EE 2920
Embedded Systems
Fall 2019

Syllabus

COURSE DESCRIPTION, GOALS, and OUTCOMES

Course Description
This course introduces students to programming and design of microprocessor-based systems. Concepts covered include microprocessor architecture, serial and parallel I/O, interrupts, interfacing of hardware components to a typical microprocessor, and microcomputer system design. The target system is used for development of both software and hardware. Each student designs at least two microcomputer subsystem interfaces entailing both hardware and software.

Prerequisites & Notes
EE 1910, EE 2050

Primary Goal:
This course will introduce students to the inner workings of modern day microcontrollers. Successful participants will understand the architectural/performance drivers, function, and design of the core elements of a microcontroller and be able to create programs to use them effectively.

Course Outline:
The course will consist of four major sections:

- Review – 1 week
- Core Functionality – 2 weeks
- Peripherals – 5 weeks
- Board Level Design – 1 week

Learning Outcomes and Objectives:
A student who successfully fulfills the course requirements will have demonstrated:

- The ability to work with binary and hex representations of numbers
- C language programming
- Bit / Byte level manipulation of registers
- Sequential and conditional program flow
- Function program control
- Interrupt program control
- Usage of the following peripherals:
    - Systick
    - NVIC
    - Comparator
    - D/A
    - A/D
    - Timers
    - SPI
    - TWI
    - UART
    - DMA
    - CRC
    - AES

COURSE MECHANICS

Class Details:

Room - L-308
Days - Monday, Tuesday, Friday
Time - 8:00 – 8:50

Lab Details:

Room - S-344
Days - Wednesday
Time - 8:00 – 9:50

Instructor:

Dr. Johnson
Office: S-336
Email: johnsontimoj@msoe.edu
preferred method of contact
(prepend all email subjects with EE2920 - subject**…)**
Website – ***https://faculty-web.msoe.edu/johnsontimoj***
Office phone - (414) 277-2682
Office hours: See web page

Text Book - required

None

Text Book –

optional
Embedded Systems Design with the Texas Instruments MSP432 32-bit Processor, Dang, Morgan and Claypool 2016
Available through the library:
http://www.morganclaypool.com/doi/10.2200/S00728ED1V01Y201608DCS051

optional (mostly a C reference)
First Steps with Embedded Systems, Byte Craft Limited
Available at www.bytecraft.com/downloads/firststeps.pdf

Class website:

https://faculty-web.msoe.edu/johnsontimoj/EE2920/index-ee2920.html
Notes, Handouts and readings will be available on the website

Support Outside of Class:

If you are struggling it is ALWAYS better to ask for help early since concepts build upon each other. In addition, office hours will be more crowded prior to the test and you may not get the kind of time needed to clarify your understanding.

Student Accessibility Services (SAS)
For students with documented disabilities, chronic medication conditions and mental health concerns; MSOE provides services to make reasonable accommodations available. If you are a student who requires or anticipates the need for accommodations, please contact Student Accessibility Services Office at 414-277-7590, by email at moureau@msoe.edu, or in person at K250 to discuss appropriate accommodations and eligibility requirements.

Your success as a student is of utmost importance to me. If you have a disability or any other special circumstance that may have some impact on your work in this class, and for which you may require special accommodations, please contact me early in the semester so that accommodations can be made in a timely manner.

Class Notes / Additional Readings:
I will make every attempt to put the class notes and additional readings on the web page two weeks in advance of the lecture but worse case these will be available one week in advance of class. It is critical that you read these over before class. They are not intended to include all the class material but will jump start the learning process. In addition, all the material in the notes may not be covered in class – but you are still responsible for it. See the notes on *Effective Learning Concepts*.

HW Assignments:
The web page will be used for scheduling and distributing assignments. Blackboard will be used for announcements and grades. Due to the nature of the material, assignments will be handed-in in hard copy form. All assignments will be due at the beginning of the class on the assigned day. **No late assignments are accepted.**

Labs and Project:
Prelabs, lab demonstrations and post lab write-ups will be due as indicated in the lab assignments.

Tests:
Test schedules are outlined on the web page.

COURSE POLICIES and PROCEDURES

Lab Attendance:
Lab attendance is REQUIRED, any unexcused lab absences will result in a 0 for the lab.

Class Attendance:
This is a sophomore level course and will move pretty quickly. While you may be able to learn the material on your own, if you fail to attend class you will not:

be exposed to the subtlety of the concepts
learn the details "between the lines"
know what points I consider important
learn from the questions of other students
get the benefit of the doubt on any borderline decisions

In Class Behavior:
You are young professionals and I expect you to act accordingly. Disruptive behavior of any kind will be referred to the appropriate administrative office.

I expect your focus in class to be on the course material. Cell phones, MP3 players, laptops, tablets, … are not allowed in my class. If you must use one of these devices you are welcome to leave the room. Research shows that taking notes on a laptop or tablet is less effective than taking them long-hand.

No video or audio recording is allowed in class. Failure to follow this rule will be treated as academic dishonesty and dealt with accordingly.

Professionalism and Academic Honesty:

A professional does not take credit for the work of someone else.

A major component of your education is learning how to learn and perform. Now is the time you must develop the discipline, mindset, and ethics to contribute in the technical society. I can assure you; those who claim the work of others in the workplace are dealt with rather harshly.

Any documented case of "cheating" will result in a **FAILING GRADE** as well as possible disciplinary action. All cases of academic dishonesty will be reported to the EECS Chair as well as to the Dean of Students.

Examples of Cheating include **(but are not limited to)** the following:
Testing

- copying the work of another student (past or present) during a test
- providing test information to students who have not yet taken it
- obtaining information about a test prior to taking it
- having someone else take a test for you
- bringing "cheat sheets" in any form with you to a test

- using a cell phone or other electronic device during a test

Homework

- modifying a graded lab or homework paper and submitting it for reevaluation
- turning in work that was done by someone else
- using another student's (past or present) homework files
- posting solutions to homework problems or lab experiments

Working collaboratively on homework assignments is allowed and encouraged. The work you turn in however must be your own. If you short circuit this process and let someone else do the work for you, you will be cheating yourself.

LEARNING OUTCOME ASSESSMENT

Assessment Overview:
The goal of this course is to ensure students learn the concepts identified in the *Learning Outcomes and Objectives* section. In order to meet this goal, students must be assessed in order to determine if they have in fact learned these concepts. To that end there will be six assessment components in this course:

• Homework / Programming Assignments	15%	
• Lab	25%	
• Lab Practical	15%	
• Tests	35%	
• Final Project	10%	
• Participation	<1%	only used on borderline cases

Homework / Programming Assignments:
Homework will serve three primary purposes in this class.

It will be used to ensure the students are keeping current with the content of the class.
It will be used as feedback to the instructor on teaching/learning progress.
It will be used to assess student understanding of the material.

Homework / Programming Assignments will represent 15% of the overall grade in the course.

Lab:
Lab work is essential to turning concepts and ideas into real world artifacts. It is intended to solidify the concepts in the students mind and enhance the overall learning process.

Lab work will represent 25% of the overall grade in the course.
The Lab Practical will represent 15% of the overall grade in the course.

Late checkoff of labs will be penalized 15% per day
No late lab reports will be accepted

Tests:
Tests will serve two primary purposes in this class.

They will be used as feedback to the instructor on teaching/learning progress.
They will be used to assess student understanding of the material.

Tests will represent 35% of the overall grade in the course.

Tests in this course will be designed such that calculators are not required and, therefore, will be prohibited unless specifically permitted on the exam cover sheet. Failure to follow this rule will be treated as academic dishonesty and dealt with accordingly.

Makeup Tests:
If you have an excused absence from a scheduled test based on documented participation in a University-related activity (e.g., sports), you must make arrangements **in advance** to take your test during an alternate time during the week the test is being administered.

If absence during a scheduled test period is excused (due to illness or family emergency, which must be verified ***in writing***), you will be given the opportunity to make up the missed test upon your return.

Final Project:
The final project is intended to ensure you can integrate all aspects of the course into a single working system. This includes planning, design, debug, and documentation.

The final project will represent 10% of the overall grade in the course.

Participation:
Participation in class is valuable to the student, the instructor, and others in the class.

Students must learn to ask questions when they don't understand, provide input where they believe it adds to the discussion, and become comfortable speaking in various settings. An engineer who is not able to provide appropriate input in a meeting or group discussion is a waste of a seat.

Most instructors know their course material very well. The key to conveying that information is constant feedback. The pace, approach and content can usually be modified to enhance the student's learning process, IF, the students provide feedback. Where the opportunity to change the lesson has passed, consider your feedback as a form of "paying it forward" to future students.

When someone asks a question there are almost always others with a similar question. In some cases the question or answer may clarify the concept for a student who thought they understood but now realize they did not.

Participation will not be officially graded. I reserve the right to use participation as the "borderline" determining factor as outlined in the *Grading* section.

Grading:
On each HW and Test you will receive a "raw score". This will reflect your un-weighted performance. Your "raw score" will be shifted with respect to the upper percentile of the class to obtain a **"**weighted score**".** It is these weighted scores that will be used in your "overall score" calculation.

For example, if the top student has a raw score of 93%, everyone's raw score will be multiplied by 1.075 (1.00/0.93) to obtain their corresponding weighted score.

For the final grade, equal-width cutoffs will be applied based on a cutoff width of 10 (i.e., the nominal cutoffs for A-B-C-D will be 90-80-70-60, respectively). Final scores in the lower 15% of each range and the upper 15% of the subsequent range will receive a mixed grade of AB, BC, or CD.

A "borderline" is officially defined as an overall score within 0.5% of a cutoff when the final grade calculation is performed. Before course grades are assigned, the instructor will carefully examine all such cases and determine if the next higher grade is warranted. Primary factors will be participation and recognition of one bad test/hw/lab.

Reporting of Grades:
Individual homework assignments, labs and tests will be graded and returned to the student. These grades are unofficial. The official grades will be kept in Blackboard and updated on a regular basis. Any errors in grading must be brought to the attention of the instructor within one week of posting to Blackboard. Blackboard will contain the raw score and weighted score for each assessment, and the current overall score.

EFFECTIVE LEARNING CONCEPTS

As an engineer you most likely consider yourself a scientist also. A critical piece of being a scientist is believing in the scientific method and not ignoring the results. Here are some key learning and learning behavior results.

- Multi-tasking reduces competency in each task undertaken
- <5% of the population can multi-task and the odds are high that you are not one of them
- Repetition is a key factor in long term retention
- Your brain tosses out anything it thinks is irrelevant each night – review material the same day to help make it relevant to your brain
- Sleep is not an option – it is critical to learning (7 hours min – no exceptions)
- Connect new concepts to concepts you already know
- Taking notes by hand increases understanding – not true for typing
- Study as you go and review in the days before the test – then sleep the night before
- Hear – Do – Teach Teaching others solidifies learning
- Cramming has no long term learning value
- Cramming works for a few hours – if you do it – do it the morning of the test

Seven Things you can do to be a better learner:

1. Make connections. Use analogies or mnemonic devices to build upon your existing knowledge. Not only do these help you remember – but the act of creating these helps you learn.
2. Never read anything without a purpose and stop once you have accomplished it.
3. When you read – stop after every major section or chapter and write down a few key notes. Review the summary within 24hrs to help transition it from short term to long term memory.
4. 20-30 min maximum at any task – then take a short stretch break (30-60sec) and get the blood flowing – review what you have been doing in your mind.
5. 2 hours total without a long break (10 - 15 minutes). Do something that stimulates other parts of your brain – music, exercise, food – when you return – review your short notes from earlier.
6. Plan your time – keep a record – modify your schedule accordingly – Stress reduces learning and being overloaded with no time left is very stressful.
7. Ask – when you don't get it, and have tried a few times - ASK

Always remember – your goal is not to accomplish a task – it is to learn something in the process.

COURSE SCHEDULE

SUBJECT TO CHANGE – depending on overall class progress and any unforeseen natural phenomena.

Please check the website for the current schedule