

Spring 2021

PHYS 122-004: Electricity and Magnetism for ECE Applications

Andrew Gerrard

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Spring 2021: PHYS 122-Section 002 + 004

Electricity and Magnetism for ECE Applications

Syllabus for Physics 122

This course is the second of the calculus-based introductory Physics series. The principal **Learning Outcomes** are to demonstrate understanding and mastery of classical electricity and magnetism up to AC circuits, not including Maxwell's Equations or beyond. The subject matter 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, Faraday's Law, inductance, DC, RC, LR, LCR, and AC circuits, including Phasor diagrams and resonant oscillations.

In any/all of the subject areas noted in the first section of this syllabus, you should be able to:

- Recall and use the conceptual and mathematical definitions and be able to explain them.
- Explain the conceptual and mathematical relationships between quantities used.
- 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.
- Explain and manipulate equations and techniques developed in the text, lectures, problem examples, and in the course of working problems.
- Apply the skills above to successfully solve textbook-level problems with numeric, symbolic, or conceptual answers.
- 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.
- Apply conceptual and mathematical definitions including flux of vector fields, scalar potentials, and relevant line, surface and volume integral relationships to vector fields.
- Utilize dimensional arguments, scaling arguments and, limits to determine the validity of calculations.
- Solve symbolically labeled DC circuits with up to three independent currents.
- Be able to carry out algebraic manipulations with complex numbers applied to multiple loop AC circuits.
- Determine the solutions for first-order ordinary differential equations using integration.
- Solve problems with nontrivial current or charge distributions by integration.
- Determine approximate solutions for E and B for limiting cases by truncating a series expansion.
- Solve problems with numeric, symbolic, or conceptual answers. Emphasis will be placed on symbolic solutions.

Instructor: Andrew Gerrard, Professor, Director; Center for Solar Terrestrial Research, Chair, Dept. of Physics
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Office hours: Tuesday 2:00-4:00 PM, and other times by appointment

Class WebEx: <https://njit.webex.com/meet/gerrard>

Class Website: <http://web.njit.edu/~gerrard>

Physics 122 Tutoring Hours: TBA

Pre-requisites (all with C-grade or better): Physics 111 (111H) and Math 111 (111H), or Math 132 (Calculus-I)
Co-requisites: Physics 121A (the lab course) and Math 112 (Calculus-II) or Math 133.

[Note: Physics 121A Laboratory SHOULD be taken along with Physics 122 unless you passed it previously or have an approved exemption. It is recommended that you take the Physics 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 Physics 122 in that the lab instructors set the requirements and grades.]

Materials for Physics 122:

- Textbook (Abbreviation: Y&F): “University Physics”, 15th Edition, authors Young & Freedman (Pearson 2019). We use Chapters 21 to 31, which are published as bound, 3-hole binder, and E-text versions. The NJIT bookstore will stock Volume 2 text bundles (chaps 21-37 bound) with the access code and E-text kit (ISBN 10: 0-135-15955-5; ISBN 13: 978-0-1351 -5955-2). Any other version of the text containing Chapters 21 – 31 is OK. Any access code kit bought separately must be for the right text, specified above, so check before you buy.
- 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 using a course identifier code: **gerrard05058**

Final Letter 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:

- 20% for Exam 1 (to be done open book/notes, on WebEx)
- 20% for Exam 2 (to be done open book/notes, on WebEx)
- 25% for the Final Exam (to be done open book/notes, on WebEx)
- 20% for homework (performed in Mastering Physics)
- 15% for class quizzes (during Recitation Sections)

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

Examinations: There will be two semester Exams (i.e., Exam 1 and Exam 2) and a comprehensive Final Exam. The Exam schedule is:

- Exam 1: Monday, March 1, 2021, 4:15-5:45 PM
- Exam 2: Monday, April 5, 2021, 4:15-5:45 PM
- Comprehensive Final Exam: Finals Week, TBD

In-class quizzes covering preceding or current work may also be given during lectures and/or recitations, 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 Physics 122 instructor AND to the Dean of Students. BOTH the Physics 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 MasteringPhysics system if you do not have one already. You may not be able to sign up for the course your instructor is using until you have a valid Mastering Physics access code. Therefore, acquire one early and contact your instructor if this is a problem. Your instructor will announce a Mastering Physics course identifier (**gerrard05058**) for you to use when enrolling in your specific class. Use your NJIT email address as the logon ID for your account.

The Mastering Physics login is <http://www.masteringphysics.com>. See instructions at end of document to sign-up for

homework. The assignments are/will be labeled HW1 to HW15.

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:

- You should expect to spend a minimum of 2 hours in outside work for each hour spent in class each week.
- You should expect to be assessed on learning outcomes by means of two Exams, a Final Exam, in-class quizzes, and scores on homework assignments.
- Students are required to agree to the NJIT Honor Code at all times.
- Do not create distractions in class that interfere with the work of other students or instructors.
- 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 a lot of problems. The last column provides additional recommended problems to be covered in the recitation. Please work them out **BEFORE** the recitation.
- In General:
 - Read the assigned sections of the text before the lecture covering that material.
 - Submit the weekly homework assignments before they are due.
 - Do the recitation problems **BEFORE** the recitation.

TOPIC	TEXT CHAPTERS	RECITATION PROBLEMS
Week 1 (Jan 17): Introduction and Settling In		
Week 2 (Jan 24) : Vectors, Intro to Fields, Electric Charge, and Force	Chap. 21.1-21.3	1.26, 1.37, 1.40, 1.82, 1.86 21.7, 21.11, 21.16, 21.75
Week 3 (Jan 31): Electric Fields	Chap. 21.4-21.7	21.22, 21.26, 21.27, 21.35, 21.50, 21.54, 21.55, 21.79, 21.84
Week 4 (Feb 7): 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
Week 5 (Feb 14): 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
Week 6 (Feb 21): 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
March 1, 4:15-5:45 EXAM I – Chaps 1, 21-23		
Week 7 (Feb 28): Capacitance	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
Week 8 (Mar 7): Current, Resistance, DC Circuits, Intro to Kirchhoff's Rules	Chap. 25.1-25.5 Chap. 26.1-26.2	25.2, 25.9, 25.15, 25.19, 25.28, 25.32, 25.37, 25.43, 26.2, 26.8, 26.11
Week X (Mar 14):	Spring Break	
Week 9 (Mar 21): Multi-Loop and RC Circuits	Chap. 26.2-26.5	26.20, 26.22, 26.23, 26.25, 26.29, 26.34, 26.42, 26.51, 26.59, 26.83
Week 10 (Mar 28): 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
April 5, 4:15-5:45 EXAM II – Chaps 24-27		
Week 11 (Apr 4): 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
Week 12 (Apr 11): 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
Week 13 (Apr 18): Inductance and RL Circuits	Chap. 30.1-30.4	30.2, 30.3, 30.6, 30.7, 30.11, 30.16, 30.19,
Week 14 (Apr 25): LC and LCR Circuits, EM Oscillations, AC Circuits	Chap. 30.5-30.6 Chap. 31.1-31.2	30.33, 30.34, 30.36, 30.37, 30.52, 30.59 31.1, 31.4, 31.7, 31.11, 31.12

Student Registration Instructions

To register for PHYS122-Spring 2021:

1. Go to <https://www.pearson.com/mastering>.
2. Under Register, select **Student**.
3. Confirm you have the information needed, then select **OK! Register now**.
4. Enter your instructor's course ID: **gerrard05058**, and **Continue**.
5. Enter your existing Pearson account **username** and **password** to **Sign In**.
You have an account if you have ever used a MyLab or Mastering product.
 - » If you don't have an account, select **Create** and complete the required fields.
6. Select an access option.
 - » Enter the access code that came with your textbook or that you purchased separately from the bookstore.
 - » If available for your course,
 - Buy access using a credit card or PayPal.
 - Get temporary access.

If you're taking another semester of a course, you skip this step.
7. From the You're Done! page, select **Go To My Courses**.
8. On the My Courses page, select the course name **PHYS122-Spring 2021** to start your work.

To sign in later:

1. Go to <https://www.pearson.com/mastering>.
2. Select **Sign In**.
3. Enter your Pearson account **username** and **password**, and **Sign In**.
4. Select the course name **PHYS122-Spring 2021** to start your work.

To upgrade temporary access to full access:

1. Go to <https://www.pearson.com/mastering>.
2. Select **Sign In**.
3. Enter your Pearson account **username** and **password**, and **Sign In**.
4. Select **Upgrade access** for **PHYS122-Spring 2021**.
5. Enter an access code or buy access with a credit card or PayPal.