

## CMPE-250 Assembly and Embedded Programming Fall 2023 Syllabus

**Section:** 01 Mon./Wed./Fri. 11:00–11:50 a.m. INS(73) 1160  
02 Mon./Wed./Fri. 2:00–2:50 p.m. GLE(09) 2129  
**Instructor:** Roy W. Melton, Ph.D.  
**E-mail:** Roy.Melton@mail.rit.edu  
**Office:** 3471 James E. Gleason Hall (GLE, Bldg. 09)  
**Office Hours:** Mon./Wed. 3:30–4:30 p.m. (drop-in office meeting);  
Tues. 4:30–5:30 p.m. (drop-in Zoom meeting);  
Thurs. 9:00–10:00 a.m. (drop-in Zoom meeting)  
(other times by prior appointment)  
**Final Exam:** Tuesday, December 19, 8:00 a.m., GLE(09) 2580 Xerox Auditorium

**Description:** This course introduces embedded systems, along with fundamental computer organization, assembly language programming, and mixed language programming with C and assembly. Using a modern microcontroller and embedded systems IDE, such as the ARM Cortex-M0+ and Keil Microcontroller Development Kit, the course covers embedded programming concepts and interface modules, as well as addressing methods, machine instructions, assembler directives, macro definitions, code relocatability, subroutine linkage, data structures, I/O programming, exception processing, and interrupts. Program design techniques necessary to write efficient, maintainable device drivers are considered.

**Prerequisite:** CMPE-160 Digital System Design I or EEEE-120 Digital Systems I (or equivalent)

**Corequisite:** CSCI-140 Computer Science for AP Students, CSCI-142 Computer Science II,  
or CSCI-242 Computer Science for Transfer Students (or equivalent)

**Class hours:** 3 lecture hours; 2 laboratory hours; 3 credit hours

**Reference text:** (not required) *The Definitive Guide to the ARM® Cortex®-M0 and Cortex®-M0+ Processors*, Joseph Yiu, Newnes, 2015 (ISBN 978-0-12-803277-0).

**Lab kit:** (required) TBA for purchase from lab manager, around week five.

**Course policy documents:** 1. Syllabus (this document) and 2. Laboratory and Writing Guidelines. Both course policy documents are posted on myCourses.

### **Course learning objectives:**

- Working understanding of a representative microcontroller instruction set, addressing modes, and integrated peripheral input/output (I/O) devices.
- Experience with elementary embedded programming concepts, such as device initialization, stack utilization, and RAM initialization.
- Experience writing device interrupt handlers and enforcing protections for critical code sections shared by background tasks and interrupt handlers.
- Software design within hardware-intensive constraints of embedded systems using assembly language with a modern IDE tool.

### **Course learning outcomes, (i.e., expectations upon successful completion of course):**

- Comprehension
  - Understand microcontroller instruction set and addressing modes, such as ARM Cortex-M0+.
- Application
  - Use IDE such as Keil MDK-ARM to simulate and debug code for microcontroller.
  - Write and demonstrate stand-alone embedded programming projects.
  - Write and demonstrate interrupt handlers for several integrated I/O devices.

**Course materials:** Course materials are posted on myCourses. They are a primary source of material, including examples for experimentation. A prerecorded presentation of lecture material, lecture notes, and topic references is posted on myCourses.

**Class time:** Prerecorded presentations and lecture notes are posted on myCourses for review prior to class, so class time is used for reinforcing important concepts, working example problems, answering questions, and taking quizzes and exams. Questions, comments, or discussions should be related to course material and relevant to the whole class. Individual concerns can be addressed outside class time, such as during office hours.

**Communication:** Both myCourses and e-mail facilitate communication outside of class. The Calendar and Announcements components of myCourses have various deadlines, test dates, and class updates. The myCourses Classlist is used for both broadcast and individual e-mail regarding this course, (e.g., cancellation

or changing of scheduled office hours). Each student is responsible for e-mail sent to the address registered with myCourses. For e-mail to the instructor, please be aware that RIT e-mail filtering may prevent delivery of mail not from the `rit.edu` domain.

**Grading:** Any issues with a particular grade must be resolved within one week from when that grade is announced. An actual or projected grade below C– may result in an academic alert. *To pass the course, one requirement is earning a passing final lab average, (i.e., 65% or more of possible lab points).* With a passing lab average, the formula below gives the calculation for total points earned during the semester, and the final course grade is determined from the total, according to RIT Policy D5.0 and the rubric that follows; without a passing final lab average, the final course grade is F.

$$\begin{aligned} \text{Total points} = & 10\% \text{ Homework average} + 20\% \text{ Quiz average} \\ & + 15\% \text{ Midterm exam} + 20\% \text{ Final exam} + 35\% \text{ Lab average} \end{aligned}$$

**Rubric for Letter Grade Determination from Total Points**

	B+ : 88–89	C+ : 78–79	
A : 92 or greater	B : 82–87	C : 72–77	D : 65–69
A– : 90–91	B– : 80–81	C– : 70–71	F : 64 or less

**Exam and quiz:** *A missed exam or quiz receives zero points.*

**Homework:** Homework assignments are due at 11:59 p.m. on the due date. *Late assignments are penalized 10% per day (or fraction thereof) and are not accepted after a solution has been posted.*

**Lab:** The course “Laboratory and Writing Guidelines” document specifies the policies, procedures, and requirements for lab. Lab exercises require completing two components to receive any points for those exercises: 1) a demonstration with interview and 2) writing assignment specified for the exercise. If a demonstration is not completed by the end of the lab section, the demonstration may be performed without penalty until the submission due date, typically the day of the next scheduled meeting of the lab section. *Late submissions are accepted within one week of the due date but incur up to a 20% deduction per day (or fraction thereof) from the grade on that exercise;* refer to the “Laboratory and Writing Guidelines” document for the late submission policy. Late submissions are not accepted after one week.

**Extenuating circumstance:** At the discretion of the instructor, an extenuating circumstance, (e.g., extreme medical emergency, family death, etc.), *may* be considered for exception(s) to course policy. Prior arrangement with the instructor and applicable official documentation of the circumstance are required.

**Academic honesty:** Although students are strongly encouraged to talk with each other and with the instructor to learn course material, each student must individually complete work submitted for grading, including quizzes, exams, graded homework, and lab exercises. Unless the instructor indicates otherwise, *grading credit is earned only for work performed independently and solely by the individual student.* Copying assignments (including programs where various changes are made to make them “different”) from any source (including internet sources and generative AI) is not permitted; all students involved in such copying receive a grade of zero for copied assignments, regardless of who copied from whom. Any questions or concerns about this policy should be discussed with the instructor. All conduct in this course is governed by the academic integrity statement below. Additionally, it is expected that students respect their peers and the instructor such that no one takes unfair advantage of anyone else associated with the course.

**RIT syllabus required policies**

- **Academic adjustments statement:** RIT is committed to providing academic adjustments to students with disabilities. If you would like to request academic adjustments such as testing modifications due to a disability, please contact the Disability Services Office. Contact information for the DSO and information about how to request adjustments can be found at <http://www.rit.edu/dso>. After a student receives academic adjustment approval, it is imperative that the student contact the instructor as early as possible to work out whatever arrangement is necessary.
- **Academic integrity statement:** All conduct in this course is governed by the KGCoe Academic Honesty Policy, RIT Honor Code (P03.0), and RIT Student Academic Integrity Policy (D08.0).
- **Title IX statement:** RIT is committed to providing a safe learning environment, free of harassment and discrimination as articulated in university policies. RIT’s policies require faculty to share information about incidents of gender-based discrimination and harassment with RIT’s Title IX coordinator or deputy coordinators when incidents are stated to them directly. The information you provide to a non-confidential resource, including faculty, will be relayed only as necessary for the Title IX Coordinator to investigate and/or seek resolution. Even RIT Offices and employees who cannot guarantee confidentiality will maintain your privacy to the greatest extent possible. If an individual discloses information during a public awareness event, a protest, during a class project, or advocacy event, RIT is not obligated to investigate based on this public disclosure. RIT may however use this information to further educate faculty, staff, and students about prevention efforts and available resources. Title IX rights and resources at RIT, including links for non-confidential reporting of an incident of gender-based discrimination and/or harassment, as well as for confidential discussion of a concern about them, can be found at <http://www.rit.edu/fa/compliance/content/title-ix>.