

# ECE 5450 - Microcontroller Design and Applications

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## Time and Place

W 6:10 pm-8:50 pm on Zoom

## Office Hours

W 3:00pm - 5:00pm or by appointment

## Textbook

Recommended but not required:

Embedded Systems: Introduction to Arm® Cortex™-M Microcontrollers, Fifth Edition  
Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C

## Prerequisites

C programming, Circuit and Hardware Fundamentals.

## Course Description

Microcontrollers (MCU) are used everywhere today...in microwave ovens, engine controls in cars, automatic bread makers, to distributed I/O Controllers in Mainframe Computers. This course is designed to provide a learning experience that will prepare students to enter the design community ready to design and work with these systems.

Through a combined lecture and laboratory environment, the students will be introduced to the concepts of ARM-based microcontrollers. These concepts will then be utilized, in the laboratory, to provide solutions to typical applications problems. Many applications problems will be assigned, and the students will be required to design and implement the solutions.

The goal of this course is to provide students with the knowledge of MCU architecture and application. At the end of the course students would acquire the following: (1) knowledge of the various software and hardware components of a microcontroller, (2) understanding of MCU design and instruction set architecture (ISA) and (3) ability to develop MCU applications using C language.

**Student Outcomes:** 1

## Course Schedule (Tentative)

- Week 1: Introduction to MCU
- Week 2: ARM Instruction Set Architecture
- Week 3: Arithmetic/Logic and Load/Store
- Week 4: Branch and Conditional Execution
- Week 5: MCU Programming (Tools and Boards)
- Week 6: Interrupt
- Week 7: Midterm
- Week 8: Break
- Week 9: GPIO
- Week 10: Timers
- Week 11: Analog to Digital Conversion
- Week 12: Step Motor Control
- Week 13: Liquid Crystal Display (LCD) Interface
- Week 14: Pulse Width Modulators
- Week 15: Full Time on Final Project (Q&A)
- Week 16: Final Project Presentation

## Grading Policy

- Assignments (mix of mini-projects and homeworks) - 45%
- Midterm - 25%
- Final - 30%

## Disability Policy

"It is the policy of Villanova to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with the Learning Support Office by contacting [Learning.support.services@villanova.edu](mailto:Learning.support.services@villanova.edu) or 610-519-5176 as soon as possible. Registration is needed in order to receive accommodations.

The Office of Disability Services collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact Gregory Hannah, advisor to students with disabilities @ 610-519-3209 or visit the office on the second floor of the Connelly Center."

## Academic Integrity

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to

place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. Students are encouraged to read the University's academic integrity policy. The College of Engineering has adopted the following exam guidelines:

Students must arrive before the start of the exam. Under exceptional circumstances a student may need to arrive late, but he/she can enter the exam no later than 5 minutes after the start of the exam.

All cell phones must be turned off and stored away until the student exits the exam room.

The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an exam.

Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this exam."

You are encouraged to consult the Academic Integrity Policy and Code at the beginning of each semester (<https://www1.villanova.edu/villanova/provost/resources/student/policies/integrity.html>).

## Attendance Policy

Where possible, students should inform their instructors if they plan to be late or absent from class. In all cases, students should be prepared to provide documentation to petition for excused absences to the Associate Dean for Student and Strategic Programs, Dr. Stephen Jones. Students should use the form for requesting an excused absence. Excused absences do not count toward a failure in the course for first year students. Absence from class does not release the student from work assigned. Students who miss an in-class obligation (exam, presentation, etc.) due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement.

The University's list of excused absences for all students includes the following:

- participation in NCAA athletic competitions

- participation in special academic events (e.g., conferences, field trips, project competitions)

- participation in official university business (e.g., student representatives attending meetings related to university governance)

- attendance at significant events involving the immediate family (e.g., funerals, weddings)

- religious holidays - see the University's policy on Religious Holidays

- college-approved participation in placement activities (e.g., job interviews, graduate school interviews, attending job fairs)

- documented serious illness or disability