

Embedded Systems II – EENG498
<http://inside.mines.edu/~coulston/courses/EENG498>
Fall 2023

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Office: BB 310E (Brown Hall)
Office hours: MWF 12:30 – 2:00
Course Title: Special Topics – Embedded Systems II
Course Meeting: Lecture MWF 9:00-9:50

Course Description: Design an advanced embedded system utilizing hardware/software co-design.

Textbook(s):

None, class notes will be provided through the term.

Course Objectives:

Design and build microprocessor-based data acquisition and control systems. In order to accomplish this, there are detailed objectives for specific topics:

1. Design and implement a complex, structured, synthesizable digital system that meets defined requirements.
2. Use contemporary software tools to debug a digital system design and verify that a digital system meets defined requirements.
3. Analyze and describe the timing, clock, and synchronization requirements for a given digital system.
4. Design and implement a digital system using a fully custom-built hardware solution, interfaced to a general-purpose processor.
5. Express the tradeoffs between choosing a microcontroller versus a custom digital system.

Lab: We will work in the classroom and in 304/305 Brown Hall.

Office Hours: I like to pile everyone in my office during office hours. What this means is I generally like to have everybody in the office asking questions. In this way, many problems can be addressed at once. Since I teach multiple classes, there may be students from a different class all piled in my office. If this is the case, please interrupt me and let me know that you have a question from a different class. I will let the students present know that I need to attend to a question from another class and give them and give them 10 minutes to wrap-up their questions before I switch to yours.

Computers: We will be working with computers throughout this semester. Inevitably there will be problems that you will encounter. If a computer or its software are malfunctioning, then please report it. I want you to deal with HW/SW problems in a manner conducive to engineering students; deal with the lab staff in an objective and rational manner. The computer center staff works hard to keep our problems to a minimum. Establishing a positive relationship with them will help expedite solutions to any problems we may have. If there are major problems with the system during critical times, I will have been made aware of them and will determine an appropriate course of action.

Topics Covered: This is an approximate timeline; changes may be made through the semester.

Session	Date		Assignments
1	Aug 21 (M)	Symbolic to VHDL	Majority Circuit
2	Aug 23	TT to VHDL	Hex To Sevent Segment Converter
3	Aug 25	Entity and Architecture	High/Low guessing game
4	Aug 28 (M)	Sequential Building Blocks	Mod 10 counter
5	Aug 30	Libraries	Mod 10 counter testbench
6	Sept 1	Design of enhanced PWM for lab 01	
	Sept 4 (M)	Labor Day	
7	Sept 6	Lab 01: Enhanced PWM	
8	Sept 8	Lab 01: Enhanced PWM	
9	Sept 11 (M)	VHDL Synthesis	Porting the PWM module to PL in Zynq chip
	Sept 12	Career Day	
10	Sept 13	VGA standard	In class quiz 05
11	Sept 15	Design of VGA to HDMI for lab 02	
12	Sept 18 (M)	Lab 02: VGA to HDMI	
13	Sept 20	Lab 02: VGA to HDMI	
14	Sept 22	Lab 02: VGA to HDMI	
15	Sept 25 (M)	Sensitivity list in process	
16	Sept 27	State diagrams to VHDL	
17	Sept 29	Datapath and Control to VHDL	
18	Oct 2 (M)	Exam Review	
19	Oct 4	Exam 1	
20	Oct 6	AD7606 chip, input, output and behavior	
21	Oct 9 (M)	Design of acquire datapath and control for lab 03	
22	Oct 11	Design of acquire datapath and control for lab 03	
23	Oct 13	Lab 03: Acquire Datapath and Control	
	Oct 16 (M)	Fall Break	
24	Oct 18	Lab 03: Acquire Datapath and Control	
25	Oct 20	Lab 03: Acquire Datapath and Control	
26	Oct 23 (M)	BRAM IP, I/O and behavior	
27	Oct 25	Design of acquire to display for lab 04	
28	Oct 27	Design of acquire to display for lab 04	
29	Oct 30 (M)	Lab 04: Acquire to display	
30	Nov 1	Lab 04: Acquire to display	
31	Nov 3	Lab 04: Acquire to display	
32	Nov 6 (M)	Building custom IP	
33	Nov 8	Programming custom IP	
34	Nov 10	Design Enhanced PWM IP for lab 05	
35	Nov 13 (M)	Lab 05: Enhanced PWM IP for lab 05	
36	Nov 15	Lab 05: Enhanced PWM IP for lab 05	
37	Nov 17	Design Acquire to display IP for lab 06	
	Nov 20 – 24	Thanksgiving	
38	Nov 27 (M)	Lab 06: Acquire to Display IP	
39	Nov 29	Lab 06: Acquire to Display IP	
40	Dec 1	Lab 06: Acquire to Display IP	
41	Dec 4 (M)	Lab 06: Acquire to Display IP	
42	Dec 6	Lab 06: Acquire to Display IP	
	Dec 8-13	No Final Exam	

Programs: Programming assignments will be evaluated using the rubric posted by the instructor or lab assistants during the class period which it is due. Your code will be evaluated on style and functionality.

- **Style** is a subjective measure which evaluates how effectively the solution was arrived at. The following are attributes which constitute good style practices.
 - Minimizing the amount of code (within reasons).
 - Minimizing the amount of data storage (within reason).
 - Approach the problem in an obvious manner.
 - Breaking the problem into logical subcomponents.
 - Consistently use all upper-case letters for constants (#define's and constants).
 - Consistently use camel case for signals.

- Consistently use camel case for entity names and the names of instanced. Any additional description of the entity or instance's name should be separated by an underline. For example, acquireToHdmi_datapath.
- Using libraries to hold entity descriptions and constants.
- Use named association of signal assignment in component instantiation, do not use positional association. Put one signal on each line and use open to declare unconnected signals.
- **Functionality** You will be asked to demonstrate that your program meets the functional requirements posted in the lab assignment.

Exams:

- Exams will be scheduled during the class meeting time,
- Exams will be administrated in person,
- The academic integrity guidelines apply while you are taking the exam.

Makeup Exams: Makeup exams can be arranged. Prior arrangements are appreciated but if some major emergency should arise and you cannot make it to an exam it is your responsibility to:

1. Contact me at my office phone (303.273.3265), or
2. Contact me by email (coulston@mines.edu).

Contact me as soon as you are able to return to campus. In general, I am pretty understanding about makeup exams – I do not want anyone hurt attempting to make it to campus as a result of foul weather. Please show me the same respect as you would like me to show you in complying with these guidelines.

Quizzes: Throughout the term I will administrate quizzes to test your understanding of material presented during that class or in a previous class. I try to make these questions similar to questions worked during class. Your lowest two quizzes will be dropped from your final grade. No make-up's will be provided for missed quizzes.

Grades: The grade you earn in this class will based on the following distribution of points:

Exam 1	20%
Labs	40%
Final Proj.	20%
Quizzes	20%

Grade	Upper	Lower
A	100	93+
A-	93-	90+
B+	90-	87+
B	87-	83+
B-	83-	80+
C+	80-	77+
C	77-	73+
C-	73-	70+
D+	70-	63+
D	67-	63+
D-	63-	60+
F	60-	0.0

Academic Integrity: The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and

effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times. Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed. For this course, the following rules should be followed.

- Copying of solutions without understanding them is not allowed; if a student copies a solution and cannot explain it adequately this is considered academic dishonesty.
- During quizzes and exams, students must do 100 percent of the work on their own.
- The nominal penalty for academic dishonesty is an 'F' in the course.

Disability Support Statement:

The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and I have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities, I encourage you to visit disabilities.mines.edu for more information.

Absenteeism (from Undergraduate Bulletin)

Class attendance is required of all undergraduates unless the student has an official excused absence.

Excused absences are granted for three general reasons:

1. Student is a varsity athlete and is representing the School in a varsity athletics activity.
2. Student is representing the School in an authorized activity related to a club or academic endeavor (academic competitions, student professional society conferences, club sport competition, program-sponsored competitions, etc.)
3. Student has a documented personal reason (illness, injury, jury duty, life-threatening illness or death in the immediate family, military service, etc.).

Students who miss academic work (including but not limited to exams, homework, and labs) for one of the reasons listed above may be issued an excused absence. If an excused absence is received, the student must be given the opportunity to make up the missed work in a reasonable period of time without penalty. While the student is not responsible for actually issuing the excused absence, the student is responsible for making sure documentation is submitted appropriately and for contacting his/her faculty member(s) to initiate arrangements for making up any missed work.