ECSE-4790 Microprocessor Systems

Course Syllabus

Basic Overview

Course Instructor: Kyle Wilt, JEC-6004, wiltk2@rpi.edu

Office Hours: In Person and on Webex. T/W 2:00-4:00 PM

Class/Lab Schedule and Location:
- Studio [Lab/Lecture]: Monday/Thursday, 4:00 PM - 6:50 PM, JEC-6309

Teaching Assistants:
- John Higham, highaj@rpi.edu

Overview: Hardware and software for real-time microprocessor based digital systems. Basic concepts and operations of on-chip components related to digital system functionality. Architectures, instructions sets, and interfacing with peripherals through serial or parallel ports. Introduction to 8-bit and 16-bit machines with in-depth treatment of 32-bit machines. Emphasis on C language cross-compilers. Laboratory exercises are included to demonstrate hardware and software development techniques practiced in industry. Fall term annually. *3 credit hours*

Overall Educational Objective: To provide fourth year ECSE students with a hands-on laboratory experience with more advanced features of state-of-the-art microprocessor systems, reading and interpreting manuals and technical documents, and to enhance their written communication skills through exploratory lab exercises and reports.

Student Learning Outcomes: Students will be able to: (1) Write a program to display messages on an ANSI terminal with attributes for position, color, background color, and animation, (2) Create a service routine that performs a function on the occurrence of an IRQ hardware interrupt and use a counter to control the accurate timing of a stopwatch display, (3) Connect RS-232 and SPI devices to the STM32 microcontroller and write programs to pass data to and from them, (4) Develop a routine to read an analog input on an ADC port, use a MAC to implement a 2nd order digital filter, and output the resultant analog voltage, (5) Employ Direct Memory Access modules (DMA) to reduce peripheral computational overhead, (6) Configure the microcontroller as a USB host and device, or program the microcontroller with a Real-Time Operation System (RTOS).

Student Assessment Measures: Assessment of student progress in the course objectives will be performed primarily through submission of laboratory code and short laboratory reports. Periodic quizzes will also be used to gauge understanding. A final project is also required, intended to allow the students to demonstrate their understanding in an open-ended fashion. Finally, the student's performance will also be assessed through individual interactions between the student and staff.

Pre-Requisite Courses:

- ECSE-2610 Computer Components and Operations
- ENGR-2350 Embedded Control

Texts:

- Various technical references provided on class website.
- Carmine Noviello, 2018, *Mastering STM32*. Leanpub. [Optional]

Additional Requirements:

- An STM32 based microcontroller development board. Model specified on class 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://www.ecse.rpi.edu/courses/static/ECSE-4790/
  - Contains all course information and links to Piazza and Gradescope Platforms.
- Cisco Webex.
  - Webex will be used to support Office Hours and course announcements.
- Gradescope
  - Submission of graded assignments will be done through this platform.
- LMS:
  - Used only for propagation of major course announcements.

Policy Detail

FERPA Statement: The online tools in the table 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.

Students will be asked to sign this statement to agree to the use of these online tools and to acknowledge understanding of their use to facilitate online content for the course.

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 this handbook. 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.

Diversity, Inclusivity and Accessibility Statement: Rensselaer Polytechnic Institute strives to make all learning experiences as accessible as possible. We strive to provide a learning environment that is equitable and conducive for all students; regardless of age, race, ethnicity, religion, gender and sexual identities, disability, etc. If any student does not feel their needs are met in this way, they are strongly encouraged to discuss their comments or concerns with the instructor(s) such that we may improve the classroom experience for all students.

Please contact the instructors as soon as possible if you anticipate or experience academic barriers based on a disability such 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.

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

Homework: There will be no homeworks assigned for this course.

Laboratories: Laboratories will be completed by **groups of two**. There are six laboratories required for completion of this course. Completion of the lab is considered when both the tasks contained in the lab are completed and checked by a TA and the corresponding group generated code submitted. Laboratory reports are also required for each. A thorough discussion on the grading of Laboratories may be found on the website: Laboratories.

Final Project: Each group is required to do a final project that heavily employs the skills learned during the course laboratories. Determination and choice of the project is entirely up the group, but suggestions may be provided by the staff. The difficulty and time required to complete the final project should be greater than that of any of the labs, at a minimum. Final projects that are deemed to be too easy will have a grade penalty assessed. Proposals for the final project should be provided to the instructor such that a determination of the acceptability (difficulty and applicability) of the project can be made. The proposals should be provided in written form with a very clear description of the goals in order for judgment of the success or failure of each goal upon project completion. If during work on the project these goals require modification, the group should consult with the instructor.

The final project requires a report to be submitted upon completion that thoroughly discusses the concept, high-level design, low-level implementation, performance analysis, and issues and bugs. Guidance on the report format and content is provided on the class website.

For final projects that are considered very difficult and time consuming, it will be permitted that two groups work together on one project with clearly outlined tasks.

Quizzes: There are three quizzes given during the course, each ocurring during the lecture session (Monday Afternoon). The quizzes will be short and open book and notes. Computers will be allowed, but the only program/document allowed open are those specified by the instructor. All other programs must be closed.

Preparation and Participation: This grade will be dependent on the observations from the instructor and TAs on each individual student's participation, commitment, and contribution to the class and group throughout the semester and will be determined after the completion of all other components of the course.

Course Logistics

Grading:

	Component	Weight
Lab 1	IDE/ANSI Terminal/GPIO	5 %
Lab 2	Interrupts Service Routines	7.5 %
Lab 3	Serial Communications	12.5 %
Lab 4	Analog Conversions/MAC	12.5 %
Lab 5	Direct Memory Access (DMA)	12.5 %
Lab 6	Lab of Choice	10 %
	Final Project	20 %
	Quizzes	15 %
	Preparation and Participation	5 %
	Total:	100 %

Late Policy: In order to successfully complete the course in the allotted time, the laboratory exercises should be checked off by the scheduled start of the next lab; however, no penalty will be assessed if this is not the case. Reports are generally due 1 week after the scheduled completion of the lab and may be submitted earlier for extra credit. Late submission of the reports will incur a penalty of 20 points per class day. All labs and lab reports along with the final project and report must be completed and submitted by the end of the first official day of final exams in order to receive a passing grade in the course; however, it should be noted that access to the classroom and the equipment contained within should not be expected at times other than the officially scheduled times.

Attendance Policy: Attendance is not strictly required for the lectures or laboratory meeting times. Successful completion of the course requires substantial time spent working on the laboratories and final project; therefore, consistent student presence during these times is expected. Substantial unexcused absences will result in deductions in the assigned Preparation and Participation grade as well as possible removal of credit from the corresponding laboratories, requiring the student to repeat the laboratory individually to receive credit.

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.

Partners, Teamwork, and The Learning Community: All students will work in groups of two students on the laboratory assignments unless requested to work individually. Laboratory deliverables will be submitted as a group, with both partners' names on each submission. Interaction between students who do not compose a group is allowed and encouraged; however, as detailed in the Policy Section, the work (code or otherwise) produced by each student or group must be their own.