

Fall 2020

## PHYS 122-001: Electricity and Magnetism for ECE Applications

Trevor Tyson

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# Fall 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>
- George Georgiou (Recitation), georgiou@njit.edu
- Robert Duffin (Recitation) robert.t.duffin@gmail.com

Office hours (Tyson) are on Saturday 12:00 noon to 1:30 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*** SHOULD be taken along with Physics 122 unless you passed it previously or have a health 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. 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", 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.
- **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 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.
- **"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 a common exam, 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 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

**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. Here are the approximate weights to be used for calculating the term average score:

- **30 %** for common exam (ProctorU Live)
- **35 %** for the final exam (ProctorU Live)
- **15 %** for homework (Mastering Physics)
- **20 %** for class quizzes (Canvas, Mastering Physics, mail-in)

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 one Common Exam plus a comprehensive Final Exam. The schedule is:

- **Common Exam:** Monday, Nov. 9, 2020 4:15 (2 hrs)
- **Comprehensive Final Exam:** After Dec. 14, 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 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 122 instructor AND to the Dean of Students - (973) 596-3466, 2nd floor Campbell Entry. BOTH the Physics 122 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 the 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 ~15 %.**
- 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 (**tyson69192**) 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 labeled HW1 to HW14.

TOPIC	TEXT STUDIES	RECOMMENDED PRACTICE PROBLEMS
Week 1 (Sept 1 to 6) 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 2 (Sept 7 to 13) 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 3 (Sept 14 to 20) 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 4 (Sept 21 to Sept 27) 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 5 (Sept 28 to Oct 4) 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 (Oct 5 to Oct 11) 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 7 (Oct 12 to Oct 18) Current, Resistance, DC Circuits, Intro to Kirchoff'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 8 (Oct 19 to Oct 25) 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 9 (Oct 26 to Nov. 1) 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
Week 10 (Nov 2 to Nov. 8) 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
<b>Common Exam</b> <b>Monday, Nov. 9, 4:15 PM to 6:15 PM</b> <b>(plus setup time)</b>		<b>Chapters 21 to 26</b>
<b>Monday Nov. 9</b>	<b>Last day to Withdraw</b>	
Week 11 (Nov 9 to Nov. 15) Faraday's Law of Induction	Chap. 29.1-24.5	29.1, 29.6, 29.9, 29.14, 29.20, 29.22, 29.29, 29.32, 29.35, 29.37
Week 12 (Nov 16 to Nov. 22) Inductance and RL Circuits	Chap. 30.1-30.4	30.2, 30.3, 30.6, 30.7, 30.11, 30.16, 30.19, 30.22, 30.27
Week 13 (Nov 23 to Nov. 29) 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
<b>Thanksgiving Break</b> <b>Nov 26 to Nov 29</b>	Wednesday Nov. 25 = Friday Schedule	
Week 14 (Nov. 30 to Dec. 6) AC Circuits, Resonance	Chap. 31.3-31.6 part 1	31.18, 31.23, 31.25, 31.27, 31.32, 31.35 31.44
Week 15 (Dec. 7 to Dec. 12) More AC Circuits (Generalized Impedance with Complex Numbers)	Chap. 31.3-31.6 part 2	31.34, 31.40, 31.43, 31.48, 31.51, 31.58, 31.68
Reading Days- Dec. 11, Dec. 14 (Complete Lectures)		

## Student Registration Instructions

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### To register for **Physics 122 Fall 2020 ECE**:

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: **tyson69192**, 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 **Physics 122 Fall 2020 ECE** 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 **Physics 122 Fall 2020 ECE** 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 **Physics 122 Fall 2020 ECE**.
5. Enter an access code or buy access with a credit card or PayPal.

**Make sure that your first and last name appear when registered!**