SIE 370
Embedded Computer Systems
Spring 2022

Class Hours: Tuesdays and Thursdays at 3:30 - 5:00 PM
Lab Hours: Wednesdays at 2:00 – 5:00 PM
Classroom: EB 128
Laboratory: EB 128
Instructor: Samuel Peffers, EB 122, (928) 317-7067, samuelpeffers@email.arizona.edu
Office Hours: M,W, F 8:30 – 10:00 AM, or by appointment

Course Description: Boolean algebra, combinational and sequential logic circuits, finite state machines, simple computer architecture, assembly language programming, and real-time computer control. The computer is used as an example of systems engineering design; it is analyzed as a system, not as a collection of components. There is a lab associated with this course.

Prerequisites: ENGR102 and ENGR 211M or ECE 207, or articulated equivalents.

Course objectives:

1. Understand number systems, Boolean algebra, Karnaugh maps, and digital logic design program so that you can design, build and test digital circuits.
2. Know how to devise a state machine to describe the actions of a microcontroller based system.
3. Understand how to translate a software implementation of a system into a hardware implementation or vice-versa.
4. Construct actual microprocessor systems using integrated circuit devices, clocks, and other electrical components.
5. Know how to analyze a problem that can be solved using a digital logic system and successfully design that system.

Textbooks:

Lee, E. & Seshia, S. (2015). *Introduction to Embedded Systems - A Cyber-Physical Systems Approach, 2nd Ed.*
        Berkley, CA: LeeSeshia.org

        ISBN: 978-1-312-42740-2

A copy of this book and other materials are all available on D2L; D2L is the primary means of distributing class material.

Absence and Class Participation Policy:
Participating in course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Students who miss class due to illness or emergency are required to bring documentation from their healthcare provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at:
http://catalog.arizona.edu/2015-16/policies/classatten.htm

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See:
http://uhap.web.arizona.edu/policy/appointed-personnel/7.04.02

Classroom Behavior Policy:
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (i.e. texting, chatting, reading a newspaper, making phone calls, web surfing, etc). Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Threatening Behavior Policy:
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to one's self. See: http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Accessibility and Accommodations:
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. For additional information on Disability Resources and reasonable accommodations, please visit http://drc.arizona.edu/.
If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate. Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity:
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

UA Nondiscrimination and Anti-Harassment Policy:
The University is committed to creating and maintaining an environment free of discrimination, http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Subject to Change Statement:
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Assessment and Deliverables:

Product	Percentage of Course Grade	
Mid-term Exam		15%
Final Exam		20%
Quizzes / Homework		5%
Lab Products & Reports (ten scores)		ea. 1%
Term Project Milestones (lowest four scores out of five graded milestones other than DAR)		
Proposal		
	Written	3%
	Oral	2%
Requirements Validation Review (RVR)		
	Written	3%
	Oral	2%
Systems Architecture Review (SAR)		
	Written	3%
	Oral	2%
Critical Design Review (CDR)		
	Written	3%
	Oral	2%
Test Readiness Review (TRR)		
	Written	3%
	Oral	2%
Design Acceptance Review (DAR)		
	Written	10%
	Product	10%
	Oral	5%

Grading Scale:

A: 90 – 100
B: 80 – 89
C: 70 – 79
D: 60 – 69
F: 0 – 59

Date	Activity / Topic	Reading
Jan 18, 2022	Course intro, Embedded systems and Arduino fundamentals	Read: *L&S*, Chpt. 1; Review: *APN*
Jan 19, 2022	**Lab 1**: Laboratory safety, procedures, simple circuits	See D2L
Jan 20, 2022	The design process	Read: *ISEHB* 5-21, 25-32; Review: *NSEHB* 282-283
Jan 25, 2022	Digital input to digital output	Read: *L&S* 261-272; Review: *APN* 23-24
Jan 26, 2022	**Lab 2**: Digital input to digital output	See D2L
Jan 27, 2022	**Project proposal presentations**	See D2L
Feb 1, 2022	Analog input to analog out put	Read: *L&S* 177-194; Review: *APN* 25-26
Feb 2, 2022	**Lab 3**: Analog input to analog out put	See D2L
Feb 3, 2022	Technical Processes 4.1, 4.2, & 4.3	Read: *ISEHB* 47-64
Feb 8, 2022	Analog input to digital output	Review: *APN* 24-25
Feb 9, 2022	**Lab 4**: Analog input to digital output	See D2L
Feb 10, 2022	**Requirements Validation Review (RVR)**	See D2L
Feb 15, 2022	Digital input to analog output	Read: https://www.arduino.cc/en/Reference/Tone
Feb 16, 2022	**Lab 5**: Digital input to analog output	See D2L
Feb 17, 2022	Technical Processes 4.4; state machines	Read: *ISEHB* 64-70; *L&S* 49-64 Review: *L&S* Chpts 4, 5
Feb 22, 2022	Rotary motor control	Read: *L&S* 201-205; https://www.arduino.cc/en/Tutorial/TransistorMotorControl
Feb 23, 2022	**Lab 6**: Rotary motor control	See D2L
Feb 24, 2022	**System Architecture Review (SAR)**	See D2L
Mar 1, 2022	Servo motor control	Read: https://www.arduino.cc/en/Reference/Servo, Include information at links
Mar 2, 2022	**Lab 7**: Servo motor control	See D2L
Mar 3, 2022	Technical Process 4.5	Read: *ISEHB* 70-74
Mar 15, 2022	Stepper motor control	Read: https://www.arduino.cc/en/Reference/Stepper, Include information at links
Mar 16, 2022	**Lab 8**: Stepper motor control	See D2L

Mar 17, 2022	**Mid-term Exam**	See D2L
Mar 22, 2022	LCD displays	Read: https://www.arduino.cc/en/Reference/LiquidCrystal, Include information at links
Mar 23, 2022	**Lab 9**: Visual display control	See D2L
Mar 24, 2022	**Critical Design Review (CDR)**	See D2L
Mar 29, 2022	Multifunctional control	Read: *L&S* 293-318
Mar 30, 2022	**Lab 10**: Multifunctional control	See D2L
Mar 31, 2022	Technical Processes 4.9 and 4.11	Read: *ISEHB* 83-87, 89-95
Apr 5, 2022	Technical Management Process 5.4	Read: *ISEHB* 114-122
Apr 6, 2022	In lab project build / test time	IAW project plan
Apr 7, 2022	Boolean algebra	See D2L
Apr 12, 2022	Karnaugh maps	See D2L
Apr 13, 2022	In lab project build / test time	IAW project plan
Apr 14, 2022	**Test Readiness Review (TRR)**	See D2L
Apr 19, 2022	Logical architecture and logic circuits	Read: *L&S* 360-369
Apr 20, 2022	In lab project build / test time	IAW project plan
Apr 21, 2022	No class meeting	No assigned reading
Apr 26, 2022	Circuit design	See D2L
Apr 27, 2022	In lab project build / test time	IAW project plan
Apr 26, 2022	Embedded System Security	Read: *L&S* 460-474
Apr 28, 2022	Design Acceptance Review discussion / preparation	See D2L
May 3, 2022	**Design Acceptance Review (DAR)**	See D2L
May 4, 2022	**Final Exam**	See D2L