

Spring 2020

## PHYS 122-004: Electricity and Magnetism for ECE Applications

Trevor Tyson

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# Spring 2020: PHYS 122. Electricity and Magnetism for ECE Applications

## Syllabus for Physics 122

### ***Instructors:***

- Trevor A. Tyson (Lectures): T-484, tyson@njit.edu, (973) 643-4681, <http://web.njit.edu/~tyson>  
Office hours (Tyson) are on Monday 11:30 to 1:00 pm. Other times by appointment  
Class Web Page: <https://web.njit.edu/~tyson/physics122.html>

Physics 122 Tutoring Hours: TBA

### ***Pre-requisites (all with grade of C or better):***

- Physics 111 or 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.

***Physics 121A Laboratory*** must be taken along with Physics 122 unless you passed it previously. **If you drop Physics 122 you automatically drop the lab (and vice versa, no exceptions).** The Lab is otherwise a totally separate course from Physics 122 in that the lab instructors set the requirements and grades. The lab manual (Physics 121A Laboratory Manual 6th Edition) should be purchased at the bookstore. The most up-to-date lab schedule is posted at [web.njit.edu/~smm8166](http://web.njit.edu/~smm8166).

### ***Materials for Physics 122:***

- **Textbook (Abbreviation: Y&F): "University Physics", 13th Edition**, authors **Young & Freedman** (Pearson 2012). We use Chapters 21 to 31, which are published as bound, 3 hole binder, and E-text versions.
- **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 for his/her Physics 122 section using a course identifier code supplied by the instructor.
- Homework assignments and tutorials posted on-line in Mastering Physics will be automatically graded. Specific information will be available directly from all the instructors, and/or their web sites.
- The NJIT bookstore will stock Volume 2 text bundles (chaps 21-37 bound with the access code and E-text kit - **ISBN = 0321928814 or 9780321928818**). 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.
- **"iClickers" will NOT be used. There will be weekly in-class quizzes**
- **Web Sites:** Instructors may post lecture notes, problems, grades, etc. on their web sites. So check there often.

***Learning Outcomes:*** This course is the second of the calculus-based introductory Physics series.

**You should expect to spend a minimum of 2 hrs. in outside work for each hour spent in class each week.**

- You can expect to be assessed on learning outcomes by means of 3 common exams, a final exam, in-class quizzes, scores on homework assignments, and a small class participation component.
- The principal learning outcome is 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, DC circuits, the Biot-Savart Law, Ampere's Law, Faraday's Law, inductance, RC circuits, LR circuits, LCR circuits, AC circuits including Phasor diagrams and resonant oscillations.
- In any/all of the above subject areas, 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 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

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

- **51%** for all three common exams (17 % each)
- **29%** for the final exam
- **8 %** for homework
- **12%** for in-class quizzes

Extra credit may be given for optional exam problems, for active class participation, etc. Negative credit may be given for being late, creating noise or otherwise interfering with the work of the class.

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 three Common Exams plus a comprehensive Final Exam. The schedule is:

- **Common Exam 1:** Monday, February 24, 2020 4:15 – 5:45 PM (1.5 hrs)
- **Common Exam 2:** Monday, March 30, 2020 4:15 – 5:45 PM (1.5 hrs)
- **Common Exam 3:** Monday, April. 13, 2020 4:15 – 5:45 PM (1.5 hrs)
- **Comprehensive Final Exam:** After May 8, 2020 2.5 hrs

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 a common exam usually receive a score of zero for that exam. Students who miss two common exams automatically fail the course. Students who expect to be absent from a common exam should discuss their situation with their instructor PRIOR TO their absence. In order to qualify for a (rare) "make-up" common 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 121 instructor AND to the Dean of Students - (973) 596-3466, 2nd floor Campbell Entry. BOTH the Physics 121 instructor and the Dean of Students must concur in permitting a "make-up" common exam. Students who miss common exams and do not contact and present documentation to their instructors within 7 days of the common exam will receive a score of zero for that common exam

**Attendance** will be taken at all classes and exams. More than 3 unexcused absences (in total) is excessive. If you have excusable absences contact your instructor or the Dean of Students.

**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 no option other than to assign a course grade of "F".

**Help:** The Physics Dept. may provide drop-in tutoring on a schedule to be posted. More information will be available from your instructor or the Physics Department office on the 4<sup>th</sup> floor of Tiernan after the term starts. Physics tutoring is also available through the CAPE and Learning Communities organizations. If you are having trouble in this course visit or email your instructor; do not simply hope for a miracle and fall further behind.

**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 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.

- **Students are required to agree to the NJIT Honor Code on each exam.**

Turn off all smart and cellular phones, wireless devices, computers, and messaging devices of all kinds during classes and exams. Please do not eat, drink, or create noise in class that interferes with the work of other students or instructors.

**The Schedule on Page 4** 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 second to last column provides additional recommended problems to be covered in the recitation. Please work them out before the recitation.

- Read the assigned sections of the text before the lecture covering that material.
- Submit the weekly homework assignments before they are due.
- **Students who do not submit homework are automatically lowering their average by 10 %.**
- The in-class quiz solutions will be posted each week

**Specific information for the Mastering Physics homework system:** You will have to create an account on the MP 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. So acquire one early and contact your instructor if this is a problem. Your instructor will announce a Mastering Physics course identifier (**MPTYSON3500002**) 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>. Click on "Student" in the upper left of the box. Respond "yes" that you have an access code (create an account if you do not already have one). Input your name exactly as it appears on NJIT's records: last name first, followed by a comma and your first and possibly middle name. Likewise, enter your 9 digit NJIT ID where indicated. For your own reference, record the unique course number announced by your instructor, and your Login ID and Password.
- Instructors cannot access forgotten logins or passwords.

TOPIC	TEXT STUDIES	RECOMMENDED PRACTICE PROBLEMS
Week 1 (Jan. 20 to 26 ) Vectors, Intro to Fields Electric Charge and Force	Chap. 21.1-21.3	1.32, 1.43, 1.46, 1.91, 1.97 21.7, 21.13, 21.19, 21.92
Week 2 (Jan. 27 to Feb. 2) Electric Fields	Chap. 21.4-21.7	21.26, 21.31, 21.33, 21.45, 21.54, 21.58, 21.61, 21.95
Week 3 (Feb. 3 to Feb. 9) Gauss' Law	Chap. 22.1-22.5	22.4, 22.7, 22.11, 22.15, 22.17, 22.26, 22.35, 22.39, 22.43
Week 4 (Feb. 10 to Feb.16) Electric Potential	Chap. 23.1-23.5	23.2, 23.11, 23.16, 23.24, 23.32, 23.39, 23.41, 23.64
Week 5 (Feb. 17 to Feb.23) Electric Potential	Chap. 23.1-23.5	23.2, 23.11, 23.16, 23.24, 23.32, 23.39, 23.41, 23.64
<b>Common Exam I</b> <b>Monday, Feb. 24, 4:15 PM to 5:45 PM</b>		<b>Chapters 21 to 22 (with math methods)</b>
Week 6 (Feb. 24 to March 1) Capacitance	Chap. 24.1-24.6	24.5, 24.9, 24.14, 24.18, 24.22, 24.26, 24.30, 24.38, 24.42
Week 7 (March 2 to March 8) Current, Resistance, DC Circuits, Intro to Kirchoff;s Rules	Chat. 25.1-25.5 Chap. 26.1-26.2	25.2, 25.9, 25.13, 25.17, 25.30, 25.37, 25.41, 25.47, 26.2, 26.9, 26.11
Week 8 (March 9 to March 15) Multi-Loop and RC Circuits	Chap. 26.2-26.5	26.20, 26.24, 26.25, 26.27, 26.31, 26.36, 26.42, 26.53, 26.63, 26.91
<b>Spring Break</b> <b>March 15 to March 22</b>	<b>Spring Break</b>	
Week 9 (March 22 to March 29) Charges and Currents in Magnetic Fields	Chap. 27.1-27.8	27.3, 27.6, 27.11, 27.15, 27.17, 27.23, 27.31, 27.37, 27.41, 27.53, 27.63
<b>Common Exam II</b> <b>Monday, March 30, 4:15 PM to 5:45 PM</b>		<b>Chapters 22 to 26</b>
Week 10 (March 30 to April 5 ) Sources of Magnetic Fields, Biot-Savart Law, Ampere's Law	Chap. 28.1-28.7	28.1 28.4, 28.11, 28.15, 28.18, 28.27, 28.31, 28.37, 28.43, 28.46
<b>April 6</b> <b>Last Day to Drop Class</b>		
Week 11 (April 6 to April 12) Faraday's Law of Induction	Chap. 29.1-24.5	29.1, 29.6, 29.9, 29.15, 29.18, 29.21, 29.29, 29.33, 29.36, 29.38
<b>Common Exam III</b> <b>Monday, April 13, 4:15 PM to 5:45 PM</b>		<b>Chapters 26 to 29</b>
<b>April 8</b> <b>Last Day to Drop Class</b>		
Week 12 (April 13 to April 19) Inductance and RL Circuits	Chap. 30.1-30.4	30.2 30.6, 30.9, 30.15, 30.18, 30.21, 30.22, 30.24, 30.27
<b>Common Exam III</b> <b>Monday, April 13, 4:15 PM to 5:45 PM</b>		<b>Chapters 26 to 29</b>
Week 13 (April 20 to April 26) LC and LCR Circuits, EM Oscillations, AC Circuits	Chap. 30.5-30.6 Chap. 31.1-31.2	30.31, 30.34, 30.36, 30.38 31.1, 31.4, 31.8, 31.13, 31.14
Week 14 (April 27 to May 3) AC Circuits, Resonance	Chap. 31.3-31.6 part 1	31.18, 31.23, 31.25, 31.27, 31.33, 31.35
Week 15 (May 4 to May 5) More AC Circuits (Generalized Impedance)	Chap. 31.3-31.6 part 2	31.37, 31.40, 31.45, 31.49, 31.51, 31.52, 31.57
Reading Day- May 6 & 7		

<b>Homework Assignment</b>	<b>Date Posted</b>	<b>Date Due @ 11:55 PM</b>
HW01	1/22/2020	2/1/2020
HW02	1/22/2020	2/1/2020
HW03	2/1/2020	2/8/2020
HW04	2/8/2020	2/15/2020
HW05	2/15/2020	2/22/2020
HW06	2/22/2020	2/29/2020
HW07	2/29/2020	3/7/2020
HW08	3/7/2020	3/14/2020
HW09	3/14/2020	3/28/2020
HW10	3/28/2020	4/4/2020
HW11	4/4/2020	4/11/2020
HW12	4/11/2020	4/18/2020
HW13	4/18/2020	4/25/2020
HW14	4/25/2020	5/2/2020