Mastering Physics Homework System:

You will have to create an account on the Mastering Physics system if you do not have one already, use the Mastering Physics course identifier: goodwin46493. Acquire one early and contact your instructor if this is a problem. Use your NJIT email address as the login ID for your account. See instructions to sign-up for homework in Canvas.

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 stop taking exams, your instructor will have no option other than to assign a course grade of "F".

Honor Code Violations:

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

General Class Expectations:

- Students are required to agree to the NJIT Honor Code at all times.
- College Rule of Thumb: You should expect to spend a minimum of 2 hours in outside work for each hour spent in class each week. That means 6 hours outside of lecture spent on this class alone.
- You should expect to be assessed on learning outcomes by means of three Common Exams, a Final Exam, quizzes, and scores on homework assignments.
- You are expected to make the time to attend the Common Exams in addition to the scheduled lectures/recitation.
- Do not create distractions in class that interfere with the work of other students or instructors.
- Electronic recording devices are permitted as long as they are not disruptive to the class. Please refrain from using electronics for anything but class related activities.
- The schedule below lists the topics covered and text readings. Do the homework problems: it is almost impossible to succeed in physics courses without working on a lot of problems.
- In General:
  - Read the assigned sections of the text before the lecture covering that material.
  - Do the recitation problems BEFORE the recitation.
  - Submit the weekly homework assignments before they are due.

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`.

Approximate Schedule

Topic	**Text Chapters**	**Recitation Problems**
Jan 16 - 18: Intro to class and settling in	Chap. 1 Vector Material	1.26, 1.36, 1.37, 1.40, 1.82, 1.86
Jan 23 - 25: Intro to Fields, Electric Charge, and Force	Chap. 21.1-21.3	21.7, 21.11, 21.16, 21.22, 21.26, 21.27, 21.35, 21.50, 21.54, 21.55, 21.75, 21.79, 21.84
Jan 30 - Feb 1: Electric Fields	Chap. 21.4-21.7	Continue
Feb 6 - 8: Gauss' Law	Chap. 22.1-22.5	22.4, 22.7, 22.8, 22.9, 22.13, 22.16, 22.19, 22.23, 22.31, 22.33, 22.37
Feb 12, 4:15 - 5:45 pm	**COMMON EXAM 1**	
Feb 13 - 15: Electric Potential	Chap. 23.1-23.6	23.2, 23.11, 23.16, 23.22, 23.34, 23.44, 23.59, 23.62, 23.71, 23.80
Feb 20 - 22: Capacitance and Dielectrics	Chap. 24.1-24.6	24.5, 24.7, 24.12, 24.18, 24.21, 24.25, 24.28, 24.30, 24.39. 24.60, 24.74
Feb 27 - Feb 29: Current, Resistance, basic DC Circuits	Chap. 25.1-25.5	25.2, 25.9, 25.15, 25.19, 25.28, 25.32, 25.37, 25.43
Mar 5 - 7: Kirchhoff's Rules (nodal/mesh analysis)	Chap. 26.1-26.5	26.2, 26.8, 26.11, 26.20, 26.22, 26.23, 26.25, 26.29, 26.34, 26.42, 26.51, 26.59, 26.83
Mar 12 - 14: Spring Recess	**No Classes**	
Mar 19 - 21: Charges and Currents in Magnetic Fields	Chap. 27.1-27.8	27.3, 27.6, 27.9, 27.14, 27.17, 27.22, 27.25, 27.30, 27.31, 27.45, 27.47
Mar 25, 4:15 - 5:45 pm	**COMMON EXAM 2**	
Mar 26 - 28: Sources of Magnetic Fields, Biot-Savart Law, Ampere's Law	Chap. 28.1-28.7	28.1 28.4, 28.9, 28.13, 28.16, 28.23, 28.29, 28.33, 28.37, 28.41
Apr 2 - Apr 4: Faraday's Law of Induction	Chap. 29.1-29.5	29.1, 29.6, 29.9, 29.14, 29.20, 29.22, 29.29, 29.32, 29.35, 29.37
Apr 9 - 11: Inductance and RL Circuits	Chap. 30.1-30.6	30.2 30.3, 30.6, 30.7, 30.11, 30.16, 30.19, 30.33, 30.34, 30.36, 30.37, 30.52, 30.59
Apr 15, 4:15 - 5:45 pm	**COMMON EXAM 3**	
Apr 16 - 18: LC and LCR Circuits, EM Oscillations, AC Circuits	Chap. 31.1-31.2+	31.1, 31.4, 31.7, 31.11, 31.12
Apr 23 - 25: Final Class	Summary and Maxwell's Equations	