Physics 240: Practical Electronics

Fall, 4 Units (3 Lecture, 1 Lab)

Lecture, Lab MTWR 3:30 - 5ish

Prof. Nicole Ackerman

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Office: Bullock 106W — 404-471-5627

1 Course Description

From Catalog: Electronic devices are all around us, but what is inside and how do they work? This course will build on a basic physics understanding of charge, current, and voltage; covering DC components, frequency response, semiconductors, op-amps, digital signals, and microprocessors. Students will design, build, and measure circuits, utilizing computer simulation and calculations to predict circuit behaviors. The class culminates in designing and building an Arduino-based project to solve a real-world problem.

This course counts towards the "Summit in STEM" requirement as a Leadership Skills course (Digital Literacy).

1.1 Course Goals

At the end of this course, you will be able to:

1. Interpret a circuit diagram, identify basic components, find the specifications of those components using online resources, and construct the circuit.
2. Design and build circuits to meet specifications, utilizing theory, simulations, and iterative design.
3. Interrogate and troubleshoot circuits using tools such as multimeters, function generators, and oscilloscopes.
4. Communicate information about circuits using videos, circuit diagrams, and graphical representations of data
5. Design and construct a functional device, based on the Arduino microprocessor, to solve a real world problem or complete a useful task

While not identically worded, note that many of the SLOs for this course relate to the Summit Student Learning Objectives (found on page 40 of the 2016-2017 Academic Catalog):

4. Communicate effectively through writing and speaking, especially across cultural or linguistic differences
7. Recognize, analyze, and employ effective teamwork (While not reflected in the learning outcomes for PHY240, this course has a substantial teamwork component)
10. Interpret quantitative information or demonstrate the methods of inquiry appropriate for investigating the natural world

This course also relates to a number of the learning outcomes for the Department of Physics and Astronomy:

1. Formulate an approach to solve fundamental problems of physics or astrophysics, using the necessary mathematical skills;
2. Write basic computer programs to solve scientific problems;
3. Conduct experiments using modern instrumentation;
4. Employ scientific modeling, analysis, and visualization tools;
6. Present scientific results, including their historical contexts, in clear written and oral language.

1.2 Intended Audience

This course is for anyone who wants to understand circuits well enough to build electronic solutions to the problems they see around them. Frequently taken by physics, astrophysics, and math-physics majors, it would also be helpful for chemistry and neuroscience majors. Students from outside the sciences who want to learn more about circuits due to personal interest are very welcome!

Pre-requisites PHY103 or PHY203 or by demonstrating basic understanding of circuits

2 Course Details

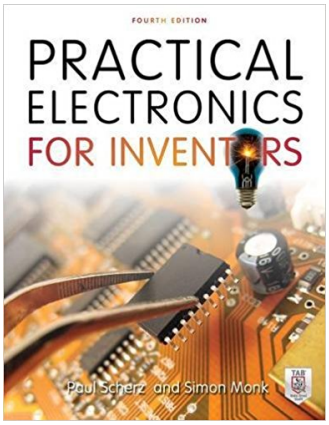
Credits:	4 Credits	3 Lecture, 1 Lab
Class Sessions:	MTWR 3:30-5ish PM	Bullock 108W
Office Hours:	Monday 2:00 - 3:00 PM	Bullock 106W
	Monday 7:00 - 8:00 PM	Bullock 106W
	Thursday 10:00 - 11:00 AM	Bullock 106W
	Friday 10:30 - 11:30 AM	Bullock 106W
	Friday 1:00 - 2:00 PM	Bullock 106W

Due to accommodating all students' schedules, the course has an unusual structure. According to the registrar and AscAgnes, "Lab" technically is Monday and Wednesday from 3:30 to 5 and "Lecture" is Tuesday and Thursday from 3:30 to 4:45. However, we will do lecture-like activities on Monday and Thursday and have "lab" on Tuesday and Wednesday. This makes more sense for your learning! I will try to wrap up class around 4:45 each day, but you may want to ask questions or continue to work with your team members during the last portion of class.

You will spend about 6 hours per week in class, but you should expect to spend many hours preparing for class, completing assignments, and building your project. The reading will vary significantly from week to week, but you should anticipate 2-3 hours on average, with some weeks requiring much more. The homework assignments are fairly short, taking an hour or less per week. There are two video projects, each of which will take many hours (but which can be distributed over two or more weeks). Finally, your Arduino project is a major undertaking, but you will have about half of the semester to work on it.

2.1 Required Materials

Required Textbook: *Practical Electronics for Inventors, 4th Ed* By Scherz and Monk



This book is available in electronic and paperback formats. This is the first year this textbook is being used for this class, so I have no information about whether the electronic version is sufficient (from a student perspective). The 4th edition was just released, so you will also see the 3rd edition widely available. Some readings will be specified at the *subsection* level, which may not agree in numbering between the 3rd and 4th edition. Note that there will not be a copy of the book on reserve in the library (to my knowledge), but there is a copy of the 3rd edition available in the electronics lab (which should not be removed).

3 Assistance for Building Your Skills

There are many resources available to help you build your skills in this course. Myself, the textbook, and assignments may be the most obvious ones, but there are additional tools that can be used if you want to improve your skills and performance.

3.1 Moodle

I will heavily use Moodle, including posting resources and assignments. There is a class forum which I encourage you to use to ask questions! It is possible that another student has the same question, so sharing the question and answer with everyone is beneficial. I will try to reply to questions on Moodle as soon as I see them, but occasionally I am away from the computer for hours at a time. You should typically expect a response within 24 hours. I will notify the class if I am traveling and Moodle responses will be slower.

3.2 Office Hours and Appointments

Questions are often addressed quickest in person, so I encourage you to come to office hours with any and all questions. I have "open" office hours, meaning that I leave the door open so students can come and go as needed. It is possible that my office hours will be utilized by students in PHY202 as well; typically there are certain sessions they use more heavily than others. I prefer to stay *in my office* during office hours, so I am unable to come to the lab to help you debug your circuit at that time.

If you are unable to make it to my normal office hours or wish to meet one-on-one, please schedule an appointment with me. Use **Compass** to book an appointment during one of my appointment slots (separate from office hours). These appointments can be used for homework, general questions, or advising. Appointments are especially recommended for "circuit debugging" help.

Due to my teaching schedule (and appointments with students), I may not be available if you just drop by my office. Please note that I will not be available to help with homework right before it is due. If you have questions on an assignment that you will be submitting late (see subsection 4.1), make sure to schedule an appointment - I will not provide assistance with late assignments during office hours out of respect of other students' time.

3.3 E-mailing and Calling Me

Typically, I will not see e-mail any quicker than Moodle posts. Of course, I'm happy to address questions and concerns through e-mail that you don't want to share publicly. Using e-mail is preferrable to the phone; the phone sits on my desk, while I am usually near an e-mail (and Moodle!) retrieving device. I don't always check e-mail during the weekends, but I will try to reply to e-mail within 24 hours during the weekdays.

3.4 ADA

Agnes Scott College seeks to provide equal access to its programs, services and activities for people with various abilities. If you will need accommodations in this class, please contact the Office of Academic Advising and Accessible Education (404-471-6150) to complete the registration process. Once registered, please contact me so we can discuss the specific accommodations needed for this course."

4 Evaluation

Grades will be determined by the following percentages. Please see subsequent sections for information on what each assignment is; many have sub-categories.

Type of Assignment	Total Percent of Grade
TBL	20%
Tutorials	10%
CATME	10%
Labs	20 %
Homework	10%
Video Projects	10%
Arduino Project	20%

There *may* also be some extra credit opportunities throughout the course. The point value (and category) will be announced ahead of time. These extra credit opportunities may require attendance of events (Maker Faire!), writing, and/or completing online activities. My standard late penalty applies and I may give partial or no credit if the work is low quality.

4.1 Late Assignments and Rescheduling TBL

Assignments have a specific date and time they are due. TBL quizzes have a specific class period they will be given. This information is available far ahead of time so that you can arrange your schedule accordingly. If you turn in an assignment late, you will lose 20% for every day it is late, including days of the weekend. Assignments turned in after homework has been graded will not be accepted. You should e-mail me to co-ordinate where you will turn homework in if it is late.

Homework should be submitted during class. Please e-mail me to let me know if you will be submitting the assignment late, and leave the assignment in the clear box outside my office. Please do not slide the assignment under my door, and please do not e-mail me scanned or photographed copies of the assignment. Note that the CATME online assignments *cannot* be submitted late. You will receive a zero if they are not complete on time.

Projects may have multiple components (electronic, written, presentation) that need to be submitted in different manners. Detailed guidelines for projects will be available on Moodle. Note that in-class presentations *must* be done on the scheduled day. If you have a conflict (sports, religious, etc), let me know at the beginning of the semester.

TBL quizzes are unique in that they have a team-based component. If you are going to miss a class with a TBL quiz, you may take the individual component on the previous Friday (make sure to e-mail me at least a week ahead of time). If you are sick or otherwise unexpectedly miss class on Monday, you may take the individual component before class on Tuesday (you *must* e-mail me to arrange this). It is not possible to "make up" the team part, but note that the lowest two TBL individual and team grades are dropped.

4.2 Grades

The final grades will be determined according to the following percentages. Descriptions are provided only as a guideline: grades cannot be negotiated.

A: 93-100 A-: 90-92	The student extensively prepared for class, made significant contributions to their team, and turned in all assignments on time. Projects and homework demonstrated conceptual understanding and the ability to perform calculations. Projects were carefully designed and clearly documented.
B+: 87-89 B: 83-86 B-: 80-82	The student prepared for class, fully participated in their team, and turned in assignments on time. Homework indicated a few problems with calculations or conceptual understanding. Projects were adequately completed but the documentation had room for improvement.
C+: 77-79 C: 73-76 C-: 70-72	The student often was unprepared for class and minimally participated in their team. Some assignments were turned in late. Homework may have indicated that the student has not mastered the conceptual understanding and calculations. Projects were not always successful and the documentation was insufficient.
D+: 67-69 D: 63-66 D-: 60-62	The student missed classes, was unprepared when present, and did not contribute to their team. Some minor assignments were not turned in, or many were turned in late. Low scores reflect poor preparation and problems with calculations and conceptual understanding. Projects were not completed and the documentation was incomplete or incorrect.
F: <60	The student missed numerous classes. Assignments were turned in late or not at all. The student's performance on assignments showed a lack of preparation and misunderstanding of the core material of the course. Projects were often not completed and much of the documentation was missing.

5 Preparing for Class

The structure of this course presumes that, as an intelligent and hard-working college student, you can learn some terminology and ideas before coming to class. This leaves class time for working with other students and getting help from the instructor. Preparing for class is therefore the *most essential* aspect of this course.

The readings will be posted to Moodle, out of *Practical Electronics for Inventors*. Note that some readings may be specified down to the subsection (such as 2.5.1) in order to reduce the reading as much as possible. You are encouraged to seek out other resources, but note that terminology, notation, and level of sophistication will vary wildly with different books or online videos.

6 Assignments

6.1 Team Based Learning (TBL)

Most Mondays will begin with a TBL quiz (see the calendar!). You will have an initial period of time during which you complete the TBL quiz on your own, and then you will have an opportunity to retake the quiz with your team. You will receive an individual score, and then everyone (present) on your team will receive the same team score. Further information will be presented in class and posted to Moodle. Please see 4.1 for information on missing class on TBL days. Note that the two lowest individual scores will be dropped and the two lowest team scores will be dropped from your grade calculation.

6.2 Tutorials

Some lectures will consist of working in "tutorials". A rubric for the tutorial is posted to Moodle.

6.3 Labs

Working hands-on with electronics is the heart of this course. It is expected that all students will stay focused on lab activities and use that time to its fullest. Some labs will be more open-ended, and others will have well-defined steps. Labs will typically have *one* deliverable that will be graded. This may be a plot, circuit diagram, or written analysis.

6.4 Homework

There will be weekly homework. It should be completed individually, but you are welcome to talk to your classmates about it. You must list the "resources" that you use on the top of homework - this may be people, websites, books, or anything else you used to complete it.

Homework is due on *Friday*, giving you the opportunity to make any changes based on Thursday's lecture. In general, you should be able to complete the homework based on what is covered in Monday's class and the reading. You should submit the homework by **2 PM** on Friday. It will not be late if it is submitted before I leave campus, but that will usually be at 2 PM. You are welcome to submit it during class on Thursday.

6.5 CATME

"CATME" is a peer evaluation system that will be used for teammates to provide feedback to each other. This is completed online, and will be administered 4 times throughout the semester. 4% of your grade is for completing the assessment (including written feedback) and 6% is based on the evaluations you receive. See Moodle for more information - while fair, this is a complicated system.

7 Tests and Exams

There are no tests or exams in this course, other than the TBL quizzes.

8 Arduino Project

This course has a capstone project that you will develop over half of the semester. More information will be posted to Moodle.

9 Course Culture and Expectations

9.1 Inclusion

This course adheres to the principles of diversity and inclusion integral to the Agnes Scott community. We respect people from all backgrounds and recognize the differences among our students, including racial and ethnic identities, religious practices, and gender expressions. We strive for our campus to be a safe space in which all students feel acknowledged and supported and, at the same time, we understand that course content, critical inquiry, and classroom dialogues give us opportunities to examine topics from a variety of perspectives, a defining feature of a liberal arts education, and in the process compel debates that challenge beliefs and positions, sometimes causing discomfort, especially around issues related to personal identities. While we uphold and preserve the tenets of academic freedom, we request and invite your thoughtful and constructive feedback on ways that we can, as a community of learners, respectfully assist and challenge one another in our individual and collective academic work.

It is important to me that the examples and language we use in physics classes are welcoming to all students. I make efforts to avoid analogies based in sexist and heteronormative language, but you may find these when looking at online resources created by others. If you are comfortable doing providing it, I welcome feedback on how I can make my examples more relevant to students from diverse backgrounds.

Working in teams is meant to deepen everyone's learning, but some students may not feel that they are respected by or well-integrated into their teams. I will do my best to facilitate positive team experiences for all students, including providing structures and time for students to develop positive team interactions. Students are encouraged to reach-out to me if they do not see improvement in negative team interactions.

9.2 Title IX

If you have experienced any form of sexual harassment or violence, dating or domestic violence, or stalking, the college urges you to talk to any faculty of staff member with whom you feel comfortable. Faculty and staff members will support you and inform the college, and the college will respond to the problem through its defined procedures. Agnes Scott has supportive professionals in place to help stop, further prevent, and remedy misconduct that you have experienced. Incidents may also be reported directly to Title IX Coordinator Marti Fessenden (mfessenden@agnesscott.edu, 404-471-6547), Deputy Title IX Coordinator Karen Gilbert (kgilbert@agnesscott.edu, 404-471-6435)or Vice President for Student Affairs and Dean of Students Karen Goff (kgoff@agnesscott.edu, 404-471-6449). You should also feel free to talk to the psychologists or health care professionals in the

Wellness Center, or the college chaplain, if you simply need support and do not want the college to initiate any further inquiry. Your discussions with these confidential resources remain confidential."

Marti Fessenden
Title IX Coordinator
mfessenden@agnesscott.edu
404-471-6547

Karen Gilbert
Deputy Title IX Coordinator
kgilbert@agnesscott.edu
404-471-6435

9.3 Academic Honesty

The Agnes Scott College honor code embodies an ideal of character, conduct, and citizenship, and is an important part of the College's mission and core identity. This applies especially to academic honesty and integrity. Passing off someone else's work as your own represents intellectual fraud and theft, and violates the core values of our academic community. To be honorable, you should understand not only what counts as academic dishonesty, but also how to avoid engaging in these practices. You should:

- review each course syllabus for the professor's expectations regarding course work and class attendance.
- attribute all ideas taken from other sources; this shows respect for other scholars. Plagiarism can include portraying another's work or ideas as your own, buying a paper online and turning it in as if it were your own work, or not citing or improperly citing references on a reference page or within the text of a paper.
- not falsify or create data and resources or alter a graded work without the prior consent of your professor. This includes making up a reference for a works cited page or making up statistics or facts for academic work.
- not allow another party to do your work/exam, or submit the same or similar work in more than one course without permission from the course instructors. Cheating also includes taking an exam for another person, looking on another person's exam for answers, using exams from previous classes without permission, or bringing and using unauthorized notes or resources (i.e., electronic, written, or otherwise) during an exam.
- not facilitate cheating, which can happen when you help another student complete a take home exam, give answers to an exam, talk about an exam with a student who has not taken it, or collaborate with others on work that is supposed to be completed independently.
- be truthful about the submission of work, which includes the time of submission and the place of submission (e.g., e-mail, online, in a mailbox, to an office, etc.).

You should understand that penalties result from dishonest conduct, ranging from failure of the assignment to expulsion from the college. You should speak with your professors if you need clarification about any of these policies.

The following behaviors are encouraged in Physics 240:

- Attempting a homework problem and bringing your work to the tutor or professor for feedback on your understanding and approach.
- Discussing your approach to a homework problem with your classmates and then listing their names as "resources".

The following actions are considered a **violation** of the honor code:

- Searching the internet for the (exact) text of a homework problem to find the answer.

- Copying the work of a classmate on a homework problem.
- Using allowed resources (the internet, other textbooks, friends) on homework, but *not listing* those resources.
- Discussing the TBL quiz, including how hard it was or general aspects, with someone who was sick and will be taking it later (or vice versa).
- Interacting with other teams during TBL, including listening to their conversations or looking at their scratchers.

Last updated August 21, 2017