PHYSICS 0111: Introduction to Physics II

Spring 2020

Lecture: Tues/Thurs 11:00AM-12:15PM

Alumni Hall 343

Recitation: Required with TA

Office Hours: Tues 10:00AM-10:50PM, Wed 4:00PM-5:00PM

Contact Information:

Instructor: Dr. Melanie L. Good
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PLEASE USE "Phys0111" in the subject of all email correspondence!

Prerequisites: PHYS 0110 or 0174 or 0475; MIN GRAD: 'C' for all listed Courses

Textbook (Required): *College Physics* OpenStax `https://openstax.org/details/college-physics`

Other Required Materials: Scientific Calculator (in addition to phone or device apps, you need a separate stand-alone calculator)

Course Description: Topics to be covered include:

- Module 1: The Ideal Gas Law and Kinetic Theory (Ch.14)
- Module 2: Thermodynamics (Ch.15)
- Module 3: Electric Forces and Electric Fields (Ch.18)
- Module 4: Electric Potential Energy and the Electric Potential (Ch.19)
- Module 5: Electric Circuit (Ch.20)
- Module 6: Magnetic Forces and Magnet Fields (Ch.21)
- Module 7: Electromagnetic Induction (Ch.22)
- Module 8: Alternating Current Circuits (Ch.23)
- Module 9: Electromagnetic Waves (Ch.24)
- Module 10: The Reflection of Light: Mirrors (Ch.25)
- Module 11: The Refraction of Light: Lenses and Optical Instruments (Ch.26)
- Module 12: Interference and the Wave Nature of Light (Ch. 27)
- Module 13: Particles and Waves (Ch.29)

Course Objectives:

The department has clearly-defined Learning Objectives for the course, listed below, and also available online: https://www.physicsandastronomy.pitt.edu/sites/default/files/PHYS_0111_LearningObjectives_2017.pdf :

PHYS 0111 Learning Objectives

Module 1. You should be able to: mathematically describe molecular diffusion; apply the ideal gas model to find pressure, temperature, volume, or number of moles; find the average molecular speed for a gas at a known temperature.

Module 2. You should be able to: identify a thermodynamic system; calculate the work done by an ideal gas during various thermal processes; understand the relation between heat and work; apply the first law of thermodynamics; calculate the efficiency of heat engines; apply the second law of thermodynamics in the context of heat engines.

Module 3. You should be able to: explain the microscopic origin of charge; distinguish conductors from insulators; apply conservation of charge; calculate the mutual force between two stationary charges; visualize an electric field from a stationary charge distribution with field lines; calculate the net electric field from multiple point charges; apply the relation between electric force and field.

Module 4. You should be able to: calculate the work needed to assemble a set of charges; apply the concept of electric potential energy; calculate the electric potential from a set of point charges; qualitatively apply the concept of capacitance; calculate the capacitance of a parallel-plate capacitor; calculate energy in an electric field.

Module 5. You should be able to: understand the microscopic origin of current; read a current-voltage characteristic; calculate the resistance of a conductor; calculate the equivalent resistance of multiple resistors either in series or in parallel; explain electromotive force; find currents in circuits of batteries and resistors; calculate electric power; calculate the equivalent capacitance of multiple capacitors either in series or in parallel; mathematically describe the charging and discharging of a capacitor.

Module 6. Upon mastering this material, you should be able to: describe the interaction between permanent magnets; visualize magnetic field with field lines; calculate the magnetic force on a moving charge; calculate the magnetic force on a wire; explain the fundamental differences between electric force and magnetic force; calculate the torque developed by an electric motor; calculate the mutual force between two long current-carrying wires.

Module 7. You should be able to: calculate the flux of a magnetic field; explain electromagnetic induction; calculate the induced electromotive force due to a changing magnetic flux; apply Lenz's law for sense of current; describe the operation of an electric generator; calculate the self-inductance of a solenoid; calculate energy in a magnetic field; predict the voltage or current at either end of a transformer.

Module 8. You should be able to: mathematically describe an oscillating voltage and derive root-mean-square power; explain electric-mechanical analogies; describe the oscillation of charges in an inductor-capacitor circuit; describe a resonance process; calculate the resonant frequency of an inductor-capacitor circuit.

Module 9. You should be able to: explain the fundamentals of Maxwell's unified theory of electromagnetism; describe the generation of an electromagnetic wave in empty space; relate the speed of an electromagnetic wave with its properties; calculate the intensity of a traveling electromagnetic wave; describe the process of polarization; calculate the effect of polarizing sheets on a traveling electromagnetic wave.

Module 10. You should be able to: explain the behavior of an electromagnetic wave at an interface between materials; correctly use basic geometric optics jargon (rays, fronts); apply the law of reflection; find the image formed by a plane mirror; find the object, distance, or focus of a spherical mirror; explain limitations of spherical mirrors.

Module 11. You should be able to: relate the index of refraction with the speed of an electromagnetic wave; qualitatively apply the concept of critical angle; explain total internal reflection; find different color paths in the case of dispersion; find the object, distance, or focus of a converging lens; find the object, distance, or focus of a diverging lens; qualitatively explain imaging by the human eye.

Module 12. Upon mastering this material, you should be able to: mathematically describe a traveling electromagnetic wave; apply the conditions for interference of two electromagnetic waves; explain the interference pattern produced by a double slit; explain the diffraction of light past an opening; calculate the size of the central bright fringe for a diffraction pattern; apply Rayleigh's criterion of resolution.

Module 13. You should be able to: explain the evidence for particle-like behavior of light; explain the evidence for wave-like behavior of particles; calculate the de Broglie wavelength of a particle; describe photoelectric effect; explain Einstein's hypothesis about quanta; find metal work function or maximum kinetic energy of emitted electrons in photoelectric effect.

Structure of Class:

Research has shown that student learning is optimized when students are actively engaged in their learning, so this course will make use of evidence-based approaches to facilitate active engagement. In order to gain the most benefit from these approaches, you will need to be an equal partner in the learning process, which will involve in-class discussions, group problem-solving, and coming to class prepared to engage with the content (for example, reading the relevant material in the textbook prior to lecture). Being equal partners in the learning process means that I will arrive to class prepared to serve and support you in your learning through interactive demonstrations, thought-provoking discussion questions, and carefully designed activities. I will also listen intently to any difficulties you encounter, be sensitive to the diversity of backgrounds of my students, and be accessible to you during my office hours and via email.

Each of the Modules related to the Learning Objectives will typically comprise 2-3 classes. Before the first class in each Module, you will be expected to have read the relevant chapter in your textbook. Then during class, you will be given a brief overview of the material for that module, via PowerPoint presentation, with conceptual discussion questions interspersed throughout the lecture. This will give you a chance to think about the material and discuss it with your peers, and receive credit for your discussions via electronic clicker response. In addition, I will typically incorporate at least one demonstration for each Module. You will be asked to participate in these demonstrations by predicting what you believe the outcome will be, based upon what you have learned in the Module. I will present example problems related to each Module and you may be asked to work in groups on problem-solving exercises.

Learning involves productive struggle, and chances to improve. As such, exams are seen as part of the learning and growing process, and each exam experience can help inform you on how to improve. My hope is that by the end of the semester, you will view the subject of physics as interesting and understandable when we work effectively towards unraveling its mysteries.

Grading Scheme:
Highest of the following:

20% Recitation, 10% HW, 5% Clickers, 40% Midterms (Lowest one dropped), 25% Final Exam
OR
20% Recitation, 10% HW, 5% Clickers, 25% All Midterms, 40% Final Exam
OR
100% Final Exam

Important Dates:
Jan. 17 Add/Drop Ends
Feb. 4 Exam 1
Mar. 3 Exam 2
Mar. 31 Exam 3
Mar. 6 Student Withdrawal Ends
Apr. 22 8:00AM-9:50AM Final Exam

Tentative Schedule:

Week	**Tues**	**Thurs**
1	**Jan.** 7 (M1)	9 (M1)
2	14 (M2)	16 (M2)
3	21 (M3)	23 (M3)
4	28 (M4)	30 (M4)
5	**Feb. 4(Exam 1)**	6 (M5)
6	11 (M5)	13 (M6)
7	18 (M6)	20 (M7)
8	25 (M7)	27 (M7)
9	**Mar. 3(Exam 2)**	5 (M8)
10	10 X	12 X
11	17 (M8)	19 (M9)
12	24 (M9)	26 (M10)
13	**Mar. 31(Exam 3)**	**Apr.** 2 (M10)
14	7 (M11)	9 (M11)
15	14 (M12-13)	16 (M13)
16	**Final Exam: Wednesday, April 22**	**8-9:50AM**

X = No Class
M1, M2, etc. = Module 1, Module 2, etc.

Homework:

Your homework will consist of reading the textbook, and practicing solving problems. While the direct impact on your grade may be small, taking homework seriously will have an indirect effect on other components of your grade. For example, careful reading of the textbook and practicing problem-solving will typically result in better test performance than skipping these activities.

Group Work:

Collaborating on problem-solving helps allow you to co-construct knowledge with your peers and tackle complex problems together. The context-rich problems given in recitation demand careful and deliberate problem-solving strategies, including conceptual analysis of the problem prior to planning and implementing your solution, and this kind of practice will help avoid the temptation to superficially "plug and chug" an answer without deeper understanding. The deeper understanding you gain will help you see connections to problems that utilize the same underlying principles, even if they superficially appear dissimilar, and that kind of transfer skill will allow you to solve problems better on exams.

Clickers:

We will make extensive use of clickers for conceptual discussion questions, and as a means of responding to other activities. Clicker questions will be formatted as multiple choice questions; however, you will receive 80% credit simply for participating in the clicker response. Should you get the correct answer, then you will receive 100% credit for that question. You do not have to give the same response as the other members of your group–your clicker responses are confidential and individual. Discussions among your group helps you think about what you believe the answer might be, but ultimately you are free to take a dissenting position from the members of your group.

Exams:

Exams will be mainly multiple choice, with 1-3 open-ended questions as well. The exams should be viewed as a learning experience, which is why you will be given 3 midterm exams, the lowest of which is dropped. This will allow you to learn from each exam experience and have an opportunity to improve.

Attendance:

Your regular attendance is absolutely crucial for obtaining a good grade. If you must miss class for health-related reasons, you should notify me in advance of your absence. If you must miss class for an emergency, please notify me as soon as you possibly can. Whether or not you are excused from in-class assignments will be at my discretion. Generally-speaking, if you have been absent more than three times, I will request a doctor's note to justify excusing any further absences. If an absence is unexcused, you will not receive credit for in-class graded activities. If an absence is excused, the activities will be excused from your grade, but there will not be time in the schedule to afford makeups of those activities. Therefore, you will be responsible for ensuring that you understand the material, concepts, and problems that have been covered in class, as you will still be expected to utilize this understanding on exams and/or recitation work. Feel free to ask your peers to share any information they have about what you missed. Even if you do not receive credit for what you missed, it will be good for you to know what was done in class in order to do well on the exams.

Code of Conduct:

Communication is key to a productive learning environment, and we can maintain productive communication by exhibiting respect for one another. The success of the course for yourself and others depends on all of our commitment to behavior that demonstrates respect for differences, understanding towards others and a willingness to listen and learn. For these reasons, it is unacceptable to harass, discriminate against, or abuse anyone because of race, ethnicity, gender, disability, religious affiliation, sexual orientation, or age. If you witness or are subject to such harassment, please report it to the instructor or to the Office of Diversity and Inclusion.

Honor Code:

Students are expected to uphold the University's standard of conduct relating to academic honesty. Students assume full responsibility for the content and integrity of the academic work they submit. Students shall be guilty of violating the honor code if they:

1. represent the work of others as their own
2. use or obtain unauthorized assistance in any academic work
3. give unauthorized assistance to other students
4. modify, without instructor approval, an examination, paper, record, or report for the purpose of obtaining additional credit
5. misrepresent the content of submitted work

Any student violating the honor code is subject to receive a failing grade for the course and will be reported to the Vice President of Academic Affairs.

Disability Services:

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and Disability Resources and Services no later than the second week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call (412) 648-7890 to schedule an appointment. The Disability Resources and Services office is located at 140 William Pitt Union, and is open Monday-Friday from 8:30AM to 5:00PM.

Title IX:

Legal text: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." As a professor I am a mandatory reporter, and I am required to report violations of Title IX that I observe or am made aware of to the Title IX office. Title IX violations include, but are not limited to, sexual harassment, sexual violence and verbal or sexual abuse. Within the classroom, behavior in violation might appear as: suggestive jokes or innuendos, inappropriate touching, and unwanted sexual behavior or advances, but my capacity and obligation to report does not end at the classroom.