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SYLLABUS: Physics 231 *Physical Computing*

Spring Semester 2024 – 4 credit hours

Instructor of Record:

Dr. Stefan Jeglinski (Dr J)
- Phillips 174
- jeglin@physics.unc.edu

Location:

Lecture: Synchronous In-person
- MF 9:05a-9:55a Phillips 247

Lab: Asynchronous
- All sections: Do not attend.

TAs:
- Yihan Liu
  - 3rd year grad student in Appl Phys Sci
- Arjun Pajni
  - completed PHYS231 in SP23
- Ethan Crook
  - completed PHYS231 in SP23
- Mulang "Charlie" Shi
  - Developer, CompSci Robotics lab

Sakai: https://sakai.unc.edu/
PHYS231.ALL.SP24
*click on **Overview** for links*

Office Hours:

M 10:15–11a
W 2–3p
F 10–10:45a
By appt:
https://calendly.com/jeglin/phys231

We'll get to the course details in a moment – meanwhile there are three important things I want to make sure you know about this course for SP24:

1. Sadly, we have to use Sakai and not Canvas this semester. I apologize in advance that you'll have to switch back and forth from/to Canvas for your other courses. For a variety of technical reasons, I haven't had the time to convert this course to Canvas – that will be deferred to next year.
2. This course has no textbook. In lieu of buying an expensive textbook, you should plan to purchase your own microcontrollers – often the microcontrollers are cheaper than a textbook anyway. I do have loaner options, but the loaner approach could cause you to fall behind depending on demand. The course site includes details on what to get and cost.
3. For the first time, this course has an Honors component. I was given this requirement at the end of SU23 and have had little time to do the development – therefore it may be hit and miss for honors students. I will contact the honors cohort independently to discuss. Non-honors students may do honors material if they want – I will try to clarify this both in the syllabus and during FWOC.

Finally, please read this syllabus carefully – this course (likely) doesn't operate like any of your other courses, and even if you've spoken to previous students from this course about how it works, there are new modifications.

That said, I 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 find interesting.

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Course Goals and Key Learning Objectives: Physical Computing is an introduction to the interaction between computers and sensors and actuators. To implement the sensing, we must *measure.* We then respond to *control* the environment. The environment can be either local (e.g., adjusting the speed of a motor in response to some mechanical process) or remote (e.g., sensing the presence of a person in a remote location and turning a light on/off in response). This sense-control pathway is mediated by a computing unit that must typically make control decisions based on the sensing, The mediation is often in the form of a *feedback loop*. Our tools are microcontrollers, software, electronic sensors, a variety of analog and digital electronic components, and algorithms that anticipate and respond in ways that humans perceive as NOT inherently computerized.

Instructional Philosophy. The course is structured to work well for either in-person or remote learning; however, the course is officially in-person. Our approach to achieving our goals is somewhat experimental, but importantly, the approach mirrors reality more than other college courses – answers will not always be found by looking them up, and those that are supplied may be incomplete or suboptimal, *often by design*. Part of your objective will be to find required completions or optimizations. In broad strokes, the course will consist of four components: lectures, labs, a feasibility proposal exercise, and a set of free labs ("projects"). Each of these components will be worth a certain number of "credits" toward course completion. In much the same way that you get your undergraduate degree, you will choose from a minimum number of required core credits (that all students must complete) and a number of elective credits. 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, in person. We plan to record lectures, but you should attend unless you have a prearrangement with the instructor; *live attendance at the synchronous lecture time is the only way to earn credits from lecture – if you do not attend, you must make up the credits up elsewhere*. In addition, there will sometimes be live assessments (short quizzes) that take place during lecture time. If you're not there, you'll get zeros for those assessments. 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 will be recorded via either Poll Everywhere or by assessment. *Instructions for signing up for PollEv can be found on the Sakai Overview page*.

Labs. There are no explicit labs times, despite what may be listed in Connect Carolina. Labs will be *asynchronous* (generally done completely on your own time and at your own pace). How to get credit for labs will be covered in a later section of the syllabus. A large 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. Students will choose which labs they want to do and when they want to do them, and even the order in which they want to do them, within the limits of due dates and prerequisites. Each lab will provide a certain number of "credits" toward finishing the course (CR). 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. *Most of the CR in the course will be awarded as a result of completing the labs*.

Feasibility Proposal Exercise. All students will be required to complete the feasibility proposal exercise. You will be given an "imaginary" project, for which you will have to write a 7-page feasibility proposal consisting of abstract, background, significance, technical objectives, and measures of success. Details will be published sometime after FDOC.

Free Labs. Students will be encouraged to either create their own labs or to create extensions to the existing labs. Such labs or extensions could be randomly focused (unrelated to each other), or they could be focused on a larger goal that could be described as a "project." This aspect of the course allows you to find and pursue what interests you (e.g., hardware, software, prototyping), and may require specific equipment or parts. Each free lab (or combination of labs) will require instructor approval and negotiation of credits. 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. To receive credit for the 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 turn your free lab into a "real" lab, either this semester or in a future semester. **The free labs are high-cost but high-impact – you should expect to work more hours on these, but a larger number of credits can be awarded.**

This Course is About Technology. To be successful in this course, you must shift from an academic mindset to a technology and entrepreneurial mindset. The focus is on *instrumentation skills and is **highly** technical*. Don't think about the labs (or even combinations of free labs) as complete projects in and of themselves – any *real* projects you do with microcontrollers (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 about 95% of the material in this course can be found merely by looking for it on the internet; 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 degree (also APPL Minor & 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 microcontroller(s) and supporting equipment. Several resources have been made available through course reserves or that can be checked out electronically. Click on **Course Reserves** on the Sakai sidebar to see the list of available resources. The instructors will advise on how to use these resources as the course progresses. In large measure, you will get your information first from the instructor or TA, then Sakai, and then the internet.

Use of ChatGPT. Unless you've been living under a rock, you know what ChatGPT is and how it can be used and misused. ChatGPT is a game-changing resource for programming in both C and Python, not to mention other programming languages. In addition, ChatGPT has significant knowledge about microcontrollers, sensors, and electronics. Create an OpenAI account and become familiar with the chat interface. *You are free to use ChatGPT in this course under one limiting rule: you must always acknowledge the extent to which ChatGPT assisted you in solving your assignments*.

Required Materials:

- Multiple microcontrollers, details will be released under **Lectures/Labs/Required Hardware** on Sakai. At the very least, you should purchase a specialized Arduino microcontroller (Cytron UNO aka "purple" Arduino) for use in the course.
- Secondary electronics components
  - breadboards, wiring kits, etc.
  - for more details, see Sakai under the same **Required Hardware** tab.
- Tertiary electronics components
  - instructor-supplied items such as servo and stepper motors.
  - details will be delivered in first week of class.
- Wireless-enabled laptop with at least 2 USB ports; Windows[1]/macOS[2]/Linux[3]
- 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 Sakai. Most of our communication and collaboration will take place via a Discord server. See our Sakai Overview page for Discord details. *Students who miss important communications because they don't check their Discord or e-mail do hereby agree to be docked accordingly, without recourse*.

Attendance. Students are expected to attend and participate in every lecture. Attendance in lecture will be measured by using Poll Everywhere. You can miss up to two lectures for any reason. After two absences, you must show cause and provide acceptable documentation for missing lecture. There is no attendance relevant to labs – only submission of the required work for credit. If you miss lectures or lab deadlines due to illness or a larger conflict, you must communicate this promptly to the instructor, preferably before the lecture time or lab due date, but as soon as possible under all circumstances. Students are responsible for learning any material that is missed due to absence. Valid excuses for extended absences include:

- Severe illness with doctor's or Dean's note or UAA.
- Grave family circumstances (UAA)
- Participating in University-sanctioned events with supporting documentation.
- Travel for other classes with supporting documentation.
- Specifically, pre-planned personal trips or family vacations are not valid excuses.

Note: two free misses constitute between 5% and 10% of the attendance and is considered a generous concession. If you miss class, you miss class –- please own up to it. As a general rule, we don't consider UAAs or absences due to illness until after you use up your two freebies.

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[1] We've not done any official testing, but our impression is that you'll probably be OK if you're using Windows 11. *Only Windows 10 is officially supported*.

[2] We've done minimal testing, but our impression is that you'll be OK if you've upgraded to Sonoma **(**macOS 14.x); however, compatibility is *not* a guarantee because we've never taught the course using Sonoma – you may have to get creative if we discover any incompatibilities. This creativity could incur a cost to you if you need to purchase virtual machine software, for example. *macOS v12.x (Monterey) or v13.x (Ventura) is officially supported*. Earlier EOL versions of macOS will work and can be supported [10.14 (Mojave), 10.15 (Catalina), 11.x (Big Sur)].

[3] Some software is not compatible with Linux (e.g., Adobe Illustrator); you may have to maintain a separate Windows or macOS operating system on the same or another computer. *Officially, we support Ubuntu v20*.

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 on-line using either Gradescope or Sakai. The dates and coverage of the midterms are tentatively set as follows and are *subject to change*:

- Midterm 1: Feb 09–19 (take-home, covers Lectures 01–09, Core Labs 00–07)
- Midterm 2: Mar 18–25 (take-home, covers Lectures 01–15, Core Labs 01–12)
- Final Exam:
    - Take-home portion: Apr 22–May 02.
    - In-class portion: **noon-3pm** on **Thu May 02** (set in stone, not negotiable)
    - Comprehensive (covers all Lectures, all Core Labs, other labs, and topics TBA)

Course Collaboration. The 231 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 PHYS351). 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, 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, microcontroller 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 we may ALL learn!

Grading. (**DRAFT**) A common misconception is that grades reflect how much you learn in a class or how much you apply yourself. 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 table below summarizes the CR structure and explains how it contributes to your grade (color highlights and strikethrough indicate changes from any earlier syllabus versions during the semester). *Although it is a very rough guide, you may think of 1CR as roughly equal to 1 hour of focused brain time – see FAQ.*

Component	Credits Available (A+)	Contribution to get A	Percent of Total
Lectures	27 @ ¼CR	6CR (3 free misses)	10%
Quizzes	8 @ 1CR (may increase)	7CR (1 free miss)	11%
Core Labs	21CR	21CR‡	34%
Midterms	2 @ 6CR	11CR	18%
Final Exam	1 @ 4CR	3.5CR‡	6%
Feasibility Practice	1 @ 1CR	1CR‡	2%
Feasibility Proposal	1 @ 7CR	6.5CR‡	10%
Additional Labs	6.25CR + much more	6CR	10%
Total	**66CR**	**62CR**	~100%

‡ *can be penalized with negative CR – if not submitted, the CR is subtracted*

- Total CR for A+: 6.75+8+21+12+4+1+7+6.25 = 66
- Total CR for A: 62+
- B: 56+ CR
- C: 50+ CR
- D: 44+ CR
- F: < 44CR

Various grade scenarios are covered in the FAQ!

Labs. 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:

- Details of requirements for each lab will be specified as part of that lab.
- As a rule, you should get full credit for each lab because you won't finish the lab or submit on Gradescope until you are more or less ready with fully correct answers and done with all tasks.
- If the grader determines that you haven't completed the lab, you will be asked to return to show mastery of the material or resubmit material.
- 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 are free to submit work and answers to the labs as many times as you like before the deadline.
- Lab deadlines are *extremely* lenient, so you shouldn't be asking for extensions except in extraordinary circumstances. You may submit lab work after each deadline for 50% credit.

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*.

Makerspace Presence. All students are encouraged to complete the on-line orientation, on-line lasercutter training, and on-line 3D printer training at the BeAM Makerspace. Simple design and manufacture will be optional parts of some labs. If you don't already have access to the Makerspace, you must sign up for the 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/

FAQ

Cool – so we're gonna build robots? No. *Learn about robots?* A little. *Build a robot 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 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 large measure, the reason you won't be able to "do robots" is a lack of time, not a lack of skill. That said, the Honors section is going to get closer to doing robots than previous versions of this course, and the "right student" may accomplish quite a bit in the robotics category. We will see how it plays out – that's all we can say.

What is focused brain time? *(from Grading section)*. When you're in class for 50 min, your brain is *focused* for perhaps 15 min – focused effort is actively figuring something out individually or in collaboration, as opposed to passively making notes of important discussions or checking your TikTok or ig. For this reason, lectures only count for ¼CR. A 1CR lab will involve anywhere from ½–2 hours (on occasion more) of *focused* brain time/work to achieve the lab goals.

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. We will do several in-class assessments in which it will be difficult to collaborate; therefore, your best approach, not only for the integrity of the academic mission, but also for the development of your skillsets, will be to learn and know the material yourself.

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. I 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!

What is a rodeo? (see collaboration question above) Your instructor works at UNC during certain 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 go faster, and questions get immediate expert answers.

I know how to ask questions, but how do I know when to provide an answer or not 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 the details and nuances. Not to mention, your future employment may well depend on the kinds of technical details and skills you develop here.

Is it possible to use less hardware, forfeit the credits associated with that hardware, and make up the credits using the remaining hardware? 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. A continuing wrinkle for 2024 is the global supply chain situation (which is much better than only a year ago) – we will address this in real time during class discussion.

The RPi is kind of expensive – can I do the course without it? Short answer: yes, you just have to find the CR to do it. Longer: Based on lessons learned from previous versions of this course, the RPi work will be a major focus for the Honors section, for which loaners are available. Therefore, non-honors students will be able to do well without the RPi work; however, if you are not honors, you'll still be able to do the RPi labs and get credit. The difference is that a non-honors student can give up on the honors material at any time without repercussion. And again, a limited number of loaners are available.

But how important is learning the RPi – can I 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, written 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? ~~Given the current global supply chain issue, it's possible that you may not be able to get a RPi device. If this is the case, the instructor will try to work out an alternate plan with you for the loaners available to us; however, Honors students will get first priority on loaner RPis. More details will be provided when the course starts.~~ *Note at press time: much of the supply chain pressures appear to have been eliminated; RPis appear to be both available and at pre-pandemic prices.*

My time is pretty tight this semester; can I choose a smaller number of more difficult labs, or a larger number of less difficult labs, 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.

I'm a perfect student, with 100% scores for everything (including exam scores) and perfect attendance before considering any additional labs. What's my grade? Your total is CR is just under 60 (A+ column in Grading table), so you only have to do a couple/3 additional labs to get an A, but wouldn't you rather be an A+ student even if UNC doesn't allow grades of A+?

I didn't complete Core Lab 2 (1CR) – what's the damage? ~~If you didn't do Core Lab 2, you can't complete Core Lab 3 (1CR). The maximum score you can then from the Core Labs is 20–2 = 18. You'll then be penalized for the Core Labs you didn't do – total CR from Core Labs = 18–1 = 17 instead of the maximum possible 20~~. *Pending update*.

I'm 100% perfect at everything, but I only got 50% scores on the 2 midterms and the final. Where do I stand? ~~If everything else is perfect without considering the additional labs, your total is 70–6.5–8CR = 55.5CR. You're somewhere between a B and a C, but you can get an A by completing enough other labs to get 64+CR. *This assumes that everything else is perfect*~~. *Pending update.*

I was too busy or not interested and decided to skip the feasibility proposal. Can I make this up with more labs? Yes, but let's look at this. There are about 6CR per letter grade. You lose the 7CR plus you're penalized an additional 7CR, which is slightly more than 2 letter grades, so you're barely getting a C. Unless you're otherwise *perfect* and do more labs, you're probably getting a D. It'll be easier and less stressful to just do the feasibility proposal assignment!

What specifically will I learn in this class, and what should I know in advance? Specifically, you'll learn elements of Python and 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 microcontroller 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.

I'm an Honors student – how does this class differ for me? This is a great question, and unfortunately, we can't tell you exactly what will be different because you will be central to developing the Honors section of this course from the start. Possible avenues include:

1. Normal: complete an honors-designated lab.
2. Extension: complete a regular lab and research or invent ways to extend it.
3. Deep dive: complete an honors-designated lab and commit to understanding how/why it works.
4. Creation: insert your idea here for work we haven't imagined yet.

All but the first of these will require collaboration with an instructor. In large measure, you can expect more sophisticated approaches to the subject matter instead of more subject matter, and also the potential for longer-term project work.

I'm an Honors student – after reading the previous question I feel like the labs might be too difficult so I'm taking the non-honors lab section. There are good reasons to not take the honors lab even though you're in the honors program; however, they shouldn't have anything to do with the course material (that is, the reasons should be external to the course). For this semester, the honors work is intended to be close to a zero-sum game – I don't expect the honors component to be more than about a 10% change in effort (larger) compared to the non-honors. 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*.

Is that all? The above FAQs are likely *not* all you need to know. The syllabus will be updated to provide more information.

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 usually 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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PHYS231 Honors

PHYS231 has an honors (H) lab section(s) available. Students may enroll in the H section if they are either in the UNC Honors program or if their GPA is 3.0 or above.

The H version of the lab is differentiated from the normal sections by requiring additional advanced work. Most of the work will be of a curated nature (that is, honors students are not free to do just anything); however, the instructor is open to discussion about the details.

- Extensive work with RPis – instrumentation and image/motion detection at a minimum.
- Laser galvanometer (e.g., lightshow demonstrator).
- Advanced actuation (stepper motors).
- Feedback and control (e.g., solar cell power point tracking).
- Advanced feedback and control (e.g., proportional-integral-differential).
- Control and command of robotic mechanisms.
- Local area mapping (e.g., LIDAR).
- Machine-learning (e.g., voice actuated control, machine vision, object recognition)
- Exposure to additional microcontrollers. See Alternative Hardware on Sakai site for details.

The grading scale for honors lab students will be modified from the non-honors lab; however, in this first iteration of the course, *we don't envision the honors section to be substantially more or less work than the non-honors section*.

- The goal is to create a set of labs that can be specifically dedicated to the honors cohort.
- We envision working in groups (typically pairs) to accomplish the goals of the honors labs.
- Submission requirements may be different from the rest of the course; specifically, we expect closer communication with instructor(s) about the work and some of the work may be checked off in a meeting setting rather than work submission.
- Possibilities for honors work includes:
    - Instrumentation Physics – Speed of Sound (required)
    - Instrumentation Physics – Collision g-forces (required?)
    - Instrumentation Physics – Radiation detection/monitoring
    - Instrumentation Physics – Gas/CO
    - Instrumentation Physics – other
    - Any and all aspects of RPi
    - Robot Dog Kit – I have one and it needs to be finished building:
        - RPi-controlled.
        - Sensor-actuation feedback loop to balance and walk.
        -
    - Machine Learning
    -

TBD

All other requirements of the syllabus will apply equally to both honors and non-honor students.

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