# ECE 476/676 - Advanced Embedded Systems

Spring 2025 - www.BisonAcademy.com

## Course Information:

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| Instructor: | Jake Glower |
| Class Times | MWF 9am, Offerdahl West (ECE) 123 |
| Lab Times: | Open Lab |
| Office Hours: | Tu/Th 10-11am (pretty much all day Tu/Th) |
| Text: | none |
| On-Line Reference: | www.BisonAcademy.com |

## Bulletin Description:

Specification, design, development, and test of modern embedded systems using a high-level programming language. Prereq: ECE 376. F, S

## Course Objectives:

By the end of the semester, students should:

- Be able to interface a microcontroller to binary inputs and outputs,
- Be able to interface a microcontroller to analog inputs and outputs,
- Be able to use a graphics display touch-screen for I/O,
- Be able to send/receive data to your cell phone using Bluetooth,
- Be able to access a WiFi network using a microcontroller, and
- Be able to do all of this using Python

## Hy-Flex Model for Spring 2025

Students are welcome to take this course however they like:

- In-Person: Students are welcome to addend class at the designated class time and location.
- Live-Stream: Students are also welcome to live-steam the class. A link with how to connect will be sent out at the start of the semester on BlackBoard and to your NDSU email address.
- On-Line: Students are also welcome to take the class on-line and fit lectures into their own schedule.

Everyone is welcome to use the on-line resources on Bison Academy. These include

- Each day's lecture,
- Detailed lecture notes for each day,
- YouTube videos for each lecture,
- Sample code,
- Homework sets, and
- Solutions to previous homework sets (which are usually similar to this semester's homework)

In addition, midterms and the final will be offered both in-class as well as remotely through BlackBoard. If you opt for BlackBoard, you will typically be allowed to start any time between 8am and midnight the day of the test. Once you start the test on-line, you have 2 hours to complete the test, 3 hours to complete the final exam.

It's completely your choice how you take the class.

## Required Student Resources:

- GeeekPi Pico Breadboard Kit: ($32 from Amazon)
- Raspberry Pi Pico-W: ($10 from Amazon, $8 from Adafruit)
- Ability to make videos and preferably post them on YouTube.

## Evaluation Procedures and Grading Criteria

Grades will be the average of the following:

| Midterms (x3) | Homework | Final Exam |
|---|---|---|
| 75% | 25% | none |

Grades are rounded to the nearest 1%, with your final grade being

| F | D | C | B | A |
|---|---|---|---|---|
| 59% or less | 60% - 69% | 70% - 79% | 80% - 89% | 90% or more |

**How to Get an A or B:** Keep up and do the homework. This class involves programming and interfacing hardware to your computer board. The only way I know to understand this interaction is to do it yourself. That's what the homework problems are for. It's also a building process. We start with getting an LED to blink and end up with controlling a DC servo motor with a touch screen. If you fall behind, it will be hard to catch up. Besides, getting your board to do stuff like play the NDSU fight song on your speaker is what's fun about this course.

The grades in this class are often bimodal: people who did the homework themselves tend to get either an A or a B. People who did not do the homework or copied the struggle to get a D.

## Homework & Lab Projects

Each student can work in a group of 1 or 2 (max). Only one homework set / term project is required per group. Note, however, that the first exam (and perhaps others) will have two parts

- A written portion, and
- A lab portion where you work along to get a program to compile, download, and run.

Likewise, please make sure that you understand how the hardware and software works for each homework set.

Most homework sets are open-ended: you are free to specify what it is you're going to build and program (subject to it including things that we're covering that week, such as stepper motors). Each write-up includes five sections:

- Requirements What your device does and the requirements it needs to meet.
- Analysis : What a typical midterm is. Schematics and calculations for the resistors, capacitors, transistor gains, etc.
- Software: Flow charts and description of how your code works and incorporated features covered in class,
- Verification: Collect data to verify your design works or mostly works. (Loop times, voltages, currents, etc.)
- Demonstration: In-person or YouTube video presentation: showing off and explaining your design.

Note that if you use trial-and-error design to get a working device, you'll probably be spending 20+ hours/week in lab and will struggle to get a C. Conversely, if you understand the design, can verify your analysis with lab data, and it just refuses to work, you still get an A. As engineering students, the important part of your design is your understanding of how it works and ability to verify your analysis.

## Legal Stuff:

**Attendance:** According to NDSU Policy 333, attendance in classes is expected. How you attend is up to you (in-person, live-stream, online). Students are responsible for the material covered in class and in assignments regardless of their attendance. Note that all lecture notes, homework sets, and solutions are available on-line at www.BisonAcademy.com

**Students with Special Needs:** Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

**Academic Honesty:** The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

**Academic Honesty Defined:** All written and oral presentations must "respect the intellectual rights of others. Statements lifted verbatim from publications must be cited as quotations. Ideas, summaries or paraphrased material, and other information taken from the literature must be properly referenced" (Guidelines for the Presentation of Disquisitions, NDSU Graduate School).

**ECE Honor Code:** On my honor I will not give nor receive unauthorized assistance in completing assignments and work submitted for review or assessment. Furthermore, I understand the requirements in the College of Engineering Honor System and accept the responsibility I have to complete all my work with complete integrity.

**Veterans and Student Soldiers:** Veterans and student soldiers with special circumstances or who are activated are encouraged to notify the instructor in advance.