INSTRUCTOR: Mike Crittenden, phone 343-0055 ext. 6397, e-mail macrittenden@genesee.edu (I check email more often than voicemail. I sometimes check my email on days the class does not meet, but I make no promises. I will usually be in my office, D369, or possibly the lab, B 202, for a while before and after class.)

TEXT: College Physics by OpenStax. An electronic version is available for free at https://openstaxcollege.org/textbooks/college-physics/get (Click one of the options at the right.) An inexpensive hard copy is available in the GCC bookstore and elsewhere.

STUDENT SOLUTIONS MANUAL, recommended. Free. Same link, click on Student Resources.

CALCULATOR with trig functions is required. For tests it must not resemble a phone.

Anticipated Schedule:

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
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<tr>
<td>Tu 7/11/17</td>
<td>Lecture on sec. 1, lab 1</td>
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<tr>
<td>W 7/12</td>
<td>Quiz 1, lecture 2, start 3, lab 2</td>
</tr>
<tr>
<td>Th 7/13</td>
<td>Quiz 2, finish 3, start 4, lab 3</td>
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<tr>
<td>Tu 7/18</td>
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<td>W 7/19</td>
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<td>Th 7/20</td>
<td>Exam 1 (sec1-4), section 7, lab 6</td>
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<td>Tu 7/25</td>
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<td>W 7/26</td>
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<tr>
<td>Tu 8/1</td>
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<td>W 8/2</td>
<td>Quizzes 9 &amp; 10, finish 11, start 12, lab 11</td>
</tr>
<tr>
<td>Th 8/3</td>
<td>Quiz 11, finish 12, start 13, review, lab 12</td>
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<tr>
<td>Tu 8/8</td>
<td>Quiz 12, Exam 3, finish 13, lab 13</td>
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<tr>
<td>W 8/9</td>
<td>Quiz 13, section 14, review.</td>
</tr>
<tr>
<td>Th 8/10</td>
<td>Quiz 14, Retests, Final Exam</td>
</tr>
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</table>

Final Exam: Anyone wanting to take the Final on Friday August 11 will be allowed to do so.

(Students with accommodations are expected to take quizzes & exams the same day as everyone else.)

GRADING SYSTEM/COURSE REQUIREMENTS:

You must earn at least two thirds of the possible lab points or you will receive an F for the course, regardless of your test scores. (This means you fail if you miss more than four labs.) Otherwise, and assuming no deduction for dishonesty, your grade is determined as follows. (You can keep track of your grades below. Keep graded papers in case you find an error in my records.)

Quizzes (10 pt each): __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ = __________

Labs (10 pt each): __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ + __________ = __________

Exams 1, 2 & 3 (100 pts each): __________ + __________ + __________ = __________

Final Exam (175 pts): __________

Total: __________

No grades are dropped, except when replaced by a retest. No extra credit.

A: 89% - 100% (663 - 745 points)
B: 78% - 89% (581 - 662)
C: 67% - 78% (499 - 580)
D: 56% - 67% (417 - 498)
F: 0 - 56% (0 - 416)

I might lower the cuts between letter grades a little (improving borderline grades) based on effort and
the difficulty of the tests. If a lab or test has to be canceled, the same percents will apply to the smaller number of possible points.

To estimate your grade before the course is over:

\[
\frac{1.88\text{ (quiz total so far)}}{\text{(number of quizzes so far)}} = \quad \frac{1.75\text{ (lab total so far)}}{\text{(number of labs so far)}} = \quad \frac{.637\text{ (exam total so far)}}{\text{(number of exams so far)}} = \quad \text{Total:} \quad \%
\]

(Some people vary a lot between exams, so early in the course, this estimate would be very crude.)

With nearly perfect lab grades, which most people have, roughly 50% is the minimum needed on quizzes and exams to pass with a D. Low 60's for a C, mid 70's for a B, upper 80's for an A. (The idea is that "B" means "above average;" about half of a typical class scores above 75% on a typical test.)

Other grades:

W: To withdraw, contact the records office by midterm. Ws cannot be issued by faculty.
IP: Contact me by the day after the final. As with any time extension, you need a legitimate reason.

Retests:

I do not drop any grades; instead, you can take another test on the same material. The better of the two grades counts. Making up a test you missed counts as a retest unless I agree otherwise.

You may take retake at most 7 quizzes. (Once per quiz; no re-retests.) Retake quizzes 1 – 4 on or before the day of Exam 1, 5 – 8 by Exam 2, 9 – 12 by Exam 3, 13 & 14 by the Final. You may take one of the 100 point exams over, on the date in the schedule above. There are no retests on the final.

IS THIS THE RIGHT PHYSICS COURSE FOR YOU?

PHY 100 is for students with an unrelated major such as Elementary Ed, Business or Drama.
PHY 121 & 122: for technology or health-related majors such as Drafting, Chiropractic or Pharmacy.
131, 132 & 133: for majors closely related to Physics such as Physics, Engineering or Mathematics.
It's fine to take a course which is more than the minimum necessary. Also, requirements vary between four-year schools; you should check what is required where you want to go.

COURSE DESCRIPTION:

Catalog description: An algebra/trigonometry based introduction to physics for career or transfer students with majors somewhat, but not closely, related to physics. Topics include Coulomb's law, potential, Kirchhoff's laws, capacitance, magnetic fields, induction, RC, RL and LC circuits, alternating currents, sound, electromagnetic waves, standing waves, interference, optics, atomic and nuclear physics. Three class hours, three lab hours.

Prerequisite: MAT 121 or MAT 136 or higher or by placement.
Student Learning Outcomes:

Upon successful completion of the course, students will be able to demonstrate:

*1. The ability to explore natural phenomena using scientific methods, in the course's laboratory. ("Natural phenomena" means actual physical processes taking place live, as opposed to videos or simulations. "Laboratory" means an appropriate facility containing necessary equipment, as defined by the list included in the Course Outline. For a minimum of ten of the three-hour labs, students must measure something real, in the presence of the instructor.) This includes the ability to
   a. use laboratory equipment when given written instructions.
   b. use methods covered in class to determine desired quantities from measurements.
   c. determine the probable error in what has been calculated from the measurements.
   d. draw valid conclusions on whether their results are in agreement with generally accepted values or principles.

Students must submit lab reports worth at least two thirds of the possible lab points to receive credit for the course.

*2. The ability to apply data, concepts, and models in the field of physics, as documented by performance on quizzes, exams and the comprehensive departmental final. These tests contain both conceptual questions and quantitative problems, with the emphasis on quantitative problems. Partial credit will be given based on how closely a student's solution resembles a correct one. The following will be demonstrated:
   a. fluency in the course's prerequisite mathematics.
   b. the ability to interpret graphs.
   c. consistent use of units.
   d. the ability to apply the meaning of terminology verbally and in solving problems.
   e. the ability to apply basic physical principles verbally and in solving problems.
   f. the ability to do the above in the context of a variety of topics, as listed in the course's content outline.

3. Critical thinking (reasoning) ability as documented by solving exam problems which are not identical to others they have seen before, and whose solution involves two or more steps, including algebraic problems in which one equation must be used to find something needed in another. Students must show, in written form, how they have done this; that is, present a well-reasoned argument for their answer.

* This course objective has been identified as a student learning outcome that must be formally assessed as part of the Comprehensive Assessment Plan of the college. All faculty teaching this course must collect the required data and submit the required analysis and documentation at the conclusion of the semester to the Office of Institutional Research and Assessment.

RULES & POLICIES:
Attendance is only monitored so I can report it to others, not for any purpose of my own. (I’m here to judge how good you are at physics, not to be your mother. Keep in mind that people who don't come to class often get low grades because they don't learn much.)

Missing a quiz or exam: If possible, contact me on or before the day of the test. You will probably need to document the fact that missing the test was beyond your control. (Paperwork from your medical treatment, the receipt for your car’s repairs or parts, the police report …) If you’re sick for a quiz but not sick enough to see a doctor, just take the retest. If this happens for a big test, discuss it with me. If it’s a day or two after the test, you will need to explain why you couldn’t contact me sooner. I try to be reasonable; however, the final judgment as to what is reasonable is mine, and I may reject any undocumented excuse. If I do, the zero can be raised by a retest the same as any other grade. Don’t miss the Final without a good reason.

Missed or late labs: Labs are due when you leave the laboratory; get written permission to finish one at home. I do not accept late papers without a reason; "I forgot to bring it" will work a few times. Make a missed lab up within one week of the scheduled date, unless you have a documented hardship.

Behavior: If I feel you are unacceptably offensive or distracting, I may deny you permission to be in class for however long seems appropriate to me. This includes possible expulsion from the course, with zeros on all remaining work. I've never had to do this; let's keep it that way. For more information on behavior, put “student code of conduct” in the search box at genesee.edu.

Plagiarism and Cheating: Cheating is obtaining or intentionally giving unauthorized information to create an unfair advantage in an examination, assignment, or classroom situation. Plagiarism is the act of presenting and claiming words, ideas, data, programming code or creations of others as one’s own. Plagiarism may be intentional – as in a false claim of authorship – or unintentional – as in a failure to document information sources using MLA (Modern Language Association), APA (American Psychological Association) or other style sheets or manuals adopted by instructors at the College. Presenting ideas in the exact or near exact wording as found in source material constitutes plagiarism, as does patching together paraphrased statements without in-text citation. Disciplinary action may include a failing grade on an assignment or test, a failing grade for the course, suspension or expulsion from the college, as described in the Code of Conduct.

A first offense will result in a course grade reduction of one letter. (If you cheat on an exam, the average of the other two exams will be used as the grade for that exam. If you cheat on a quiz, the average of the other quizzes will be used as its grade. If you cheat on a lab (fabricate or copy data for a lab you did not participate in), the average of the other labs will be used as its grade. After that, 83 points = 11% will be subtracted from your grade for the course.) I will notify the Dean of Students, which will lead to more severe penalties if you have a previous history of dishonesty. A second offense, meaning you previously cheated in any course at GCC, will result in a course grade of F.

Punctuality: If you are late for a quiz or exam, your paper will be collected when everyone else's is, unless you offer a reasonable explanation. If you arrive over 15 minutes after the class has started a lab, you will have to make it up, within one week.

TIPS ON STUDYING & WHAT TO EXPECT FROM THE COURSE:
In class: Take good notes. A lot of this material will not stick to you the first time you hear it. You need something to refer to as you do the homework. If following the lectures is hard, do the reading before I go over it so you have an idea of what I’m talking about.

At home, for each section of the course: It’s more important to practice solving problems than to read the text over and over. Work on the homework until you can put the solutions on blank paper, just like during the quiz. Once you can do it at home, you can do the exact same thing in class. (Unless you have issues with test taking. Go to the CAP center for help in that case.) If you need more practice than just the homework, go over the sample problems from the notes and text: cover up the solutions, try them, and then compare. There are also many end of chapter problems, which I would be glad to help you with.

For the 100 point exams (and final): Refresh your memory by reading back through your notes. If there are areas where you do not feel confident, practice by solving problems. Doing new ones, such as end of chapter problems from the text, is better than the same old ones over again.

This is a fairly demanding course for the average student. Expect to follow the 2 to 1 rule. (Two hours outside of class per credit, in a regular semester. Since a summer course goes three times as fast, this means 24 hours per week outside of class for this course.) You don't get good at a sport or musical instrument without regular practice; the same is true here. On the other hand, don't be intimidated. Just because every detail is not crystal clear does not mean you're doomed to failure. While people who study hard don't always get A's, it's rare for them to actually fail. And who knows? You may even discover that the mathematical description of nature can be an interesting subject.

SUPPORT SERVICES: If you need any sort of help, please ask me for it; repeatedly if necessary. A tutor is usually available. Ask me or at the C.A.P. to find out.

For information on other kinds of support such as testing services, disabilities support, internet access, help desk, financial, transfer or career services, or contact information for GCC people or offices, see genesee.edu. There is an “Information for All Students” document: From www.genesee.edu, click Student, just below the search box. Under Student Services, click Help Desk/Technical info. Click IFAS.
I will quiz you on homework rather than collecting it. Each assignment consists of five quizzes; on the dates indicated earlier, you will be given one of them in class, with the numbers changed.

Complete, line by line solutions are at [http://faculty.genesee.edu/macrittenden/phy122.htm](http://faculty.genesee.edu/macrittenden/phy122.htm) and at the library's circulation desk. (I do not use Blackboard; this website is on a different server.)

Do not try to save time by just memorizing these solutions. The quizzes are only 19% of your grade; the rest of the time, you need to understand what you're doing. You can't learn to play the piano by just watching other people play, and you can't learn physics by just watching problems be solved. This course is primarily about analytical skills, and skill comes from practice:

First, try to do the assignment yourself, from the text and your notes. If you don't spend 2 or 3 hours on it before you decide you need help, you're not making a serious attempt.

Then, use my solutions to help with the parts you're stuck on. If the part you're stuck on is the whole assignment, see me or a tutor.

Remember, I'm paid to do this. It's not an imposition if you come to my office and ask me to do my job.

Sec. 1: Electric Forces and Fields

Reading: From PHY 121: unit conversions p. 17 – 19
Ch. 18, sections 1 – 5.

Quiz A. 1. (2 points) Draw an arrow in the direction of the force on the electron. Draw another arrow in the direction of the electric field vector at the electron’s location. (Indicate which is which.)

2. (2 pts) An electron is placed between charged parallel plates. Explain why using Coulomb’s law in this situation gives an incorrect answer for the force on the electron.

3. (6) An iron nucleus contains 26 protons (among other things). How far from it to a point where its electric field is one billion pounds per coulomb?
   ans: 2.90 nm

Quiz B: 1. A small charged object A creates an electric field. At a point P located 0.250 m directly north of A, the field has a value of 40.0 N/C directed to the south. What is the charge of object A? (Include its sign.)
   ans: -278 pC

2. A second object B, with the same charge as A, is then placed at 0.250 m south of A. What is the magnitude of the total electric field produced by the two objects at P? ans: 50.0 N/C
Quiz C. A ball is given a charge of 2.70 μC. An electron is placed 14.0 mm to the right of it. Find
a. the force on the electron, including its direction.
b. the electric field vector at the electron’s location, including its direction.
c. the electric field vector, including direction, at this same point if a +3.2 x 10⁻¹⁹ C ion was there instead.

ans: 1.98 x 10⁻¹¹ N left, 1.24 x 10⁸ N/C right, 1.24 x 10⁸ N/C right

D. Two small charged objects are on the x axis: q₁ = 5.00 μC is at x₁ = −1.00 m and q₂ = 3.00 μC is at
x₂ = 1.50 m. Find the force \( \vec{F} \) exerted on a charge q = -5.00 μC placed at the origin (x = 0).

ans: .165 N left

E. Two charged objects are located on the x axis, as shown. If a proton is placed at a certain point to the right of both charges, the
total force on it is zero because \( \vec{F}_4 = \vec{F}_6 \). (The force from the 4 μC charge is the same size as the force from the 6 μC, so they
cancel.) Find this value of x.

ans: 16.3 m

Sec. 2: Potential, Capacitors & Dielectrics

Read: Work & energy from PHY 121: Skim the early part of Ch. 7, especially sec. 1 & 3.
Ch. 19, sec. 1, 2, 5 & 6.

Quiz A. 1. (1 point) A proton and an electron are in empty space, far from any other sources of electric fields. Which is at the higher potential?

2. (4 ) Ten joules of potential energy is lost by a +1.00 C charge as the electric force pulls it from point A to point B. (a) What is the potential difference between A and B? (b) How much potential energy is lost by a proton moving from A to B?

ans: -10 V, 1.6 x 10⁻¹⁸ J

3. (5) The plates of a parallel plate capacitor are .116 mm apart. When the plates are in a vacuum, the
capacitance of the device is 4.9 pF. (a) Calculate the value of the capacitance if the space between the
plates is filled with nylon. (b) What is the maximum potential difference that can be applied to the plates
without causing dielectric breakdown?

ans: 16.7 pF, 1.62 kV

B. 1. (2) Explain the difference between potential and potential energy.

2. (2) Two capacitors in series are connected to a battery. They have different capacitances; call the larger
one $C_1$, ($C_1 > C_2$).

a. Compare their charges. ($Q_1 > Q_2$? $Q_1 = Q_2$? $Q_1 < Q_2$?)
b. Compare their voltages. ($V_1 > V_2$? $V_1 = V_2$? $V_1 < V_2$?)

3. (6) Find the equivalent capacitance between points a and b.
   ans: $12.9 \mu F$

C. 1. (1 points) If you double the voltage between the plates of a capacitor, what effect does it have on the capacitance?

2. (4 pts) Two conductors having net charges of +10.0 $\mu C$ and -10.0 $\mu C$ have a potential difference of 10.0 V. Determine
   a. the capacitance of the system, and
   b. the potential difference between the conductors if the charges are increased to +100 $\mu C$ & -100 $\mu C$.
   ans: 1.00 $\mu F$, 100 V

3. (5). An electron is placed in the uniform electric field between two charged parallel plates which are 12 mm apart. To have a force of $1.64 \times 10^{-14}$ N on the electron, what should the potential difference between the plates be?
   ans: 1.23 kV

D. 1. (4 pts) A parallel plate capacitor with air between its plates is charged to 31.5 volts. The capacitor is then isolated from the charging source, and the volume between its plates filled with paper. Determine the new potential difference across the capacitor.
   ans: 8.51 V

2. (6) What is the equivalent capacitance between points A and B?
   ans: $11.8 \mu F$

E. 1. (2 points) A test charge is located at a certain point in an electric field. If the charge of this test charge is doubled, with no change in the field it was placed in, what happens to the electric potential (the "voltage") of the point?

2. (8) Determine (a) the capacitance, and (b) the maximum voltage that can be applied to a Teflon filled parallel-plate capacitor having a plate area of 1.75 cm$^2$ and plate separation of .0400 mm.
   ans: 81.3 pF, 2.40 kV
Sec. 3: Current, Ohm’s law, Power.

Read: Review Ch. 18, sec. 2.
Ch. 20, sec. 1, 2, 4 & 6.

Quiz A. 1. (7 points) 4.76x10^21 electrons flows through a certain space heater each minute. (It is using direct current.)
   a. How much charge flows through it each minute?
   b. What is the current in it?
   ans: 762 C, 12.7 A

2. (3) A certain radio resistor is marked 1.73 x 10^5 Ω. How much current flows through it when connected to a 1.57 V battery?
   ans: 9.08 μA

B. 1. (2) The battery in a circuit is like the pump in a water system.
   a. The pump's pressure could be compared to the battery's __________________.
   b. How many gallons per second flow through the pump is like the battery's __________________.

2. (2 points) A safety rule one sometimes hears is to always keep one hand behind your back while working on a live electronic circuit. Explain the idea behind this rule.

3. (6) A certain 1400 W space heater is designed to operate on 120 V. How much current flows through it when it is operating? What is its resistance when operating?
   ans: 11.7 A, 10.3 Ω

C. 1. (1 point) Two bare wires are both connected to 12 V. One carries 1 A and the other carries 10 A. Which is more of a shock hazard, or are both the same?

2. (2 pts) Children are warned not to fly kites around high voltage power lines, yet birds sit on them without harm. Explain why the wires are dangerous for children but not birds.

3. (7) A 1500 W electric heater, a 750 W toaster, and a 1000 W electric grill are all connected to the same 120 V circuit. (a) How much current does each draw? (b) Is a 25 A circuit breaker sufficient in this situation? (Show how you got your answer; a "yes" or "no" that looks like a guess will not get full credit.)
   ans: 12.5 A, 6.25 A, 8.33 A, No

D. 1. (3 points) Electric current flows into a light bulb through wire A, and out of the bulb through wire B.
   a. The current in A is ________ (more than, less than, equal to) the current in B.
   b. The voltage in A is ________ (more than, less than, equal to) the voltage in B.
   c. The energy per unit charge in A is ________ (more, less, equal) that in B.
2. (7) The potential at each of the labeled points is \( V_A = V_B = V_C = 0 \), \( V_D = 10 \text{ V} \), \( V_E = 12 \text{ V} \), \( V_F = 24 \text{ V} \). Find the current through each of the four resistors.

ans. \( I_1 = 4 \text{ A} \), \( I_2 = I_3 = 2 \text{ A} \), \( I_4 = 6 \text{ A} \)

E. 1. (2 pts) Two light bulbs are both plugged into the same voltage. One has a greater power (“wattage”) than the other. Which bulb has the higher resistance? Which bulb carries the greater current?

2. (3) \( 9.00 \times 10^{12} \) electrons cross a given cross section of a conductor in three seconds. Calculate the current.

ans: 481 nA

3. (5) A man puts some stuff in his attic, and forgets to turn off the 60 watt light. He notices and turns it off a month later. (Exactly 30 days.) At \( 3.00 \times 10^{-6} \) cents per joule, how much did this cost him?

ans: $4.67

Sec. 4: Kirchhoff’s laws.

Read: Ch. 21, sec. 1, 2 (just to middle of p. 816) & 3

A. 1. (2 pts) a. Draw a circuit consisting of a battery and two resistors such that the resistors have the same current.
b. Draw a circuit consisting of a battery and two resistors such that the resistors have the same potential difference.

2. (8) Find the charge on the capacitor. (Hint: First, use one of Kirchhoff’s laws to get the voltage across it.)

ans: 6.00 \( \mu \text{C} \)

B. 1. (2 pts) Two identical resistors are connected in parallel. The equivalent resistance of the group is ______ (more than? less than? equal to?) the resistance of one resistor alone.

2. (8) Find the power consumed by the resistor R.

ans: 20.0 W

C. The ammeter reads 2.00 A. Find \( I_1 \), \( I_2 \), and \( \varepsilon \).

ans: .714 A, 1.29 A, 12.6 V
D. 1. (2 pts) A student uses the loop rule to write this equation: $3 \, V + (5 \, \Omega)(I_1) - 7 \, V - I_2 = 0$. Without even seeing the circuit, how can you tell that this is incorrect?

2. (8) What does the ammeter read?
   
   ans: .167 A

E. 1. (2.5) In this circuit, what is the potential difference across resistor R?

2. (7.5) The resistor at the lower left has a resistance of R. The others are two or three times as much, as shown. What is R?

   ans: 2.25 \, \Omega

Sections 5 - 14 will be handed out later, and are available now at http://faculty.genesee.edu/macrittenden/phy122.htm