

EECE.4520/5520 Microprocessor II and Embedded System Design

last update: 9/1/2021

General Course Information

Instructor: Yan Luo

Course Zoom Meeting Schedule: Wed 6:30pm – 9:20pm, US Eastern Time

E-Mail Address (for use ONLY when Blackboard is down): Yan_Luo@uml.edu

[Please note that this email is **only used when Blackboard is down. All communications must be within Blackboard communication tools** (Mail, Discussion Board, etc.)]

Course Description

Continuation of 16.317. CPU architecture, memory interfaces and management, coprocessor interfaces, bus concepts, bus arbitration techniques, serial I/O devices, DMA, interrupt control devices. Including design, construction, and testing of dedicated microprocessor systems (static and real-time). Hardware limitations of the single-chip system. Includes micro-controllers, programming for small systems, interfacing, communications, validating hardware and software, microprogramming of controller chips, design methods and testing of embedded systems.

Prerequisites for the Course

EECE 3110 Electronics I Lab, EECE 3170 Microprocessor Sys Design I, and EECE 3650 Electronics I. Or Permission from the Instructor

Course Materials:

Required Book:

Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, MIT Press, ISBN 978-0-262-53381-2, 2017.

The book is free for download at

<https://ptolemy.berkeley.edu/books/leeseshia/>

Required Hardware:

Arduino development kit. (Recommended kit: <https://www.amazon.com/ELEGOO-Project-Starter-Arduino-Mega2560/dp/B01EWNUUUA?th=1>). You do not have to purchase this kit if you already own the components and accessories. The instructor will provide further details during the first class.

Required Software:

You will need to have Web browser software such as Microsoft Edge, Firefox, Safari, which are normally available on modern computers. Microsoft Office software is recommended for writing lab reports. Zoom is used for class and office hour sessions.

You also need to download and install additional software (e.g. Arduino IDE, Python3, PCB schematic software such as Ki-Cad) on your computer per the laboratory setup instructions given by the professor.

If you do not currently have Office, please follow this link to get access: [UMLIT Software Services for Students - My Office](#)

Course Materials “Release” Day

Each "week" of this course typically begins on a Monday (12:00 AM ET), and ends on a Sunday (11:59 PM ET). The course calendar at the end of this syllabus provides additional details with regards to the course schedule. Your final exam will be scheduled per the university calendar when it gets close to the end of the semester. More details will follow one week before the finals.

Attendance and Participation

Students are expected to attend class regularly, as regular attendance is one of the most important contributors to student success. However, students may occasionally need to miss class due to illness, emergency, or caring for a sick family member. In such cases, you are responsible for notifying me of your absences and working with me to arrange to make up any missed work. I will be very accommodating to students who are experiencing pandemic-related challenges, but you must communicate your requests with me regularly and with as much advance-notice as possible. Likewise, if I should become ill or need to miss class, I will communicate with you via Blackboard as soon as possible with clear instructions.

A note on Zoom Participation: Because I believe that the class will be more engaging if we can see one another, I strongly recommend that students keep their cameras on during class unless you have a valid reason not to which you should discuss with me ahead of time. Please silence your cell phones during class time. During midterm and final exams, you will be asked to turn on Webcam during the whole exam time.

Interaction Guidelines – Communication and Participation

Class (Zoom Session at Course Schedule Time. Zoom Meeting ID: **913 6260 8346** with passcode.): The weekly class will be on Zoom and recorded. The recordings will be made available for review after the classes. The passcode will be given through Blackboard and subject to change.

Mail (My Messages and **Mail** on the Course Menu):

We use the Mail function in Blackboard **exclusively** for sending and receiving course related messages. The Mail tool is to be used for private or personal communication only. You are recommended to use the Discussion board if the question and answer might benefit the whole class. Please do **not** use external email (gmail, Yahoo or your work email). You can expect my

reply to Mails in a couple of days. If I am not able to respond in time, I will notify you as soon as possible.

Virtual Office Hours (Zoom Meeting ID: 913 6260 8346 with passcode):

The professor and the TA will hold office hours weekly on Tuesdays from 1pm to 2:30pm and Thursdays from 1pm to 2:30pm (subject to change). We intend to use this time to provide timely responses to your questions and concerns. Attending office hours is optional.

Discussion Board (**Discussion Board** on the Course Menu):

You are encouraged to use the discussion board to participate in class discussions. I will periodically create specific forums on certain important course topics. You are encouraged to participate all the forums by posting your opinions and/or responses to other students.

Netiquette

Please be considerate and polite when posting your messages or interacting online. You are expected to treat the other students as you would want to be treated. Please be careful about how your words may cause misunderstanding or hard feelings. You can use emoticons to show your tone.

Assignment Guidelines

How You Will Be Graded

Your final course grade will be based on the following:

Table 1: Points Distribution

Requirement	Number @Points each	% Total Grade
Homework	4 @ 10 pts	20%
Lab assignments	3 @ 15 pts	45%
Mid-term Exam	1 @ 100 pts	15%
Final Exam	1 @ 100 pts	20%
Total:		100%

Your final course letter grade will be determined as follows:

Numeric Grade:	Letter Grade:
97-100	A+
90-96	A
87-89	A-
84-86	B+
80-83	B
75-79	B-
70-74	C+
60-69	C
0-59	F

Homework:

Four homework will be assigned and graded. Each student submits homework **individually**. Typically, your homework should reflect your understanding of the topic in your own words and be submitted by the due date. The due date is the end of Sunday of the following week, that is, you have **three** weeks (21 days) to complete it. Your homework will be graded based on the quality and the timeliness of submission. Late posting is accepted but will be graded with late penalty of 20% per each week late, or 4% per each day late.

The quality of your homework will be evaluated in several aspects: (1) they should be in English [1 points]; (2) they should be complete sentences and/or clear mathematical or engineering explanations, organized in a cohesive manner, free of typos and grammar errors [2 points]; and (3) they should correctly answer the questions asked [7 points]. The total points per homework is 10 points when being graded. The points will be used to calculate as weighted scores towards the final score according to Table 1.

Lab Assignments

Three lab exercises will be assigned and graded. You need to complete all the labs per their descriptions and instructions. **You need to work on the labs as teams**. A lab report for each lab needs to be submitted by the posted deadlines. The due date is usually the end of Sunday of the week after the following week, that is, you have typically **three** weeks (21 days) to complete the lab **and** submit your report. **The exact due dates are posted in Blackboard**. Please follow the given template posted on Blackboard to write your lab reports and submit **in pdf format**. Late submission will be accepted but graded with late penalty of 20% per each week late, or 4% per each day late.

Every lab involves hardware circuit design and wiring, and programming exercises. Some labs only require you to compile and execute the programs that are provided by the instructor, and to report the results and/or findings in the reports. Some labs require you to design your own program based on given examples, debug the program, run the code on specified development platforms, obtain results and analyze them in the lab reports. ***The lab assignments are to be completed remotely.***

Your lab will be graded for correctness [10 points] and completeness [5 points]. Your programs developed for the labs will be demonstrated to the Teaching Assistant and/or the Instructor. The correctness of the program requires two aspects: (1) your program pass compilation without errors and can generate executable for the lab development kit [3 points] and (2) your program executes without error and produce all the correct/expected results [7 points]. Both of these two aspects need to be demonstrated to the TA or instructor. The demonstration should be done through a live zoom session or a recorded video that shows the names and presence of the students in a team.

Partial points may be given if the result produced is not entirely correct. In order to receive the completeness points [5 points], your lab report should include all the required details outlined in lab report template. You may submit a lab report even if you cannot complete the programming part successfully. In this case, you can still earn up to 5 points by describing in detail your efforts and lessons learnt in your lab report.

Teams for Lab Assignments:

Teams of **up to three** students need to be formed to work on the labs collaboratively. Team members work on and submit one report per team. In the lab report, each student's contributions to the lab must be clearly stated with specific details. For example, student A debugged functionA() in the program, student B designed the state machine to switch on/off LEDs, and student C wired up the circuit and drew schematic. We expect every team member contributes to the work, and in some extreme cases, your individual lab scores may be affected due to lack of or no contribution to the team.

A student should form a team with the fellow students in the same course section, either EECE.4520 or EECE.5520. A team should **NOT** be formed across the two sections. This is for grading purpose because undergraduate level and graduate level have different requirements on assignments and graded on separate scales. Please let the instructor and the TA know if you have any questions on team forming. The membership of a team cannot change without the approval of the instructor.

Exams

One mid-term exam will be administered on Wed Oct 13, 2021 between 6:30pm and 9pm. The exam is open-book, but **students must complete the exam individually**. The questions will include multiple choices and short answers. There will be multiple choice questions and short-answer questions, although the exact numbers of questions are to be decided. The exam will be administered through Blackboard. The instructor will provide update-to-date instructions before the exam is released, and students are required to follow such instructions.

One final exam will be administered during the exam week. The exam is open-book, but **students must complete the exam individually**. The questions will include multiple choices and short answers. There will be multiple choice questions and short-answer questions, although the exact numbers of questions are to be decided. The exam will be administered through Blackboard. The students can either write the answers to exam questions on paper, scan the paper to pdf and submit, or write the answers in a Word file and submit the Word file, or answer questions directly on Blackboard **if** instructed to do so. The instructor will provide final instructions before the final exam is released, and students are required to follow those up-to-date instructions.

EECE.5520 Requirements

Students in EECE.5520 will need to fulfill requirements specific to EECE.5520. These include but not limited to additional requirements in labs and exams. Final grades in EECE.4520 and EECE.5520 will be assigned at different scales.

Make Up Policy

Please note that no additional assignments will be given as an extra work for students who miss the assignment submissions. Please contact the instructor immediately if you cannot attend the exam due to emergency.

Academic Integrity Policy

UMass Lowell students are expected to be honest and to respect ethical standards in meeting academic assignments and requirements. A student who cheats on an examination or assignment is subject to administrative dismissal. Please visit the [Academic Integrity](#) Web site for specific details regarding this policy.

Student Disability Services

UMass Lowell Online students requiring academic accommodations should contact [Student Disability Services](#) for assistance.

UML Library Off-Campus Access

Off-Campus library access requires users to login to the proxy server. Information can be found at this link: [Off-Campus Access to UML Library](#)

Course Calendar (subject to change)

Week	Topics	Practices	Labs	Homework
1 (9/1)	Introduction to embedded systems, lab dev kit	Apply github accounts, git commands	Lab prep Team forming	
2 (9/8)	Model based design, Embedded processors, Arduino example labs	Setup dev environment on host git clone.	Team formed	homework 1 released
3 (9/15)	Discrete Dynamics I/O	check in local revisions push to github repo	Lab 1 released	
4 (9/22)	Sensors, ADC, datasheet of accel/gyro	Read weekly notes		
5 (9/29)	Input and Output, bus			hw2 released hw 1 due 10/3
6 (10/6)	I ² C, Actuator, PWM, motors,		Lab 2 released Lab 1 due 10/10	
7 (10/13)	Mid-term Exam			
8 (10/20)	MCU and memory arch, DMA, multicore, SoC and accelerators			hw3 released hw 2 due 10/24
9 (10/27)	timer, watchdog, interrupts, quantitative analysis		Lab 3 released Lab 2 due 10/31	
10 (11/3)	Atmel uP, C programming, cross compilation, multitasking,			
11 (11/10)	OS, scheduling, quantitative analysis			hw4 released hw 3 due 11/14
12 (11/17)	networking, IoT		Lab 3 due 11/21	
13 (11/24)	Thanksgiving Recess			
14 (12/1)	advanced topics (embedded OS, baremetal, etc)			hw 4 due 12/5
15 (12/8)	Course review			
15 Finals wk	Final Exam (date TBD)			