version 1 – draft

SYLLABUS: Physics 231 *Physical Computing*

Spring Semester 2026 – 4 credit hours

Instructor of Record:

Dr. Stefan Jeglinski (Dr J)
- Chapman 315
- jeglin@physics.unc.edu

Location:

Lecture: Synchronous Remote[1]
- Zoom: MF 9:05a-9:55a

Lab: Mostly Asynchronous Remote/In-person[1]
- All sections: No classroom assigned

TAs:
- Simon Tang
  - 1st year grad student in Physics
  - PHYS231 in SP24
- Ashleigh Smith (PHYS231 in SP25)
- Kevin Zhang (PHYS231H in SP25)
- Sophie Lietzen (PHYS231H in SP25)
- Reichen Schaller (PHYS231 in SP25)
- Yucheng Zhou (PHYS231H in SP25)
- Lily Foo (PHYS231H in SP25)

Canvas: https://canvas.unc.edu/
PHYS231.ALL.SP26
*click on **Home** for links+Zoom*

Office Hours:

MF 10:00–10:45a (Zoom)
TTh 1:15p until close (In Person)

By appt days/nights/weekends:
https://calendly.com/jeglin/phys231

There are three important things to understand about this course for SP26:

1. Due to renovations in Phillips Hall during AY26, this course will be taught in a quasi-remote ("hybrid") fashion. Details are explained below.
2. This course has no textbook. In lieu of buying an expensive textbook, you will purchase your own microcontrollers (aka uCs) – often uCs are cheaper than a textbook anyway. Limited loaner options are available, but the loaner approach could cause you to fall behind depending on demand, and stocks are limited. *The Canvas site includes details on what to get and expected costs – click on Support in the left sidebar*.
3. This course has an honors component. See details further down in syllabus and contact the instructor to clarify or change your status in the course.

Finally, please read this syllabus *very* carefully – this course doesn't operate like any of your other courses, and even if you've spoken to previous 231 students about how this course works, there are important new modifications for SP26.

That said, we can promise that you'll learn more than usual from this course, have more fun than usual in this course, and quite possibly gain future employment more directly, either in the private sector or while still in school as a result of the skills you will pick up in this course! – Dr J

This syllabus has a FAQ that ~~most~~ students ~~would~~ will find ~~interesting~~ necessary.

[1] https://registrar.unc.edu/instruction-modes/

Course Goals and Key Learning Objectives: Physical Computing is an introduction to computers, sensors, and actuators, and how they interact as part of sensor-control pathways. These pathways are facilitated by a computing unit that makes control or actuator decisions based on sensor readings. The computing unit is the microcontroller (abbreviated as uC). In addition to the uC, our tools are software, electronic sensors, and a variety of analog and digital electronic components. These random elements are tied together by feedback algorithms; together, the components anticipate and respond to their environment in ways that humans perceive as not inherently computerized. The environment can be either local (e.g., adjusting the speed of a motor in response to some mechanical process controlled by the motor) or remote (e.g., sensing the presence of a person in a remote location and turning a light on/off in response).

Instructional Philosophy. The course is structured to work well for either in-person or remote learning. Our approach to achieving the course goals is somewhat experimental, but importantly the approach mirrors the real world of employment more than other college courses – answers won't always be found easily and may be incomplete or suboptimal; you will rely on outside help more than you may be used to. Our *goal* is to introduce you to the world of the uC and the required programming and support electronics that makes the uC ubiquitous (and often invisible). Your *objective* in part will be to find completions or optimizations to well-specified assignments. In broad strokes, the course will consist of four components: lectures, labs, assessments, and a feasibility proposal exercise. Each of these components will be worth a certain number of "credits" (CR) toward course completion. In much the same way that you get your undergraduate degree, you will complete a minimum number of required core CR and a number of elective CR of your choice. This approach will allow you to tailor the course to your interests while still guaranteeing that you are minimally competent from the instructor's point of view. Each of the four components are described in more detail below:

Lectures. Lectures are scheduled twice per week, on Zoom. Lectures are required; they will be recorded; your attendance is technically optional (see FAQ for important clarifications). The goal of the lectures is to deliver as much technical information as possible in the allotted time so that you can do the labs, and to give you practice with certain concepts. *Students that elect not to attend lectures will find it more difficult to complete the course with a satisfactory grade*. Attendance at lecture is ***highly*** recommended for the following reasons:

- Real-time course announcements are not uncommon during lecture and may not be repeated. "I didn't attend/watch the lecture" will not be considered a valid excuse for missing work, deadlines, or course changes. Hence the lectures are "required" for maximum impact.
- Questions that arise during lectures often provide critical insight that may not be obvious from the course material otherwise provided to students.
- Students can gain extra CR (XCR) from attending and *correctly* answering poll questions given during lecture (see PollEv below). **No Attendance = No XCR**.
- The instructor will remain on Zoom for 45 min after each lecture to answer follow-up questions from students or clarify concepts.

PollEv. Students who want to gain XCR will use PollEverywhere[2] to answer questions or surveys during lecture. XCR will be awarded for *correct* answers to questions. Incorrect or missing answers will not count against students. The instructor will use PollEv as well at Zoom diagnostics to informally track attendance. Although non-attendance will not count against the student, the instructor will use informal attendance information to help assess which students may be struggling in the course. Instructions for signing up for PollEv can be found on the

[2] https://edtech.unc.edu/service/poll-everywhere/

Canvas Home page and in the footnote on the previous page. *The absolute value of the XCR component toward a course grade will not be shared with students*.

Labs. There are no explicit labs times, which should be listed as TBD in Connect Carolina. Unless you're getting honors credit, it doesn't matter which lab section you're enrolled in. Labs will be *asynchronous* (generally done completely on your own time and at your own pace), but not necessarily remotely. How to get CR for labs will be covered in a later section of the syllabus, and each lab on Canvas will include specific details for credit. A wide variety of labs will be available – some will require a local presence (e.g., a lab that requires an oscilloscope in the electronics room), while many if not most can be done remotely. Outside of the required "Core Labs," students will choose which labs to do and when to do them, and even the order in which they do them, within the limits of due dates and prerequisites. Each lab will provide a specific number of CR toward finishing the course. At a bare minimum, students should expect to spend at least 4 hours per week preparing for and working on the lab activities themselves, completing 2 or 3 of them, and an extra amount of time preparing a video submission and an assessment. Roughly 50% of the CR in the course will be awarded as a result of completing labs.

Because of logistical considerations, students are discouraged from suggesting their own labs or extensions to the existing labs. That said, we realize that our subject is both broad and deep and goes far beyond a single semester course; therefore, we do provide lab ideas that students may find interesting to pursue. Although a student's ability to include these in the course will be limited, the instructor will consider requests to earn CR from labs outside of the mainstream offerings. See the FAQ and Canvas site for more information.

Assessments. The course will see a regular stream of quizzes and exams. Time-limited quizzes will be delivered via Gradescope alone; midterm exams will be take-home (to be submitted on Gradescope) and delivered on Gradescope. Virtually every lab will include a Gradescope assessment.

Feasibility Proposal. Every student will be required to write a Feasibility Proposal. Part of this assignment is to carefully define what such a proposal is and its parameters, so we're not describing it in detail here. You'll be given an "imaginary" product to consider, and you'll be responsible for framing the question of whether it's possible to achieve the realization of the imaginary product, given constraints (e.g., financial, technical, ethical, other). This assignment will be a combination of short answer questions on Gradescope and a longer proposal in essay format. *Each lab in the course begins with a listing of goals and technical objectives, which are the two most important components of a feasibility proposal*. Therefore, each lab can be viewed as a dry run for feasibility and provides written examples that can be leveraged. The proposal is envisioned as a 7-page effort consisting of Abstract, Background, Significance, Technical Objectives, and Measures of Success. Details of this course requirement will be delivered during the course.

In the spirit of this description, we can concisely apply this mindset to the course overall:

Course Goals: gain an understanding of the workings, capabilities, and features of small computing units such as microcontrollers and microcomputers.

Course Objectives: install and run development environments; physically connect to computing units, write code; install compiled executables on the computing units; control and/or sense the environment.

This Course is About Technology. To be successful in this course, you must broaden your academic mindset to embrace a *technology* mindset. The focus is on *instrumentation skills and is **insanely** technical*. Many physics classes require analytical insights that are non-intuitive and can be difficult to learn; in contrast, insights in this class are more rule-oriented and fact-based – the rules aren't too difficult, but uCs behave in a very specific way and you must follow the rules precisely and without fail for them to work.

Don't think about the labs (alone or in combination) as complete projects in and of themselves – any *real* projects you do with uCs (e.g., robots, autonomous vehicles) will be realized *outside* of this course, in the future, on your own time and because of your own dedication, either as part of a hobby or a job or your higher education. Your task is to find ways to extend human capabilities of sensing and control to machines, one small piece at a time. Students who complete this course will possess *employable* skills in programming, analog/digital electronics and assembly, instrumentation, and prototyping.

You may find it interesting that 95% of the material in this course can be found merely by looking for it on the internet and "following directions;" however, if you use the internet as your main resource, you can look forward to incomplete, disorganized, incorrect, and outdated information. To learn the same material on your own using the internet would easily take the average student a year if not more.

Prerequisite: PHYS114 or PHYS118 or permission of the instructor. We're required to list these prereqs officially because this course is an elective for the PHYS BS/BA, APPL Minor and COMP BA; however, the instructor pretty much lets anyone into the class. *If you have ABSOLUTELY NO physics or programming or electronics experience, this course will be more challenging and will take more of your time, but it's designed to bootstrap those with no experience*.

Textbook. Textbooks on the topics in this course are mostly obsolete the moment they are published; in lieu of a textbook, you are asked to purchase your own uC(s) and supporting equipment. Some resources are available through course reserves or can be checked out electronically, but few are modern. In large measure, you will get your information first from Canvas, then the instructor or TA, and then the internet.

Use of AI. Students are expected to follow these UNC-developed AI guidelines:

1. AI should help you think, not think for you. You may be able to use AI tools to brainstorm ideas, research topics, and analyze problems, but you must decide what's appropriate and accurate.
2. Engage responsibly with AI. Evaluate AI-generated outputs for potential biases, limitations, inaccuracies, false output, and ethical implications. *Do not make personal or confidential data available to AI tools*.
3. Any AI use must be open and documented. You should declare, explain, and cite any use of AI in the creation of your work using applicable standards (e.g., APA, MLA, course guidelines) as set by the instructor. Understand that you are ultimately 100% responsible for your final product.

Unless you've been living under a rock, you know what an LLM is (Large Language Model) and how it can be used and misused. LLMs are nothing short of a game-changing resource for programming. In addition, LLMs have significant knowledge about uCs, sensors, and electronics. **Access to an LLM is virtually a necessity for this course**. Select an LLM, create an account, and pay for it if you feel the need. *Unless otherwise specified in an assignment, you're free to use LLMs in this course under one limiting rule: you must always acknowledge the extent to which the LLM assisted you in solving your assignments*. See FAQ for more!

Required Materials:

- Multiple uCs – details can be found under **Support/Required/ Recommended/Optional Hardware** on Canvas. At the very least, you should purchase a specialized Arduino uC (Cytron UNO aka "purple" Arduino) for use in the course.
- Secondary electronics components:
  - breadboards, wiring kits, etc.
  - for more details, see Canvas under the **Required… Hardware** tab.
- Tertiary electronics components
  - instructor-supplied items such as servo and stepper motors.
  - details will be delivered before and during FWOC.
- Wireless-enabled laptop with at least 2 USB ports; Windows[3]/macOS[4]/Linux[5]
- Scientific calculator: for lab activities and exams.
- BeAM Makerspace access – see below.

Communication with Instructors or TAs. The official method of communication in this course is e-mail; however, only critical communications will be sent by e-mail or as posted announcements to Canvas. *Most of our communication and collaboration will instead take place via a Discord server*. See the Canvas Home page for Discord details. *Students who miss important communications because they don't check their Discord or e-mail do hereby agree to forfeit credit accordingly, without recourse*.

Attendance. Students are strongly encouraged to attend and participate in every lecture. Although technically optional, lecture attendance will be documented by using PollEv and Zoom diagnostics. There is no attendance relevant to labs – only submission of the required work for credit by the due date. If you miss lab deadlines due to illness or a larger conflict, you must communicate this promptly to the instructor, preferably before the lab due date, but as soon as possible under all circumstances. Students are responsible for learning any material (lecture or lab) that is missed due to absence. Valid excuses for absences that interfere with due dates include:

- Severe illness with doctor's or Dean's note or UAA.
- Grave family circumstances (UAA).
- Religious reasons (UAA or EOC determination).
- Participating in University-sanctioned events with supporting documentation.
- Travel for other classes with supporting documentation.
- *Pre-planned personal trips or family vacations are <u>not</u> valid excuses*.

In large measure, there are no make-ups in this course. If you miss a deadline, we suggest you supply a UAA; otherwise, just do more work later to compensate!

To our knowledge no other class at UNC uses this strategy. Take advantage of it and don't worry too much if you miss something.

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[3] Windows 10 and 11 are officially supported. Windows 10 became EOL on Oct 14 2025.

[4] Tahoe (macOS 26) and Sequoia (macOS 15.x) are officially supported; however, compatibility with the latter is *not* a guarantee because we've never taught the course using Tahoe – we may have to get creative if we discover any incompatibilities. Sonoma (macOS 14.x) is also supported. Older macOS systems can be supported but are EOL.

[5] Some software is not compatible with Linux (e.g., Adobe Illustrator); Linux users should maintain a separate Windows or macOS operating system on the same or another computer. *Officially, we support Ubuntu v22 and v24*.

Quizzes/Exams. An unspecified number of short quizzes and evaluations will be administered, including two longer midterm exams and a comprehensive final exam. These assessments will be a combination of in-class, take-home, and/or on-line using either Gradescope or Canvas. The dates and coverage of the midterms are tentatively set as follows and are *subject to change*:

- ~~Midterm 1: Feb 13–20 (take-home 1, covers Lectures 01–09, Core Labs 00–0x08)~~
- Midterm 1: Feb 16–23 (take-home 1, covers Lectures 01–09, Core Labs 00–0x08)
- Midterm 2: Mar 23–Apr 01 (take-home 2, covers Lectures 01–19, Core Labs 00–0x0F)
- Final Exam:
    - Note: since this course doesn't have a room assignment, it doesn't have a final exam location specified; this will be resolved during the course of the semester.
    - Take-home portion: Apr 24–May 01 at noon.
    - In-class portion: **noon-3pm** on **Wed Apr 29** (set in stone, not negotiable)
    - Comprehensive (covers all Lectures, all Core Labs, other labs, and topics TBA)

The feasibility proposal information will be released as soon as is practical and is due on Apr 17.

Other Important Dates: (https://registrar.unc.edu/registrar-calendar-spring-2026/)

- Mon Oct 20 2025: Registration open.
- Wed Jan 07: University FDOC, no class.
- Fri Jan 09: 231 FDOC.
- Mon Jan 19: MLK, no class.
- Mon Feb 09: wellness day, no class.
- Mon Mar 16: spring break, no class.
- Fri Mar 20: spring break, no class.
- Fri Apr 03: holiday, no class.
- Mon Apr 27: LDOC!

ARS Students: If you have ARS accommodations, register this course via ARS so that the instructor can find out and plan for those accommodations, and contact the instructor immediately with details.

Course Collaboration. Our enrollment is typically dominated by Physics and Computer Science majors. Physics majors are typically good at analytical aspects of the course (and electronics if they've already taken PHYS451). In contrast, CompSci majors are typically good at programming. If you're neither of these majors, you may feel intimidated – try to suppress this feeling, because we promise to include enough material to frustrate everyone.

- We encourage you to make connections in the class – join the Discord server immediately (invite on Canvas Home page), ask questions, and make friends.
- Find someone you can rely on to bring you up to speed and speak to the instructor and/or TA about any insecurities you have or experience – we are here to help, not to hinder!
- In this day and age, uC skillsets are infinitely variable; the TAs and even the instructor may not have certain skillsets that some students bring to the course. Everyone is strongly encouraged to share their skillsets and ideas so that ALL may learn!

*Note that **collaboration** is allowed but **appropriation** is not*:

- Collaboration: working together to learn and/or understand by sharing knowledge – **YES**
- Appropriation: using another's effort or output as your own – **NO**
- See FAQ for very important clarifications!

Grading. A common misconception is that grades reflect how much you learn in a class or how much you apply yourself ("effort"). No physics professor grades on this basis, and the department discourages it. This course is not graded in either fashion – grading is instead based on mastery alone. Grades will be determined by considering credits earned in the course – each component of the course is worth a specified number of credits (CR). The **DRAFT** *Course Grade Table* below summarizes the CR structure and how it's related to your course grade:

	Category	Number	Avg CR	100% CR (A+)	93% CR (A)	Percent Total	
	Quizzes	10	1	10	9.3	13%	
	Core Labs	16	1.4	23	21.4	30%	
	Midterms	2	8	16	14.9	21%	
	Final	1	8	8	7.4	11%	
	F Practice	1	2	1	0.9	1%	
	F Proposal	1	8	5	4.7	7%	
non-honors →	Add'l Labs	12 min	variable	13	12.1	17%	← non-honors
honors →	Add'l Labs	6 min	variable	7	6.5	9%	← honors
honors only →	Honors	6 min	6	6	5.6	8%	← honors only
	Total			76	70.7	100%	

PoV: Labs		
Labs @14 weeks	Labs @15 weeks	Core Labs 23CR
2CR per week	2CR per week	Other Labs 13CR
= 28 CR total	= 30 CR total	= 36CR total
Penalized with negative credit if not done – See FAQ		

Grade	Min CR
A+	76
A	71
A–	66
B+	61
B	56
B–	51

Grade	Min CR
C+	46
C	41
C–	36
D+	31
D	26
F	<26

PoV: Types of Work	
Assessments	45%
Labs	47%
Proposal	8%
Total	100%

There will be no rounding – this table was difficult enough to create as it is! If you want a higher grade, do more labs! We promise it will pay off in your career more than any other credit at UNC.

Lab Requirements. In general, labs will include the following components to get credit, although not every lab will require every component:

1. Demonstration of working lab (video acceptable in many or most cases).
2. Code upload.
3. Demonstration of knowledge gained (Gradescope assessment).

Notes:

- Requirements for each lab will be specified as part of that lab.
- As a rule, you normally get full credit or very close to it for each lab because you won't finish/submit on Gradescope until you're more or less ready with fully correct answers and have done all tasks.
- If the grader determines that you haven't completed a lab, you'll be asked to return to show mastery of the material or resubmit material for partial credit; this option may not apply to *every* aspect of a lab assignment.
- In certain cases, the grader may award you a high but not full percentage of the CR if you haven't mastered the material, but judges that you will reasonably learn the material elsewhere in the course; an example of this might be "imperfect but mostly working code" that you would reasonably understand better before the end of the course.
- You're free to resubmit work and answers to the labs as many times as you like before the deadline, within reason.
- Late submissions will be penalized 5% per day. Lab deadlines are *extremely* lenient – don't ask for non-penalty extensions except in extraordinary circumstances.
- *Core Labs are required; skipping a Core Lab will result in negative CR (see table above and FAQ).*

16 (0x0F) Core Lab Topics: **parts kit not required** **parts kit required**

Syllabus Draft Note: this SP26 table is subject to change

0x00 Blink 2CR	0x01 0x02 Digital I/O (any uC) 2CR	0x03 0x04 IMU phyphox (smartphone) 2CR	0x05 4-bit counter (any uC) 2CR
0x06 C I/O Control Coding (any uC) 1CR	0x07 Analog Input (ADC, any uC) 1CR	0x08 Serial Port Secrets (any uC) 1CR	0x09 Analog Output (DAC, ESP32) 2CR
0x0A Analog Output (PWM, any uC) 1CR	0x0B 0x0C 0x0D IoT (ESP32) 4CR	0x0E MIDI (Teensy) 3CR	0x0F Bluetooth (ESP32) 2CR

Incompletes:

- Incompletes (grade of IN) in this course are *strongly* discouraged. You signed up for this course in the spring because you and the Instructor of Record expect you to take the course in the spring – *you didn't sign up for this course in the spring so you could take it in the summer*.
- Any equipment or components loaned to students that are not returned by the Registrar's grade submission deadline will result in an IN grade until such equipment is returned or replaced by the student, and a registration hold will be placed on the student's record with Academic Advising. *The instructor will clearly denote which equipment in the course will be subject to this IN rule*.

Due Dates for Labs. The structure of this course allows a lenient schedule of dues dates – no extensions for any reason will be granted except in the case of a UAA or other extraordinarily documented circumstance. Many labs allow for late reduced credit, especially earlier in the semester (limited later in the semester). If you miss a deadline, move on and make it up with more work. During the semester, some due dates may be changed. How/when/where such changes happen is at instructor discretion but won't be punitive. *See FAQ for how lab late penalties work.*

Lab Grading. Labs in Gradescope will be *published* at some point *after* grading commences but *before* all labs are graded. Scores will be regularly pushed to Canvas. *This means that you will often see that your lab isn't graded yet and may even show up as zero in either Gradescope or Canvas*. Do not panic. This discrepancy is normal and your labs will be updated as they are graded. Also, it's likely that some students will submit links to incorrectly shared or unshared video until learning the procedure. These will be assessed a minor penalty and will not be scored further until link sharing has been corrected – it's your responsibility to check these. Fixing the sharing will allow grading to proceed. *To minimize lost CR, resolve any such issues promptly*.

Gradebook. Canvas will not properly reflect the grading structure of this course. Ignore any *projected course grades* that appear in Canvas – they're meaningless. You should primarily look for Canvas to properly reflect your Gradescope scores and course CR; you can then compute your letter grade from the grading table found earlier in this syllabus. Essentially, you will start with 0 CR (grade of F) and watch your grade increase over the course of the semester (as a result every CR total you have in the course represents a *minimum* grade). The instructor will attempt to create a structure in Canvas that reflects the CR you get for assignments, but this isn't guaranteed due to Canvas limitations. Notify the instructor about any discrepancies.

Gradescope-CR conversion. This is best illustrated by example. Assume that an assignment or lab or assessment is worth 1.5 CR and that your Gradescope score is 0.85 (85% correct). You would then receive 0.85 x 1.5 = 1.28 CR toward your final course grade.

Makerspace Presence. Simple design and manufacture will be optional parts of some labs. If you want to take advantage of this option, you're encouraged to complete the on-line orientation, on-line lasercutter training, and on-line 3D printer training at the Makerspace to gain access to BeAM. If you don't already have access, you must sign up for ***in-person*** orientation (BeAM 101) and training for at least the laser cutters and the 3D printers. *Students are strongly encouraged to become oriented and trained as soon as possible!*

Photograph and Video Release Form. Registration at BEAM includes a photograph/video release form. If you agree to submit this form, you may be recorded or photographed during a class or presentation or at the Makerspace, and/or for publicity about this course. We may document both the everyday activities and any project work, and the course may be highlighted on the Physics Dept web page, other UNC publications, or even outside news organizations or social media if warranted. If you don't want your image to be used in such ways, do not sign the form, and alert the instructor so we can make efforts to guarantee your privacy.

BeAM Links of Interest:

- Home page: https://beam.unc.edu
- Registration: https://beamreg.oasis.unc.edu/login/auth
- BeAM Scheduling: https://beam.unc.edu/hours/
- BeAM Training: https://beam.unc.edu/trainings/

version 1 – draft

FAQ – General

This course is weird. Why is it taught this way? In a nutshell, Covid nearly destroyed this course because of the need to ship equipment to students to do labs, which had been taught in a conventional format (specific meeting times). As a result, we flipped the script. Students now buy their own lab equipment instead of a textbook (and spend less than for a typical textbook) and do the labs on their own terms with lots of support. We supply kits at no charge for lab items that are too cheap (that is, they can only effectively be bought in bulk).

But we're not in Covid anymore. This particular subject is commonly learned, even by real engineers, in individual desktop settings and on kitchen tables, so to speak. No labs ever meet on a regular schedule, but we supply extra glue for those students who need support. The course has a much stronger on-line support presence than most other courses, as the subject matter is often crowd-sourced in the real world in exactly the same fashion. We also encourage working in groups, although there are no group assignments.

Speaking of weird, how is it possible that the lectures are both required and optional at the same time?!? This may be the greatest departure from typical coursework at UNC and for this class too, and has two important components:

- The lectures are *required* because you will get information from the lectures that appears nowhere else. This applies to both technical information as well as class announcements about course changes which may occur. *Any excuse regarding deadlines or content that relies on "I missed that lecture" will not be accepted under any circumstances*. If you literally miss the lecture, check the video recording.
- In contrast, attendance will be *recorded*, but it is *not required*. Attending lectures live and answering questions correctly is the only way to get XCR in the course. If you do neither, you will not be penalized except as occurs as a result of the first bullet.

Can you define/explain the instructional mode(s)? The UNC web description is pathetic. Here is it in a nutshell:

- *Synchronous* means "meets at a specific time."
- *Asynchronous* means "does not meet at a specific time or doesn't meet at all."
- *In-person* means that you are physically present with an instructor.
- *Remote* means Zoom.

The whole thing is making me a bit nervous. If you think you're nervous, you should talk to the Dean, who is *very* nervous. To calm this a little, every student is "required" to make an appt with the instructor in the first 2-3 weeks of class to review individual goals for the course and express any concerns.

Cool – with that out of the way, are we gonna do robotics? No. *Learn about robotics?* A little. *Build a robotic arm?* Sorry, no. *Maybe design an autonomous vehicle?* Not enough time. *A non-autonomous vehicle?* Probably not enough time. *How about a motorized wheel that rolls by itself?* Possibly, but you'd be surprised at how much work that takes when you design and build it yourself.

Hmmm – well what are we gonna do then? You're going to set yourself up to do everything in the previous question in the future without actually doing it in the course (with rare exceptions). In large measure, the reason you won't be able to "do robotics" is a lack of time, not a lack of skill or knowledge. That said, the honors section will get closer to robotics than previous versions of this course, and the "right" student may accomplish quite a bit in the robotics category. We'll see how it plays out – that's all we can say.

Well what if I do robotics anyway, can I get bonus credit? That's a fantastic idea and yes – if you present your work at the SP26 MakerFest you can receive bonus CR. Details to be clarified.

What about something other than robotics, could I get extra credit? Possibly, but the details must be arranged with the instructor. For now, the course's bonus credit focus will be on presentation at MakerFest.

What is a CR in terms of time/effort? *(see Course Grade Table)*. A 1 CR lab should take about one hour IF everything works correctly (instructions and your attention to them). *In short, 1 hour is the time it takes Dr J to do a 1CR lab*. In practice you should invoke a multiplier between 1 and 3 since things rarely go perfectly – the time could still vary widely depending on your skill set and distractions. If you do 2 CR of lab work per week for 14 weeks, the 28 CR for labs might translate to 28–84 clock hours total. If you attend two lectures and do 2 CR in labs every week, that's approximately 4–12 contact hours + outside effort. Stronger students therefore might expect to put in about 4–5 contact hours + outside effort; weaker students probably double.

Can we share equipment or parts to cut costs? Yes, but everyone is required to do their own work. Be careful about sharing – if you loan your parts or equipment to a colleague, you may not be able to get it back right away even if everyone is being responsible.

How will the requirement to do our own work be enforced? We have our ways, but primarily this must work on the honor system. You are bound by the Honor Code of the University, and we expect students to commit to it and to report any knowledge of violations. Some assessments will be difficult to collaborate on – your best approach will always be to learn and know the material yourself, not only for the integrity of the academic mission but also for the development of your skillsets.

So, we're allowed to collaborate, or not? To be clear, you are not only allowed to collaborate but encouraged to! As adults, you should know when you're crossing a line, or you should ask an instructor if unsure. At the heart of technology development is the need to collaborate, and this course will mirror that environment as much as possible – *rodeos* are the perfect opportunity. We fully expect each of you to help each other in this course – ask questions and provide answers, but when you get checked off for a lab, your work must be your own!

Wait what's a rodeo? (see collaboration question above) Your instructor works at UNC during certain nights and weekends, and this provides a perfect opportunity to collaborate with your peers and get help from the instructor. The rodeos will be put on the calendar as time allows. You should consider making connections with your peers in class and arrange to come in and work together. The labs then go faster, and questions get immediate expert answers.

Tell me how not to cross the line on collaboration. Do not submit the same code as your classmate. Do not build a circuit and then loan it to your classmate. Do not copy any answer from your classmate. These are all examples of appropriation, not collaboration, and will be treated harshly.

I know how to ask questions, but how do I know when to provide an answer on Discord or to my peers when it comes to labs? The instructors will try to lead by example here. We're unlikely to just provide you with a "here this works do this" answer. Instead, we will focus on where your questions might be vague or misdirected and provide relevant hints. Those of you that have already figured things out will be encouraged to do the same. The material in this course is *highly* technical, and you will feel a special kind of power as a result of knowing details and nuances. Not to mention, your future employment may well depend on the kinds of technical details and skills you develop here – successfully explaining concepts to

your peers will further cement your knowledge, but direct sharing of your work with someone else helps no one and may be treated as an Honor Code violation.

What specifically will I learn in this class, and what should I know in advance? Specifically, if you choose to, you'll learn: elements of Python and C/C++; analog/digital logic; Boolean algebra; assembly of analog/digital electronic circuits; networking and communication; actuation (motors); sensing and data acquisition; data plotting; machine analysis; instrumentation concepts; and more. In short, you'll end up with the *skills* to build robots or autonomous vehicles, *but for the most part you won't actually do such building in the course without extraordinary dedication*. You'll also have the opportunity to build simple prototypes in the Makerspace (BeAM). This course assumes no prior knowledge of these subjects, but it *will* require significant time and effort, much like a hobbyist or employee in a technology company who uses the tools of collaboration, documentation, and *effort* (building/rebuilding until your lab *finally* works).

Will we do any theory or is it all uC programming and circuit-building? Yes, we will delve into at least two advanced subjects: the sampling theorem and its connection to digital signal filtering; and PID (proportional-integral-differential) control. These are inherently mathematical – if you're not comfortable with mathematics, be prepared to seek out extra help from the instructors or TAs.

Why will we have to understand some concepts before they're covered in Lecture? There's more than one answer to this question. Mainly, there's just too much to cover at the start of class, so some things will necessarily require comprehension as part of the labs before you would typically see them in lecture. More generally, this need echoes the entire uC field – getting to functional operation is non-linear and there are very few beginners who understand much of what they're doing when they first do it. We will strive to minimize the impact of this version of a "flipped classroom" with bulletproof documentation. Which leads to the "flip" side of this question – if you see a lab available and are interested to learn about it or especially get ahead, then you're free to choose it even if we haven't covered the source material.

I understand the Remote Labs, but what are the Local Labs? Local Labs require you to work in-person in the Electronics lab to access specialized equipment. As a general rule these will be done with supervision nearby; in addition, you will need to demonstrate the operation of the lab to and instructor and answer questions directly, in addition to a Gradescope component. Like the Remote Labs, Local Labs are *optional*.

What are the "physics" labs? These labs are actual physics experiments that focus on instrumentation for data acquisition and the subsequent data analysis. These labs can be thought of as PHYS118/119 studio activities on steroids. They're awarded credit as for any other labs – see the individual labs for details. *None of the physics labs are required unless specified by an advisor*. Contact the instructor if you have questions.

Who should do the physics labs? These labs will typically be recommended for students with advisors that either recommend or require specialized, vertically integrated knowledge about experimental physics: experimental design and setup, customized instrumentation, data acquisition, and data analysis. Students interested in optimizing their skillset for either undergraduate research or graduate school should consider these labs.

What does the NCGA think they're doing? Beats me – "delusional pinecones try arsenic long term" is the end of an obscure haiku. Principles of diversity, equity, and inclusion (DEI, for the search engines) are not on the wrong side of history. Our legislators actually know this, but they're cowards and idiots of the highest order. Also news: the sun rises in the morning.

version 1 – draft

FAQ – Grades

Is it possible to use fewer uCs, forfeit the credits associated with those uCs, and make up the credits using other uCs? Yes, but we can't answer this question definitively. There are too many combinations of acceptable work to explain how you might do this. If such a calculation is your game, then proceed at your own risk. Although the great global supply chain crisis of 2020–2023 appears to be over, it's possible that you could be impacted by lack of parts availability. We will address this in real time during the course.

My time is pretty tight this semester; can I choose a smaller number of more difficult labs (higher CR), or a larger number of less difficult labs (lower CR), to get the same credit and grade? In principle, yes, but it's difficult to predict the outcome of all scenarios. We don't suggest that you get too creative; work on this with the instructor in advance.

What are the red CR indicators in the grading table? The red credit designators indicate CR that can be *deducted* from your total grade. Although the course is generally additive and non-punitive, certain assignments are required and can be penalized if not submitted. If such a "red" assignment is not completed, you will not only not get that CR, but the same value CR will be deducted from your total.

I'm a perfect student, with 100% scores for everything (including Core Labs, exam/quiz scores) but without any additional labs. What's my grade? Your total CR is 76–13=63 (B+ or A–) so you only have to do a few additional labs to get an A, but wouldn't you rather be an A+ student even if UNC doesn't allow grades of A+? Of course, keep in mind that it's very difficult to have 100% on all assignments!

I didn't do Core Lab 06+08 (2CR) because I really really hate programming and don't get it – what's the damage? If you didn't do these two Core Labs, the maximum score you can get from the Core Labs is 23–2=21. You'll then be penalized for not submitting them; your max CR from Core Labs total will be further reduced to 21–2=19 instead of the maximum possible 23. The 4 CR discrepancy is almost half a letter grade just for skipping two Core Lab. *You really shouldn't skip Core Labs*.

I'm 100% perfect at everything required, but I only got 50% scores on the 2 midterms and the final and I didn't do any additional labs because I have too much other work. Where do I stand? The midterms and finals are worth 24 CR and the additional labs are 13 CR. Your CR is therefore 76–13–12=51 (B–). Not too shabby but you should make up for the lower exam performance by doing some additional labs.

I was too busy or not interested and decided to skip the feasibility proposal but I'm otherwise perfect. Can I make this up with more labs? Yes, but let's look at this. The feasibility proposal including the practice assignment is worth 6 CR. You don't get those 6 but you also get penalized 6, so your standing is 76–12 = 64 (B+ or A–). That's not so bad but if you're skipping the proposal you're probably skipping other CR as well (and note we're still assuming perfect assessment scores). It's a slippery slope – it'll be easier and less stressful to just do the feasibility proposal assignment!

How can I figure out how much all my correct lecture answers will be worth in the end? You can't. The instructor will keep track of all XCR during the semester and assign a total value at the end before grades are posted. It's highly unlikely that your XCR will be worth an entire letter grade; however, it's more than possible that XCR could/would bump you up if you're near a grade boundary. This credit takes the place of any rounding of grades. If you want your grades to be "rounded up," come to lecture, answer questions to the best of your ability, and see what happens.

I decided that I don't get anything out of lecture, and they're recorded anyway. I think I'll be OK. Fair, but dangerous. Unlike for some assignments, there's no penalty for skipping lectures. But experience shows you're likely to miss important announcements along the way (*are you really going to watch those lecture videos?*), not to mention instructor fickleness or sudden brainstorms like doing a pop-quiz on Gradescope. You'll be less likely to understand the feasibility proposal, and your lack of daily connection with peers and fine tech brahs will lead to malaise and an increased tendency to watch Skibidi Toilet. Yeah you're almost surely dropping well below an A. It is for this reason that the lectures are designated as "required."

I don't like making videos for the lab assignments or ***I'm not good at videos. Can I check the labs off in person?*** Absolutely – confer with the instructor about meeting to do so. That said, consider that you will have to transport your entire setup to a meeting, sometimes in the rain and cold, and still make it work, which can be a challenge. Most students find the making of their videos to be fun, and it affords them the opportunity for some creativity!

I checked my Gradescope, and I got a zero for some or all parts of an assignment – why? You either didn't submit work, didn't properly share video links, or your work hasn't been graded yet. If you've fixed a broken share, DM the instructor.

I have a score in Gradescope but not in Canvas – why? Your score hasn't been pushed by the instructor yet. If all parts have been fully scored in Gradescope and don't appear in Canvas shortly thereafter, check for announcements first and DM the instructor if there are none.

I would like to question a score I got on Gradescope. DM the instructor with the assignment, question number, and reason for request. Limit your description length on Discord; you may be asked to present for an oral discussion to fix the credit.

I forgot to share a video for lab credit and got docked for it, but I fixed it. Can I get that dock back? No. The dock is minor but is the only score you will receive for a lab until fixed. After you fix it, the lab will be graded subject to other penalties if they apply, but the dock will not be removed. This is to encourage careful submission on the part of students and to distinguish from those labs that were submitted perfectly.

It's the end of the semester and my work is not scored or uploaded. Everyone will get their correct score and grade, but some may not happen until after grades are submitted, especially those late in the semester. This is not an IN; if your work isn't finished grading, you'll get a temporary minimum grade based on completed grading at that time.

The syllabus states "You're free to resubmit work and answers to the labs as many times as you like before the deadline, within reason." Can you clarify what "within reason" means? This is an important question. We do not encourage points grubbing. Students who are judged to be points grubbing by submitting incremental changes after getting help will discover it doesn't pay off. Instead, we suggest that you complete the lab and are satisfied with your answers before submitting. Gradescope records submission history, and students with a large submission history of small changes may be viewed negatively. This issue is a bit difficult to assess but has not been a problem in the past. The instructor will take a wait and see approach – abuse of privilege may lead to stricter/unpopular policies being established.

Can you explain the lab late penalties? All labs are due at midnight (11:59pm specifically) on their specified due dates. These dates should match on Canvas and Gradescope – alert the instructor to discrepancies. Gradescope will then allow late submission until there is no credit left. Late penalties will be assessed in Canvas. To be explicit, consider a lab that is due at 11:59pm on Mar 01. The penalties will then work as follows:

90% credit until Mar 02 11:59pm.
80% credit until Mar 03 11:59pm.
70% credit until Mar 04 11:59pm.
60% credit until Mar 05 11:59pm.
50% credit until Mar 06 11:59pm.
40% credit until Mar 07 11:59pm.
30% credit until Mar 08 11:59pm.
20% credit until Mar 09 11:59pm.
10% credit until Mar 10 11:59pm.
on Mar 11 at 12:00 am there will be no credit.

Is there anything else I should know about turning labs in late? Yes – if you get no credit for a lab, just move on as per the advertised strategy of replacing it with other CR; however, in the case of Core Labs, in addition to getting negative credit for not doing the lab, often you will have to do the missed Core Lab anyway, at least informally, to know enough to do subsequent labs.

FAQ – RPi

The RPi is kind of expensive – can I do the course without it? Short answer: yes, but the total number of available CR will be reduced. Longer: based on lessons learned from previous versions of this course, the RPi work can be challenging because it lacks central uC capabilities. In addition, the RPi presents challenges because it is a computer as opposed to a simpler uC. The RPi is the most expensive part of your commitment to equipment, and fewer RPi loaners will be available.

But how important is learning the RPi – can I really do the course without it? The RPi has become a ubiquitous device in the hobby and technical markets – if you avoid it, you're doing yourself a disservice. With respect to this course, some assessments will in part assume that you have experience working with the RPi; although these assessments will not be exceedingly detail-oriented, you will do better on the assessments if you have hands-on experience.

The RPi is unavailable – can I do the course without it? Many supply chain pressures of the recent years (e.g., pandemic, Ukraine) appear to have been mostly eliminated; RPis appear to be both available and at pre-pandemic prices. The newer RPi5 is more expensive but the older RPi4 or RPi3 are widely available. There should be no problem acquiring an RPi.

Why are the RPi Labs broken out separately? Since the RPi isn't a true microcontroller and tend to be quite different to implement, these labs are broken out separately, but they can be considered Remote Labs unless otherwise specified. Secondly, a number of RPi labs are "merely" uC labs that require reconfiguration from existing Remote or Core Labs. In this sense, the RPi labs are easier to implement. In the end, the difficulty is about the same as for Core or Remote Labs. As for the Remote Labs, RPi Labs are *optional*.

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FAQ – Honors + Projects

I'm an honors student – how does this class differ for me? This is a great question and is evolving based on previous semester experiences. The honors cohort uses a modified grading table and has a short but informative closing section in the syllabus (see below).

I'm an honors student –I worry that the requirements might be too difficult so I'm taking the non-honors lab section. You may have good reasons to not enroll in the honors section even though you're in the honors program; however, the reasons shouldn't be related to our material (that is, the reasons should be external to the course). Honors work is intended to be close to a zero-sum game – we don't expect the honors component to be more than about a 15% change in effort (larger) compared to the non-honors, but that could strongly vary depending on your skillset. We understand the limitations we're imposing on you, and we plan to go out of the way to make the honors segment *rewarding* and the honors grading *non-punitive*. You are ***strongly*** encouraged to reach out to the instructor to discuss your concerns.

Are the regular lectures and honors lectures different? No. Everyone has the same lecture regardless of what the lecture section designation is. Likewise, all labs are available to all students. H-enrollees have their own lecture and lab sections, but this is merely for administrative (ConnectCarolina) purposes.

Are the submission requirements for Honors work different from other submissions? Yes and No. In general, H work does not include a Gradescope assessment; in lieu of that, you will meet with the instructor more often to both evaluate progress and show the completed work. In addition, you will be required to write a summary report. Reports may easily require several pages but are more bulletized than an official report. In large measure, your report should look like the basic instructions in most of our labs. The goal is to provide a set of instructions that an experienced person (the instructor) can follow to demonstrate the work. Screenshots and/or documentary videos are strongly suggested.

Is a project required? Not for non-honors students. For honors students, there is project work but that's covered in a different section of the syllabus.

So… can I do a project? Regardless of what you may think, you don't have enough time to do a project in this class. That said, we have a list of what are referred to as Free Labs that are mostly unrelated to each other. These free labs could form the basis for further work or even become assigned labs, but they haven't been developed into such yet – think of them mostly as brainstorms that you may find interesting. This aspect of the course could allow you to find and pursue different interests but may require specific equipment or parts that are not immediately available. Attempting any free lab *will require instructor approval and is limited to a maximum of 5 CR, which is not a good reflection of the effort required*. Free labs which focus on software alone will be discouraged but not explicitly disallowed – we will listen to software-only proposals, but the bar will be set high against them. To receive credit for free labs, you must a) demonstrate a working lab as you do for the regular labs and b) provide a written outline to the instructor that can be used to transform your free lab into a "real" lab in a future semester. *The free labs are high-cost but high-impact – you should expect to work more hours if you do any free labs.*

version 1 – draft

FAQ – Artificial Intelligence

What's the deal with ChatGPT? *ChatGPT* by OpenAI is the best-known example of a *Large Language Model* (LLM), which in turn is the latest and most impactful manifestation of AI in our society. Other well-known LLM examples are Google's *Gemini*, Anthropic's *Claude*, and X's *Grok*. As a rule, we will refer to these technologies as simply GPTs (Generative Pre-trained Transformers) or LLMs. We don't require that you use one specific LLM, although your experience with different LLMs may lead to different outcomes. These are the main things to keep in mind about LLMs:

1. You're free to use an LLM in this course.
2. You must *always* acknowledge the extent to which an LLM assisted you in solving your assignments, and any type of reflection on your experience will help your score.
3. Many of you are unlikely to successfully complete some labs without LLM assistance!

Beyond these statements, we expect you to use any form of AI in the spirit of learning as opposed to the spirit of cutting corners (and certainly not in the spirit of plagiarism). Above all, unless you are directly coding, do not copy/paste LLM answers. Instead, use an LLM to glean information that you can use to learn. If you succeed in doing this, always recast the answers as your own in a way that demonstrates that you learned something about the material – you must convince the grader that if you were present for an oral exam at that moment, that you would be able to address the question competently. In contrast, if you're using an LLM merely to code, you may use the code as-is; however, such use should be accompanied by comments in the code and a reflection somewhere in the same assignment. You should always strive to make observations about how well LLM-generated code works.

Put yourself in the professor's shoes: if you put a great deal of thought and effort into creating material for the benefit of students and all they do is copy/paste someone else's answer without further attempts at understanding, how would you react?

If I use an LLM, I may end up submitting a better answer than I could have all by myself. Will I be graded down for this? No. We will view the LLM specifically as your personal assistant or tutor. Your answers are very likely but not guaranteed to be **better** because of the LLM. It's up to you to *gain* from this experience. Note: you will be downgraded if you don't acknowledge your use of LLM in a reflection, or if you just submit a copy of what you were given.

I was given a zero for an assessment/lab due to an answer that was too LLM-ish. But I reported that I used an LLM so what gives? We've already imbued the LLM with a human-like quality in our discussion ("personal assistant," "tutor," etc), so review our discussion about collaboration vs appropriation. The instructor has significant experience using LLMs for this material, and over the course of the semester will get to know you personally. In short, if we suspect that you've answered a question by using an LLM output without a corresponding understanding, with or without attribution, we may zero your answer due to this perceived lack of understanding. This is honestly for your own good, but you will have a recourse – make an appt with the instructor for an oral exam on the subject matter. If you are judged to have an acceptable understanding of the answer, your credit will be at least partly if not fully restored!

So how do I use an LLM specifically? There are too many possibilities to list. The most common example would be something akin to a direct request to do your work for you. See Canvas Support for more information or speak to the instructor.

Really? I just ask the LLM to do all my work for me? You can if you want but beware of *vibe coding*. Aside from the moral aspects of relying on an LLM (see earlier Syllabus guidelines and also Honor code

notes), we think this will end badly. And specifically, there will be times when you're explicitly prohibited from using an LLM. Your best resource here would be to ask previous students of this course their opinion. Obviously, speak to the instructor with any and all concerns.

What's vibe coding? Google is your friend here; you should be aware of its meaning. Vibe coding is a brand-new (2025) term referring to the exercise of having an LLM do your coding for you, often with little to no oversight. The outcomes are typically two-fold: 1) people with no experience and no idea what they're doing create software that may actually work fairly well; 2) the resulting software, if it works, does so until it does not, possibly with devastating consequences to the user.

Is that all the FAQs? The above answers are likely not all you need to know. This FAQ will be updated to provide more information over time. The best way to add to this FAQ is to ask insightful questions!

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PHYS231 Honors (H)

PHYS231 has an available honors (H) section. The H lecture meets at the same time and location as the non-H lecture. As for the other lab sections, H labs do not meet physically.

- You may enroll in the H section if **either** of these is true:
  - You're in the UNC honors program.
  - Your GPA is 3.0 or above.
- If you aren't in the H program, your enrollment in the H section may be restricted until the H program office releases seats.
- If you enroll in the H section, you must fulfill the H requirements, even if you are not an H student.

H enrollees are differentiated from normal enrollees by the requirement of advanced work of a curated nature (that is, H students are not free to do just anything). Honors students will work under a modified grading scheme shown previously in the grading table. This table may be difficult to parse, so here is the difference between H and non-H students in a nutshell:

- Non-H students must complete at least 12 CR of extra lab work to achieve A+ status.
- H students must complete the same 12 CR of extra lab work, but only 5 CR is from the regular list of labs. The other 7 CR must be derived from working on one of the following categories of project labs, listed in order of expected effort (easier to more difficult):

  1. Object recognition and tracking (RPi).
  2. Feedback and control (e.g., solar cell target tracking).
  3. IoT applications (e.g., home automation).
  4. Local area mapping (e.g., LIDAR).
  5. Long-range communication (e.g., cell network or LoRA).
  6. Machine-learning (e.g., voice actuated control).
  7. Robotics (e.g., Metalhead *vis a vis* **Black Mirror**).
  8. Advanced feedback and control (e.g., proportional-integral-derivative control).
  9. Navigation (e.g., Kalman filter dead-reckoning).
  10. Laser Galvanometer (e.g., comprehensive light-show implementation).

- H work requires certain Core or Remote or Local Labs as prerequisites – therefore, your ability to pick and choose or skip certain topics may be more limited than for non-H students.

The Canvas site has more documentation on these possibilities and prerequisites. Honors work can be started at any point in the semester but is designed to be done in the 2nd half of the course.

Important aspects of the honors commitment:

1. The highest CR will be awarded for honors work that is accompanied by a report. The report should look like our published lab instructions, but not in as much detail. A successful report will provide a procedure by which experienced personnel (aka instructor) can follow to successfully duplicate the student's work.
2. It is acceptable to submit honors work that is not original; that is, honors work can be a duplication of other work found on the internet; however, such work must be approved beforehand by the instructor.

Honor Code. The Honor code and the Campus Code, embodying the ideals of academic honesty, integrity, and responsible citizenship, have for over 100 years governed the performance of all academic work and student conduct at the University. Acceptance by a student of enrollment in the University presupposes a commitment to the principles embodied in these codes and a respect for this significant University tradition. Your participation in this course is with the expectation that your work will be completed in full observance of the UNC Honor Code.

In this course you will be collaborating with other students, so you might be sharing data, results, and ideas; however, you are encouraged to think independently, and any submissions for credit must be in your own words and not copied from someone else. Note the following:

- Individual labs or assignments in this course may be worked on collaboratively but must be reported or described by each student in his/her own words and format only.
- Exams, quizzes, or other assessments will be solely the work of each individual student.
- If you are not sure whether collaboration might constitute an honor code violation, ask the instructor for guidance.
- In contrast to the other bullets here, beware of performing others' work for them – this material requires DOING to learn. Do not dilute your grade for the sake of someone else.

Academic dishonesty in any form is unacceptable, because any breach in academic integrity, however small, strikes destructively at the University's life and work. If you have any questions about the Honor Code, please consult with someone in the Office of the Student Attorney General or the Office of the Dean of Students. Any issues that students encounter related to fairness or inappropriate conduct should be brought to the immediate attention of an instructor or TA.

Accessibility Resources. The university facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability, or pregnancy complications resulting in barriers to fully accessing University courses, programs, and activities. Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS Website for contact information: https://ars.unc.edu or email ars@unc.edu.

Counseling and Psychological Services. PHYS231 is generally well-liked by students but can be challenging enough to create anxiety. We strongly encourage you to contact your instructor to discuss your concerns. The university CAPS system is committed to addressing the mental health needs of the student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. The Heels Care Network website is a place to access the many mental resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website https://caps.unc.edu/ or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more.

Title IX Resources. Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at https://eoc.unc.edu/report-an-incident/. Please contact the University's Title IX Coordinator (titleixcoordinator@unc.edu), Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (gvsc@unc.edu; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.

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2025 Schedule (for Reference)

the 2026 schedule will track 2025 somewhat, more or less

Lecture 01: FDOC, Course Intro
Lecture 02: Course Update, Ohm's Law
Lecture 03: Ohm's Law and LEDs
Lecture 04: Ohm's Law and LEDs
Lecture 05: Number Systems
Lecture 06: Number Systems and C Typing
Lecture 07: Analog/Digital I/O I
Lecture 08: Analog/Digital I/O II
Lecture 09: Digital Gates and Boolean Logic I

Release of Exam I

Lecture 10: Digital Gates and Boolean Logic II
Lecture 11: Operational Amplifiers I
Lecture 12: Operational Amplifiers II
Lecture 13: Digital-Analog Conversion (DAC)
Lecture 14: Feasibility Proposal
Lecture 15: I2C and Discrete Functions
Lecture 16: Feasibility Proposal
Lecture 17: Duty Cycle and PWM
Lecture 18: PWM Demos

Release of Exam II

Lecture 19: Feasibility Proposal
Lecture 20: What is Ground?
Lecture 21: Waveform Logistics
Lecture 22: Fourier Analysis
Lecture 23: Fourier Analysis and Sampling
Lecture 24: Sampling Theorem Deep Dive

Feasibility Proposal Due
Release of Final Exam Take-home

Lecture 25: Aliasing in Real Life
Lecture 26: LDOC: TBD
Lecture 27: *Did not exist in 2025*

In-class Final Exam