# College of DuPage
# Engineering 2223-001
# Spring 2026

**Instructor** . . . . . . . . . . . . . . . . . . . . . Dr. Alyssa J. Pasquale (she/her)

**Office Hours** . . . . . . . . . . . . . . . . . . see Blackboard for times and locations

**Office Location** . . . . . . . . . . . . . . . BIC 3E01

**E-mail** . . . . . . . . . . . . . . . . . . . . . . . . pasqualea185@cod.edu

**Instructor Website** . . . . . . . . . . <http://www.doctor-pasquale.com>

**Course GitHub** . . . . . . . . . . . . . . <https://github.com/DoctorPCOD/DoctorPCOD>

**Blackboard** . . . . . . . . . . . . . . . . . . . <http://bb.cod.edu>

**Lab System** . . . . . . . . . . . . . . . . . . <https://www.myopenmath.com>

**Lecture Hours & Location** . . . MF $9:00 - 10:15$ a.m. in BIC 3F07

**Lab Hours & Location** . . . . . . W $9:00 - 11:50$ a.m. in BIC 3F07

**Textbook** . . . . . . . . . . . . . . . . . . . . . Microcontrollers by Alyssa J. Pasquale, Ph.D.

**Lab Manual** . . . . . . . . . . . . . . . . . . Microcontrollers Lab Manual by Alyssa J. Pasquale, Ph.D. (**printed copy required**)

# Contents

# 1 Course Logistics

## 1.1 Prerequisites

ENGIN 2213 (Introduction to Digital Systems) and either CIS 1400 (Programming Logic and Technique), CIS 2485 (C++ for Science and Engineering), or CIS 2541 (Introduction to C++ Programming) with a grade of C or better.

## 1.2 Lecture Activities

Attendance at all lectures is mandatory. You must arrive within 10 minutes of the start of lecture (that is, by 9:10 a.m.) to be admitted into the classroom. The tentative schedule of lecture topics is included at the end of this syllabus. I recommend reading the relevant textbook sections prior to class.

Lecture sessions will be dedicated to reviewing topics from the textbook and completing activities. The activities are to be completed in class. Activities will not be accepted from students who are more than 10 minutes late to lecture or who are absent. The activities are designed to provide hands-on experience learning the concepts in class. Each successfully completed activity is worth 10 points.

> ⋆ **Why do I have to show up by 9:10?**
>
> Some of our lecture time is spent learning the principles and theory of a new topic (traditional lecture), and some is spent doing an activity to get hands-on experience with that topic. Both of these components are important, and missing the introduction will make it difficult if not impossible to be successful at truly learning a topic.
>
> Essentially, this rule was built to prevent students from skipping the "lecture" part of our classes and just showing up to do the hands-on activity. If you think this class is too boring to spend time learning the material, consider not taking this class!

> ⋆ **What if I have a question during lecture?**
>
> Please ask! Hopefully you will notice that I am a big fan of interactive lectures. I always appreciate students asking questions. Feel free to raise your hand, or if you're not interrupting, just ask!

**⋆ What if I have to use the restroom during lecture?**

Just go! Do not ask permission, do not raise your hand, just go.

**⋆ Do I need to let you know if I'm going to miss a lecture?**

You do not need to tell me if you are going to miss a lecture. I will take attendance for my records, but your grade will not be directly affected by your attendance. I do not need any doctor's notes or explanations. If you cannot make it, you simply do not show up.

**⋆ What do I do if I miss a lecture?**

Don't panic. Missing one or two lectures is not a big deal. Catch up by borrowing notes from a peer and reading the relevant sections in the class textbook. Feel free to ask clarifying questions about the lecture you missed during office hours, but do not expect me to re-teach entire topics to you. Unfortunately, if you are absent to a class where an activity is completed, then you will receive a zero on that activity.

**⋆ What do I do if I don't understand a lecture (or two, or more)?**

Please come to office hours for help. There are also sometimes tutoring sessions (although these are not always guaranteed if we don't have a tutor) that are strongly recommended. Study with your peers in the class. Make sure that you've read the relevant sections in the textbook.

## 1.3   Design Project

A design project will be a centerpiece of this class. You will be asked to form groups (between 2–4 students) and complete a Smart Car embedded control project. The design will consist of a design proposal, subsystem checkpoints and reports, and a final presentation and report. Checkpoints for each major subsystem will occur throughout the semester with subsequent reports due the following week. Due dates are included in the schedule and rubric document posted on our class GitHub page.

It is expected that you will turn in all design project assignments by the due date and times provided in the schedule and rubric document. You will not necessarily receive any reminders about deadlines and requirements.

> ### ⋆ What if my design partner drops the class?
>
> This is unusual in microcontrollers, but it sometimes happens. As long as the number of group members is at least two, you should be set to complete your design project. If there are significant issues due to a group member dropping the class, let me know.

> ### ⋆ What if a member of my design group doesn't do anything?
>
> Unfortunately, this happens. Do the best you can, and please chat with me if you need me to intervene in some way. For each of the reports that you complete, every team member will have their grade weighted by an effort score. This is an attempt to encourage students to pull their own weight, and to reward students who do the work.

### 1.3.1 Subsystem Checkpoints and Reports

Subsystem checkpoints will be graded on whether or not the Smart Car is able to perform the required objectives by the deadline. If all of the objectives are met, then full credit will be awarded. Otherwise, an extension of one week will be allotted for the possibility of half credit if all of the objectives are met. If the objectives are not met by that time, then the subsystem grade will be 0. You **must** be present at the checkpoint to receive credit for your group's work. These dates are listed in the schedule and rubric document posted on our class GitHub page.

Subsystem reports will be graded using the aforementioned rubric. You will also fill out a peer evaluation form giving out 100 points to all students in your group based on the amount of effort put in by each group member. Each group member will receive a score equal to the report grade weighted by their effort score. It is not possible to receive a score greater than 100% of the possible grade.

### 1.3.2 Final Demonstration and Report

The final demonstration will be held during the last week of the semester. (These dates are listed in the schedule and rubric document posted on our class GitHub page.) All Smart Cars will have to successfully complete objectives which are available on the rubric. Failure to successfully complete the objectives will lead to a grade of 0. Otherwise points will be awarded as indicated in the rubric. You **must** be present at the final demonstration to receive credit for your group's work. The

final report will be graded using the rubric document. Similarly to the subsystem reports, each team member will receive a grade that is weighted by their effort score.

### 1.3.3  Project Grades

All rubrics for each of the graded components of the design project (design plan, subsystem reports, etc.) are posted on the schedule and rubric document posted on our class GitHub page. The rubric outlines my expectations for each section of your submitted work. Please note that you are not graded on the amount of time it took you to write the assignment or the amount of effort you put into it. In addition, it is possible to have a wonderfully functioning project and not receive a good report grade due to lack of supporting documentation in your presentation. (For example, merely providing a design schematic without providing detailed supporting documentation and explanation will likely not be eligible for credit, even if those schematics are correct and led to a fully-functioning design. Additionally, software code without any comments will likely not be eligible for credit.)

If you have clarifying questions about a rubric item, or are unsure of whether or not you are giving enough information in your assignments, have a conversation with me during my office hours in advance of the due date. Do not come to me after I have graded your work to ask for more points. Regardless, I will not entertain requests for more points over e-mail. Discussions must be had in person during my office hours.

## 1.4  Exams

There will be one in-class practical exam (i.e. writing software and wiring hardware using the Arduino) and one final exam. The final exam will be comprehensive and cover material from lectures, activities, and labs. **The final exam for Spring 2025 will be held on Wednesday, May 20, from 9:00 − 10:50 a.m.** Exams **must** be completed at the time that they are given. There are no make-ups for any reason.

You will be provided with a printed copy of the textbook to use on each exam. (You are not allowed to write in the textbook. Writing in the textbook will cause a deduction of five points on each exam where this takes place.) Please note that the printed copy of the textbook is not necessarily the most up-to-date version of the textbook, and should not be relied on as the definitive guide to answering all exam questions. Both exams are open notes. Cellphones, tablets, laptops, and smart watches cannot be used during either exam. You will be asked to remove or turn off all digital electronics prior to taking an exam. Use of any digital electronic device

during an exam will result in a grade of zero on that exam and will be submitted to the Dean of Student's office as a violation of COD's Code of Academic Conduct.

### ⋆ Are the exams open book / notes / etc?

For the practical exam, you are allowed to use everything except the Internet (and any Internet-connected devices). You will be allowed to use the lab computers, disconnected from the Internet. This means you can bring and use: a calculator, your notes, the textbook (exam copies will be available if you don't have a printed copy), a USB stick with all of your lab code, your lab manual, and any other resources you'd like.

For the final exam, you are allowed to use a calculator, your notes, your lab manual, and the textbook (exam copies will be available if you don't have a printed copy). No computers, devices, or Internet use is allowed.

### ⋆ How long will I get to take the exams?

You get three hours to take the practical exam. That's because we only have three hours allotted to us for lab time, and the exam is completed during a lab session. Partial credit is possible if the circuits are not fully completed by the conclusion of our lab session.

For the final exam: you will get as much time as you want (sort of). We will start the final exam in the classroom at 9:00 a.m. If you don't finish by the end of the exam session, we will go to the testing center together so you can finish up. You don't have unlimited time, because the testing center eventually closes.

### ⋆ What if I'm absent during an exam?

Both exam dates are given in <span style="color:red">section 6</span> of this syllabus. You know these dates at the start of the semester: do not plan anything on those dates! The practical exam cannot be taken on a different date, as we are constrained by our very limited lab availability.

## 1.5   Laboratory Sessions

Laboratory sessions will take place every Wednesday in BIC 3F07. Labs are designed to provide you with hands-on experiences related to the topics that are discussed in

the classroom. Each lab consists of a pre-lab, in lab material, and lab report. **You must arrive within 10 minutes of the start of lab (that is, by 9:10 a.m.) in order to participate in the week's lab activities.**

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⋆ **What if I miss a lab?**

Unfortunately, as our lab time is extremely limited, there are no makeups allowed for any lab. Please plan accordingly! If you miss a lab, it is still expected that you have completed the pre-lab prior to attending. It is not possible to complete a lab report for a lab that you have not completed.

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⋆ **Why did you kick me out when I was only 11 minutes late?**

Remember this from digital?! I give a TON of information to students at the start of lab. If you show up late, you have essentially missed all of the important relevant information that I've just spent a fair amount of time explaining to students. I've been teaching this class since 2017, wrote all of the lab circuits myself, and have also built every last one of them. At this point, I have a really good handle on the things students commonly misunderstand or do incorrectly, and I spend time at the start of each lab making sure you don't fall into any of those traps. Be respectful of my time and your time, and come early.

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### 1.5.1   Lab Manual and Lab Submission

The lab manual is published under Creative Commons and is freely available for you to download as a PDF. You are required to have a printed copy of the lab manual (or of each individual lab) at each lab session. Copies will not be provided to you. The library's print on demand service is strongly encouraged for you to obtain a print copy of the lab manual. Note that you are responsible for having the manual printed early enough that it is ready by the first lab of the semester!

> **⋆ Can't I just print out each lab on the lab printers?**
>
> The lab printers are not for students to use to print out hundreds of pages. The physics department pays for every piece of paper that is printed, and that cost is reflected in your tuition.
>
> You may print documents at the COD library using your Smart Print account, or at home using a personal printer. Any Creative Commons-licensed work can also be printed at Staples, Kinkos, or any other physical or online print retailer.

> **⋆ What if there's a typo in the lab manual?**
>
> It is very likely that a typo was unintentionally included in the lab manual. If I catch something early enough, I will include information about any errata on the lab folder in our class GitHub page, so it is important to read that page prior to each lab. Failure to read information about the lab in advance of class will not excuse incorrect or missing work.

All lab assignments will be turned in using MyOpenMath. MyOpenMath is free to use, and the access code is available on our class Blackboard page. More information on work submission is included in section 2.1 of this syllabus.

It is expected that you will turn in all lab assignments by the posted due date and time (which are available on https://www.myopenmath.com). You will not necessarily receive any reminders outside of this syllabus about lab assignments, deadlines, and requirements.

### 1.5.2    Pre-Labs

Before starting a lab, it is expected that you read the lab information in our class GitHub page. Pre-labs are provided in the lab manual. Complete the pre-lab before coming to lab and submit in MyOpenMath by the indicated due date and time. Each pre-lab will be worth one point toward that day's lab (it is not extra credit). Late pre-labs will not be accepted.

> **⋆ What's the point of the pre-lab?**
>
> This is something you should be extremely aware of from digital systems. The purpose of the pre-lab is for you to derive equations and quantities, draw schematics, watch equipment videos, do simulations, and conduct research on any topics you're uncertain about. Usually, the lab cannot be completed in the allotted time if the pre-lab has not been completed.

> **⋆ How long do pre-labs take?**
>
> Some of them are short, some of them are not. I strongly suggest working on these as soon as you finish the previous week's lab. Do not start them a half hour before lab starts and expect to finish them. If a significant amount of pre-lab work needs to be completed, it will be formatted as an activity.

### 1.5.3   In-Lab Activities

During the lab, you will build a bunch of microcontroller circuits. The topics of the labs follow the topics in our lectures, but sometimes we get ahead in lab. In those cases, you may need to read the textbook and familiarize yourself with some topics before lab starts. Throughout the lab session, you will build the circuits, write C or assembly code, and record relevant information in your lab manual. When you've successfully completed a circuit, I will stamp your lab manual to indicate that it was working. By the end of lab, you'll take pictures of each of the lab manual pages and upload to MyOpenMath. All of your code will be uploaded to GitHub. This will be worth 10 points of your lab score.

> **⋆ How long do the labs take?**
>
> Based on my many years of experience (I've taught this class since 2017), every lab in the lab manual can be completed in the allotted lab time (2 hours 50 minutes). That said, I've seen some groups finish early and other groups struggle to finish at all. Plan to spend the entire lab session in lab.

> **⋆ What if I have to leave early?**
>
> It's OK if you have to leave lab early once or twice, but it is not OK for you to plan to go to work at 11 a.m. every Wednesday (or something similar). If you finish early, then I always suggest students stick around and start the next week's pre-lab, but you're welcome to leave once you complete the lab.

> **⋆ What if I don't finish a lab?**
>
> Sometimes we have open lab sessions over the next week during which time you can complete lab circuits. (Refer to section 6 in the syllabus for the tentative open lab dates.) If we have a tutor, then you can complete the lab circuits by attending drop-in sessions. You still have to finish up prior to the next lab session, though. I do my best to accommodate students in microcontrollers. Talk to me if there is an extenuating circumstance. Otherwise, upload what you've completed to MyOpenMath for partial credit.

### 1.5.4  Lab Reports

Lab reports (worth 10 points) are to be completed over the week and submitted at the beginning (that is, at 9:00 a.m.) of the next laboratory session. They must contain all of the required well-documented software code and other printouts requested in the lab manual. A list of report requirements will be included at the end of every lab in the lab manual. Lab reports may be submitted in the following formats (but must contain all of the required information, regardless of format).

- Written report
- Presentation
- Website
- Other, upon consent of instructor

### 1.5.5  Laboratory Safety

In order to keep our laboratory sessions as safe as possible, food and drinks of all types are not allowed in the laboratory room **at any time**. Students seen to have food or beverages out in the laboratory room (even if they are in closed containers, and even if they are in a side pocket of a back-pack) will be asked to leave and will receive a score of zero on that week's lab.

> **⋆ What if I need to eat or drink during lab?**
>
> That's fine, you're welcome to do so – outside! Just don't eat inside the classroom, or bring food or drink inside. We have a few couches in the hallway outside the lab, so feel free to go outside and eat, drink, walk around, whatever, in the hall. No need to ask my permission.

## 1.6 Course Resources

Additional course resources are available on:

- BlackBoard: http://bb.cod.edu

- Dr. Pasquale's website: http://www.doctor-pasquale.com

- Our class GitHub page: https://github.com/DoctorPCOD/DoctorPCOD

If you have any cool resources you'd like to share with me, please let me know!

If you're old-school like me and enjoy looking through textbooks, I have a few textbooks on reserve in the library (available at the circulation desk).

# 2 Course Policies

## 2.1 Work Submission

All assignments must be submitted by the due date and time that is provided either in this syllabus or on MyOpenMath. Individual reminders **will not** be sent out to remind you to submit an assignment.

All assignments must be submitted through the relevant platform (MyOpenMath or GitHub). It is your responsibility to ensure that you

- upload your work by the due date and time of the assignment,

- upload the correct assignment,

- do not crop out any pertinent information,

- upload all of the relevant pages showing all work and stamps, and

- upload work that is readable, legible, and in focus.

All code must be uploaded properly to GitHub. It must be viewable as a commit to the feedback section of the assignment. It is your responsibility to ensure this uploads correctly. To verify that your code has uploaded correctly, the video posted at https://youtu.be/eTR8f5genEE shows how to get to the feedback section of GitHub. Your code should be listed in the commits tab. Any code not properly uploaded will not be eligible for any credit.

It is your responsibility to ensure that you have a charged cellphone or other device that is capable of submitting your work on time. It is your responsibility to convert all relevant files to the correct file format before uploading. It is your responsibility to ensure that your file is not too large to be uploaded to MyOpenMath. It is your responsibility to ensure that your WiFi or cellular connection will lead to a reliable upload prior to the due date and time. **Late or e-mailed work will not be accepted for any reason, including (but not limited to) the reasons outlined above.**

## 2.2  Regrade Requests

If I have made an error in grading your work, then you will have **one week** from the original due date and time of the assignment to e-mail me and ask me to regrade your work. Note that this is not an opportunity to re-do an assignment, simply an opportunity to point out any mistakes I may have made while grading your work.

Exams must be viewed in my office during office hours (they will not be handed back to you in class), and any requests for a regrade on a question must be made to me within **one week** of the exam date. Note that regrades cannot be requested on the final exam, due to the fact that the semester will have ended by the time I have graded the final exam.

> ⋆ **But Dr. P, I asked you to regrade something, and you didn't do it. What gives?**
>
> Verbally asking me to regrade something is a virtual guarantee that I will forget. That is why I ask you to submit regrades over e-mail.

## 2.3  LatePasses

**Four** 24-hour LatePasses will be automatically assigned to you in MyOpenMath. These can be used at any time, for any reason, throughout the semester, on the

following assignments:

- Lab reports

- Subsystem reports (LatePasses will be deducted for all group members)

It is possible to use multiple LatePasses to extend a due date more than 24 hours.

**LatePasses cannot be used on activities, exams, pre-labs, labs, and project demonstrations.** It is not possible to use a LatePass on the final project report, or on any other assignment if it pushes the due date beyond the date of our final exam.

## 2.4   Late Material and Make-Ups

**Labs** must be completed as outlined in the lab section of this syllabus. Late pre-labs will not be accepted. Due to the lab equipment and space requirements, in-lab activities cannot be made up and must be completed and submitted during the assigned lab session. Late in-lab activities will not be accepted. Unless a LatePass has been used, late lab reports will not be accepted.

**Activities** must be completed by the due date, and late activities will not be accepted.

**Design project checkpoints** must be completed on the date and time provided in the schedule, due to lab equipment and space limitations.

**Design project subsystem reports** must be completed by the due date, unless a LatePass has been used.

**Exams** must be completed at the time that they are given. **There are no make-ups for any reason.** The practical exam, in particular, requires lab space and cannot be completed other than on the assigned date and time.

## 2.5   AI (e.g. Chat GPT) Policy

Any use of AI (such as Chat GPT) to assist in answering questions, writing code, or writing reports or other documents is allowed only if the following conditions are met:

1. You let me know exactly where and when your answers or responses include AI output.

2. You are responsible for ensuring the accuracy and correctness of any text that AI creates.

Any assignment that is turned in with incorrect AI answers will be graded on the quality of the work. If the AI tool you use gives you incorrect answers, and you use that to write down an answer that is confusing or incorrect, then you will receive no credit on the affected questions (assuming you disclosed your use of AI).

If, however, you turn in an assignment using AI without telling me, and I make the observation that AI contributed to your response, then you will receive a zero on the entire assignment.

Note that my policy is very lenient. Just let me know you use AI! I am not against it on principle! However, I will point out that the quality of the responses given by AI (particularly Chat GPT) is very low, and that AI does not give very good answers to, say, the specific procedure and results questions that I ask on lab reports. In addition, by relying on artificial intelligence to create responses to questions that I ask, you are not really giving yourself the opportunity to understand the answer. While it may help you to organize your thoughts, it cannot do your learning and conceptual understanding for you.

## 2.6   Typos

The textbook and lab manual were both written by me, and therefore may contain some typos. Finding an actual **technical typo** and letting me know about it will be worth 2 extra credit points. A technical typo consists of an error in mathematics working out one of the questions in the textbook. Finding an actual **grammatical typo** will be worth 0.5 extra credit points. A grammatical typo would be something like finding a misspelled word or sentence that does not make sense. Unless there is a very incorrectly placed comma, no credit will be given for nitpicking my use of commas in the textbook or lab manual.

To receive credit for the typo, you must tell me where you found it, the page number (preferably, include a screen shot), and evidence about why the textbook or lab manual is incorrect. (For example, saying that "this answer doesn't look right" is not evidence; working out the problem and proving me wrong would be evidence.) Up to 20 points of extra credit can be accrued by finding typos. **Typos must be sent to me by the last instructional day prior to finals to be eligible for extra credit.**

## 2.7 Class Announcements

Important class announcements will be sent using Blackboard announcements. You will be responsible for checking Blackboard (or your dupage.edu e-mails) regularly to ensure that you have the most up-to-date information regarding due dates and requirements. These announcements will not necessarily be made during class time. Failure to read these announcements will not excuse any missing, late or incorrect assignments.

## 2.8 Disruptions

If your phone or other device goes off during lecture or lab (notably: when I'm talking at the start of the lab session), I will deduct 10 points from your class grade. There is no limit to the number of points that can be deducted in this manner; for this reason it is imperative to keep your phones off or on silent mode or do-not-disturb during lab sessions.

> ⋆ **But why?**
>
> Teaching is difficult and requires a lot of focus. Especially at the start of lab, I have a lot of information to give you, and I really need to concentrate on what I'm doing. Coming in late, having a phone go off, talking with your peers, these are very disruptive to me and make it very hard to do my job well. Please be respectful of my needs, and I will be respectful of yours.

## 2.9 Withdrawal Policy

The last day to withdraw from this course is noted on the College of DuPage Academic Calendar at https://cod.edu/academics/calendar/index.aspx. After the official drop deadline, students may file a petition for late withdrawal according to the College of DuPage Course Catalog: Academic Policies and Procedures.

## 2.10 Academic Honesty

Anyone who partakes in academic dishonesty will receive a failure on the related assignment (which could be a lab, homework, or exam). Every occurrence of academic dishonesty will result in the professor filing a Code of Academic Conduct Violation Incident Report. Multiple offenses may include receiving a failure for

the entire course. COD's code of academic conduct is available online at `https://www.cod.edu/student_life/dean-of-students/academic-integrity.aspx`.

## 2.11 Conduct

You are expected to participate in dialogue with me and fellow students in a prideful and respectful manner, both in person and online (including Zoom and e-mail). This includes polite conversation and consideration of viewpoints and perspectives that are perhaps different from your own.

Deviations from these, including, taunting, derogatory slurs, personal attacks, physical outbursts or aggression, and other forms of blatant disrespect towards a person or their race, ethnic group, gender, physical/learning disabilities, socioeconomic status, sexual orientation, or gender identity will NOT be tolerated and may result in dismissal from the class.

# 3 Scope

This syllabus contains information on course policies and procedures. The College of DuPage has its own policies and procedures outlined in the COD Academic Catalog: `https://catalog.cod.edu`. You are responsible for being aware of this document and its contents.

# 4 Disclaimer

To the best of the instructor's knowledge, the information in this syllabus was correct and complete at the start of the semester. However, the instructor reserves the right, acting within the policies and procedures of the College of DuPage, to make changes in course content, instructional techniques or grading policy during the term. It is assumed that you have read this course syllabus. **Your continued enrollment in this course means that you accept the terms and conditions outlined in this syllabus.**

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⋆ **How often do you make changes to this syllabus?**

Almost never. I keep this section in here just in case something unexpected comes up. That said, I do expect you to read this syllabus and abide by it. I will abide by it as well.

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> **⋆ How often do you bend the rules of this syllabus?**
>
> Never. I need to keep my policies equal to all students, and that means keeping my policies consistent among all students. You are welcome to ask me to bend the rules, but do not be disappointed when I say no.

# 5 Grading

Your final grade for this course will be tentatively based on the following components:

| | | | |
|---|---|---|---|
| **Activities** | 150 points | **A** $\geq$ 900 points | |
| **Practical Exam** | 125 points | **B** $\geq$ 800 points | |
| **Final Exam** | 150 points | **C** $\geq$ 700 points | |
| **Lab Sessions** | 275 points | **D** $\geq$ 600 points | |
| **Design Project** | 300 points | **F** $<$ 600 points | |

> **⋆ What if I have 799 points?**
>
> If you're really close to the edge of the next letter grade up, I will take into account things such as: your attendance record (remember, I do keep track of this!), sincerity, attitude, and changes in performance. But, please read the next question below for why this is not always true.

> **⋆ But, Dr. P, I was SO CLOSE to a C!**
>
> Usually I do not round up to a C. If you get 690 points, very likely you will be receiving a D in the class. Why? Because giving you a C is the same as saying that I think you will be able to successfully complete the next classes in the sequence at your transfer school). Students who do not demonstrate at least C-level work in microcontrollers will probably not go on to be successful in these next classes.

# 6 Tentative Class Schedule: Spring 2026

| Week | Topic(s) |
| --- | --- |
| 1 | Introduction to microcontrollers and embedded design |
| | Model microcontroller |
| | ATmega328P block diagram |
| | I/O registers |
| **No lab: we will have lecture on Wednesday instead** | |
| 2 | Arduino IDE, datatypes, and operators |
| | Operators |
| | Reading from PINx registers |
| | Conditional control flow |
| **Form design project groups** | |
| **Lab 1: Introduction to Arduino Uno** | |
| 3 | Integer math |
| | Analog to digital conversion |
| | Iterative control flow |
| | Arrays |
| | External functions and variable scope |
| **Lab 2: Digital and Analog Input Devices** | |
| 4 | Timing and delays |
| | Sensors |
| **Design Plan Report due** | |
| **Lab 3: Displays** | |
| 5 | Interrupts |
| **Lab 4: Sensors and Sensor Calibration** | |

| | |
|---|---|
| 6 | Watchdog timer |
| | System clock |
| | Timer/counters (non-PWM) |

**Lab 5: External Interrupts**

| | |
|---|---|
| 7 | Pulse-width modulation |

**Lab 6: Timers/Counters and Timed Interrupts**

| | |
|---|---|
| 8 | Input capture unit |

**Lab 7: Pulse-Width Modulation and Motors**

| | |
|---|---|
| 9 | H-bridge motor driver |
| | Serial communication |

**Lab 8: Input Capture Unit**

Monday to Sunday, March 29 to April 4 – Spring Break – No Classes

| | |
|---|---|
| 10 | Smart Car barrier detection: open lab and demonstration |

**Lab 9: SPI: Serial Peripheral Interface**

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|---|---|
| 11 | Closed loop feedback and PI control |
| | Fuses |
| | Sleep modes |

**Barrier Report due**

**No lab: we will have the practical exam on Wednesday instead**

| | |
|---|---|
| 12 | Smart Car line detection: open lab and demonstration |

**Lab 10: Proportional and Integral Control**

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|---|---|
| 13 | Review and open lab |

**Line Detection Report due**

**Lab 11: Power Consumption and ATmega328P**

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|---|---|
| 14 | Assembly |

**Lab 12: Transmitting and Receiving a Secret Message**

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|---|---|
| 15 | Smart Car final demonstrations |

**Lab 13: Assembly**

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|---|---|
| 16 | **FINAL EXAM** |

**Final Report due**

# 7    Course Description

This is an introduction to the structure of microprocessors. The topics include architecture, instruction set, assembly language programming, assembler directives, input/output operations, C language programming for an embedded device, timers, analog-to-digital conversion, interrupts, and timing analysis. The course includes a lab component and is intended for electrical and computer engineering students.

# 8    General Course Objectives

Upon successful completion of the course the student should be able to do the following:

1. Describe the basic architecture of a stored-program computer.

2. Describe the addressing modes of a sample microcontroller.

3. Apply the principles of top down design to microcontroller software development

4. Develop assembly language programs for a microcontroller

5. Describe the interfaces for input and output including computer buses, parallel, and serial

6. Identify timing issues and events

7. Describe different types of memory used in microcontroller systems

# 9　Topical Outline

1. Computer architecture

2. Registers

3. Addressing modes

4. Assembly language programming

5. Top down software design

6. Computer buses and parallel input/output

7. Interrupts and real-time events

8. Computer memories

9. Serial input/output

10. Analog input and output

This syllabus was last modified on 2025/09/19.