ENGR-2350 Embedded Control

Course Syllabus

Basic Overview

Course Instructors:

- James [Dylan] Rees, JEC-6046, reesj3@rpi.edu
- Prabhakar Neti, JEC-6038, netip@rpi.edu
- Kyle Wilt, JEC-6004, wiltk2@rpi.edu

Office Hours: In Person and on Webex. Timing TBD

Lecture/Lab Schedule and Location: This class requires in person attendance when possible. Support for Hybrid students will only be offered for students with extenuating circumstances.

- Section 1: [Wilt] Monday/Thursday, 10:00 AM - 11:50 AM, JEC-4201
- Section 2: [Rees] Monday/Thursday, 2:00 PM - 3:50 PM, JEC-4201
- Section 3: [Neti] Tuesday/Friday, 10:00 AM - 11:50 AM, JEC-4201
- Common Lecture: [Wilt] Wednesday, 10:00 AM - 11:50 AM, Ricketts-
- Open Shop: Schedule TBD.

Teaching Assistants: See course website for teaching assistant and undergraduate support assistant information.

Schedule: The class calendar is hosted on the course website.

Overview: Engineering laboratory introduction to the microprocessor as an embedded element of engineering systems. Students simultaneously develop the hardware and software of one or more target systems during the semester. Topics include concepts and practices of microcontroller hardware and software for command, sensing, control, and display. Specifically, this includes control of dynamic systems and sensor interfaces; analog-digital conversion; parallel input/output; driver circuits, modular programming, and subsystem integration. *4 credit hours*

Overall Educational Objective: This course is designed to provide students with basic understanding on what embedded systems are, how they work, and the tools to build rudimentary implementations. This includes development of skills associated with algorithm development, procedural programming, and debugging and troubleshooting, with a fairly strong emphasis on troubleshooting.

Student Learning Outcomes: On completion of this course, the student will: (1) Be able to design interface hardware and software to sense, display, command, and control simple engineering processes. (2) Be able to write software for a real-time embedded control system. (3) Be able to prototype, implement, and debug the hardware for an embedded control system. (4) Understand the basic operation of microcontrollers and their role in embedded control systems. (5) Understand the role of sensors and actuators and how they are integrated into systems. (6) Understand and be able to use the laboratory voltmeters, logic probes, and usb tools required to troubleshoot these systems.

Student Assessment Measures: Assessment of student progress in the course objectives will be performed through a variety of mechanisms. Activities/Homeworks will be assigned for each major topic in the class. Hands-on laboratories will be assigned to guide student learning in each topic and quizzes will also be used to gauge understanding. Finally, two comprehensive exams will be given during the semester. There is no final exam for this course.

Pre-Requisite Courses:

- CSCI-1100 Computer Science I (Recommended), OR
- CSCI-1190 Beginning Programming for Engineers

Texts:

- No text required. All material required for the class may be found on the course website.

Online Tools: The following online tools will be used to support this course. If you do not have access to any of these tools, please inform the instructor as soon as possible.

- Course Website: https://ecse.rpi.edu/courses/static/ENGR-2350/
  - Contains all course information.
- Cisco Webex: https://www.webex.com/video-conferencing
  - Asynchronous communication platform between the students and staff.
  - Used for propagation of course announcements.
- Gradescope: https://www.gradescope.com
  - Submission of graded assignments will be done through this platform.
- RPI LMS: https://lms.rpi.edu/webapps/login/
  - Used as a hub to access other components of course.
  - Used for propagation of high-priority course announcements.

Policy Detail

FERPA Statement: The Online Tools used in this course provide a service designed to assist schools, teachers and other educational partners to improve student learning outcomes. In some circumstances, these online tools may receive personally identifiable information about students ("Student Data") from the instructor in the course providing this service. For example, an instructor will provide a class roster, email addresses of all students in the class, as well as coursework data that may be linked to a particular student. All listed online resource companies used by the instructor consider Student Data to be strictly confidential and have physical, administrative and technical security protections in place to protect such data. They do not use personally identifiable Student Data for any purpose other than to provide the services to the instructor, and they do not share personally identifiable Student Data with any third party except as authorized or required by the instructor. The online tools above may collect, analyze, and share anonymized or aggregated data or data derived from Student Data for certain purposes, but only if the disclosure of such data could not reasonably identify a specific individual or specific School. Collection and use of Student Data provided by the instructor is governed by Terms of Service for each platform and by the provisions of the Family Educational Rights and Privacy Act (FERPA). Student Data is provided and controlled by the instructor. If you have questions about reviewing, modifying, or deleting personal information of a student, please contact (point of contact TBD).

Inclusivity and Accessibility Statement: Rensselaer Polytechnic Institute strives to make all learning experiences as accessible as possible. We strive to provide an environment that is equitable and conducive for learning for all students. Please contact the instructors as soon as possible if you anticipate or experience academic barriers based on a disability, please let the instructor know immediately so that alternative options may be discussed and determined early. To establish reasonable accommodations, please register with The Office of Disability Services for Students. After registration, make arrangements with the instructors as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. To receive any academic accommodation, you must be appropriately registered with DSS.

DSS contact information: dss@rpi.edu; 518-276-8197, 4226 Academy Hall.

Collaboration and Academic Dishonesty: Intellectual integrity and credibility are the foundation of all academic work. A violation of Academic Integrity policy is, by definition, considered a flagrant offense to the educational process. It is taken seriously by students, faculty, and Rensselaer and will be addressed in an effective manner. If found responsible for committing academic dishonesty, a student may be subject to one or both types of penalties: an academic (grade) penalty administered by the professor and/or disciplinary action through the Rensselaer judicial process described in the Handbook of Student Rights and Responsibilities. Three relevant academic integrity violations to emphasize include:

Collaboration: Collaboration is defined as deliberately facilitating an act of academic dishonesty in any way or form; for example, allowing another student to observe an exam paper or allowing another student to "recycle" one's old term paper or using one another's work in a paper or lab report without citing it as another's work.

Copying: Copying is defined as obtaining information pertaining to a graded exercise by deliberately observing the paper of another student; for example, noting which alternative a neighboring student has circled on a multiple-choice exam.

Plagiarism: Plagiarism is defined as representing the work or words of another as one's own through the omission of acknowledgment or reference. Examples include using sentences verbatim from a published source in

a term paper without appropriate referencing, or presenting as one's own the detailed argument of a published source, or presenting as one's own electronically or digitally enhanced graphic representations from any form of media.

The Rensselaer Handbook of Student Rights and Responsibilities defines the full list of forms of Academic Dishonesty and you should make yourself familiar with these. In this class, all assignments that are turned in for a grade must represent the student's own work. In cases where help was received, or teamwork was allowed, a notation on the assignment should indicate your collaboration. If you have any questions concerning this policy before submitting an assignment, please ask for clarification.

Students in this course should be aware that the items emphasized above also apply to the source code generated by each student towards the completion of the laboratories and final project. Tools exist to detect similarities between source code files and the staff reserves the right to employ such tools to deter source code based academic dishonesty.

Any assignments that have been identified as violating the Academic Integrity policy will be assigned a 0 for all parties involved, with multiple violations or egregious violations resulting in immediate student failure and referral to the Dean of Students.

Use of AI and Other Code Generation Tools: Students are not prohibited from using AI tools in working on laboratories; however, the bulk of the development for the assignment must be done primarily by the students, and students must understand any externally generated code. Further, appropriate attribution must be added for any such code.

AI tools are explicitly prohibited during quizzes.

For students suspected of using AI tools to complete the labs and/or quizzes, the instructors reserve the right to perform an impromptu oral review of all applicable assignment(s) to assess understanding of the material. Student grades may be adjusted upon the outcome of this review.

Assignments and Gradeables

Activities and Homeworks: Most laboratory meetings will have class activities. These activities will be primarily individual based and are designed towards providing students with experience in using features of an embedded system that are introduced within the lecture. In-person activities should be completed priory to working on laboratories. Many activities will have additional tasks; for example, calculations, coding examples, etc., that will be completed as homeworks and submitted at a later time. There will be no standalone homeworks.

Laboratories: There are five total laboratories required for completion of this course. A description of each laboratory will be provided in the shared lecture or during the individual section meeting times. Students will be provided limited pseudocode or other guidance within the laboratory document as guidance for implementing the lab. Labs may be completed in groups of two students.

Each laboratory will require one or more "checkoffs" to demonstrate the required functionality; one checkoff per day of laboratory work. If a satisfactory checkoff is not obtained prior to the end off class, student teams will be able to receive a checkoff during Open Shop times prior to the next laboratory meeting.

Further, the code produced for each lab must be submitted upon completion. Laboratories will be completed by teams of two students. Student teams must satisfactorily complete all laboratories to receive a passing grade in the course with the exception that:

- If a student or group fails to complete a single laboratory but has shown sufficient effort, a full letter grade penalty will be assessed as opposed to course failure.
- If a student or group is unable to complete a laboratory due to extenuating circumstances beyond their control (e.g., class hardware faults), the instructor may grant leniency for the applicable laboratories if the affected students can show sufficient understanding of the required tasks.

Final Project: The class will culminate in student teams building a comprehensive laboratory to complete the semester. The teams will select from predefined project descriptions or are free to propose their own final projects. The predefined final projects must be successfully complete by the end of the semester, however, a custom project will be granted leniency as unforeseen obstacles to a 100 % completion may arise. The final project must be documented with a thorough final report. A rubric for the final report will be available on the course website.

Quizzes: Short quizzes (< 30 minutes) will be given focusing on the main topics of the course. These quizzes will be given on Gradescope during either the scheduled lecture or laboratory times and must be taken in the classroom. Conflicts to the quizzes must be disclosed to the instructor at least 24 hours before the quiz; otherwise, no credit will be given for the quiz. The quizzes will be open-book/open-computer. Solutions to each quiz will be posted once all students have taken the quiz, usually embedded within the associated Gradescope assignment.

No chat interactions or "AI" tools are allowed.

Exams: Two exams will be given during the lecture period. The exams will be performed on paper, with only a crib sheet provided. All questions will be similar in content to questions given in activities/homeworks and quizzes or comparable to portions of laboratory code. For problems requiring calculations, work must be shown in order to receive credit for the problem. Solutions to each exam will be posted once all students have taken the exam.

Course Logistics

Grading: The course will be graded following the table below. Additionally, all laboratories must be successfully completed (not just submitted) in order to receive a passing grade for the course.

Component	Quantity	Weight
Exams	2	35 %
Quizzes	4	12 %
Activities	13[1]	15 %
Laboratories	5	20 %
Final Project	1	13 %
Attendance and Participation	-	5 %
	Total:	100 %

[1]The lowest activity score will be dropped.

Late Policy: Deadline extensions may be granted under exceptional circumstances and only with prior notification of the instructor or official Dean's excuse. Without an official extension granted:

- Activity assignments will be accepted with a 50 % penalty if submitted after the due date and by the end of the activity's "catch-up day."
- Intermediate laboratory checkoffs are due as marked on the class calendar. No credit will be given for intermediate checkoffs after the deadline.
- Final laboratory checkoffs are due as marked on the class calendar and are required for satisfactory completion of the lab. 25 % deductions on the checkoff will be assessed after the deadline and each week afterwards.
- All labs must be submitted and must receive a "satisfactory" checkoff by the last day of classes:
  - If one laboratory is marked "insufficient," a full letter grade penalty will be assessed.
  - If multiple laboratories are marked "insufficient," a final grade of 'F' will be assessed.
- The final project and report (if applicable) will not be accepted after the last day of classes.
- Quizzes and Exams must be taken in person and at the scheduled date and time.

Attendance and Participation Policy: Attendance during the laboratory classes are required unless a student has completed all assigned work in advance. Explicit attendance may be taken randomly throughout the semester but will not be taken each class period. The means by which attendance is taken will be announced as applicable. A 1 point penalty on a students final grade will be assessed for each missed attendance, excluding excused absences.

Attendance during lectures is not strictly required.

As laboratories are completed in teams, it is expected that each group member contribute roughly equal contributions to the effort. After each laboratory is completed, each group member will be asked to submit a breakdown of member contributions. These breakdowns will be reviewed by the course staff to identify group balance issues and to intervene as necessary.

The submitted reviews, as well as staff observation and attendance, will be used to generate the associated grading component.

Getting Help: It is not expected for all students to be able to complete the laboratories without some aide from the staff. Students are encouraged to ask for help if stuck on an issue. In order to receive help, students can:

1. Ask the instructor or staff during official class times,
2. Attend an Open Shop session,
3. Attend an instructor's office hours. Students are encouraged to interact with both instructors of the course as needed.
4. Ask a question on the Webex group space. **Do not share your code on the Webex group chat**. Do not expect immediate help from the Webex group space during Open Shop (or other) times as it is likely the staff will be busy with in person help.

Re-Grading Policy: All assignments and gradeables are subject to regrades. As each of these items will be submitted to Gradescope, all regrades should be requested through Gradescope's regrade request feature. In order to achieve a successful regrade, make sure to be as explicit about your challenge as possible such that the grading error is clear and easily correctable.

Regrade periods for assignments will be limited to 2 weeks after publication of grades. Assignments submitted near the end of the semester will have regrade periods ending after the last study day.

Partners, Teamwork, and The Learning Community: Students will submit work individually or in a team for assignments as specified by each. However, interaction between other students and other teams is allowed and encouraged. However, as detailed in the Policy Section, the work (code or otherwise) produced by each student must be their own.