****

**COURSE SYLLABUS**

**EGR 326: Embedded System Design**

**Lecture Section 20**

**Fall 2022**

#### Instructor Information

Instructor: Associate Prof. Nabeeh Kandalaft

Office: 231 Kennedy Hall of Engineering

Phone: 616 331 6180

E-Mail: [kandalan@gvsu.edu](mailto:kandalan@gvsu.edu)

Office hours: W 3:00 – 4:00

T 2:00 – 3:00

TR 5:00 – 6:00

*Other office hours by arrangement - please email*

#### Meeting Times

Lecture: KEN 122 M, W 10:30 – 11:45 PM

#### Prerequisite

EGR 214, EGR 226

#### Corequisite

You must be enrolled in one of the EGR 326 lab sections

**Texts and Materials**

**Required:**

* A lab notebook (either a bound notebook called a Computation Notebook available in the bookstore and office supply stores, this is preferred or a 3-ring binder).
* A lab/project kit that includes a Texas Instruments MSP432 Launchpad development board, and an assortment of interesting parts that will be used in lab and your project design (available in the bookstore).

**Supplementary:**

* Mazidi, et.al., *TI MSP432 ARM Programming for Embedded Systems,* Vol. 4, September, 2016
* TI MSP432 ARM Programming for Embedded Systems (ARM books) (Volume 4) Paperback – September 16, 2016 by Muhammad Ali Mazidi (et.al)
* Microcontroller Engineering with MSP432: Fundamentals and Applications 1st Edition by Ying Bai
* Embedded Systems: Introduction to the MSP432 Microcontroller, by James Valvano

Additional resources that you may find useful will be posted on the class Blackboard site.

**Course Description**

***This course will introduce you to the design and implementation of embedded electronic systems that are fundamentally part of almost every modern electronic system. At the heart of most embedded systems is a microcontroller. We will use the Texas Instruments MSP432 (an ARM M4 architecture) on a Launchpad development board (that interfaces to a PC for download and debugging of programs) to implement embedded system designs in this class.***

Embedded systems employ sensors and actuators to enable programmed control of the monitoring and interactions with the environment in which they are embedded. This course will introduce you to the interface between the digital signal microcontroller and the mostly analog signal real environment, and will provide you with extensive opportunities to exercise your C programming skills in order to manage this interface. In the lectures and laboratory you will explore both analog and digital input and output interfaces with the microcontroller and will use this knowledge and experience to design, document, build, and test a complete embedded system.

This course will make extensive use of the software development tool, TI Code Composer Studio. Some class or lab time will be spent on introducing you to this tool, but, you are expected to invest time outside of class to become proficient during your lab and project design assignments. Embedded system design depends heavily on computer based support tools.

**Objectives**

1. Construct digital circuits as breadboard prototypes
2. Design and simulate microcontroller software
3. Design a complete embedded system involving digital components, analog components, and a microcontroller.
4. Describe how concepts in signal integrity and heat dissipation apply to embedded systems\
5. Create and requirements document to effectively plan and describe the term project.
6. Communicate effectively in both written and oral forms.

**Course Topics**

1. Digital input and output models
2. Analog interface and power components
3. Timing Analysis
4. Transmission lines, ringing, ground bounce, cross talk
5. Heat dissipation, thermal resistance, heat sinks
6. UART, I2C, and SPI protocols.
7. Requirement and test documentation

**Means of Evaluation**

***Quizzes:*** There will be a short quiz (a couple of questions that should take about 10 minutes to answer) nearly every week covering material prior to that lecture (including pre-lab and lab) so see me during office hours if you have questions.

**Your best scores (I will drop the lowest score out of approximately 10 quizzes) will be averaged and will be worth about 15% of your grade.**

**There are no make-up quizzes.**

***Exams:*** There will be two one-hour exams. **Each exam is worth 20% of your grade.**

***Laboratory:*** Initial weekly structured laboratories enable you to explore and apply concepts discussed in lecture. You are expected to attend all labs and be actively involved in the lab procedures. You are expected to maintain a laboratory notebook recording your methods and observations. In addition, you will be submitting a short report summarizing the objectives and drawing conclusions from your lab notebook entries after each laboratory.

**The demonstration of a successful lab assignment and the lab notebook submissions will comprise about 20% of your final grade.**

***Pre-Laboratory:*** In lieu of homework, you will be assigned tasks that will help prepare you for the upcoming lab assignment and weekly project work. These must be completed and documented in your lab notebook prior to the lab. The prelab assignments will comprise about 5% of your final grade. There are prelab assignments for only the first 7 labs.

***Design Project:*** There will be a significant design project implemented using a microcontroller. This will give you a chance to practice your engineering skills and apply methods of design presented in lecture. You and a partner will submit a specifications document based on the project requirements. Then you will submit a design document that describes your design in complete detail including costs, validation procedures, and schedule. This is the procedure you will follow for your senior project capstone experience.

**The project documents, demonstrations, and your participation in making it successful will comprise about 20% of your final grade**.

***Participation:*** Your attendance and participation in all lectures and labs is expected and can make a difference in your final grade (possibly raising or lowering your total point score).

**Note: you must demonstrate at least a C 70% average on combined quizzes/exams and a C 70% Lab grade to receive a C in this class**

**Important dates**

Credit/No Credit Deadline September 2

Last day to Add, Register, or Pay September 2

Labor Day Recess September 4-5

75% Tuition Refund Deadline September 23

Fall break October 23-25

Withdrawal Deadline with a W October 28

Thanksgiving Day Recess November 23-27

Classes End December 10

Examinations December 12-17

**GVSU Policies**

This course is subject to the GVSU policies listed at

<https://www.gvsu.edu/coursepolicies/>. (See University Policies SG 3.04.C for more details.)

|  |  |
| --- | --- |
| **A** | **94-100%** |
| **A-** | **90-93%** |
| **B+** | **87-89%** |
| **B** | **83-86%** |
| **B-** | **80-82%** |
| **C+** | **75-79%** |
| **C** | **70-74%** |
| **D+** | **65-69%** |
| **D** | **60-64%** |
| **F** | **0-59%** |

**Grade Assignments**

The following grading scale will be used throughout the course for all grading components (quizzes, final exam, lab reports, project, and final grade).Note that letter grades are only assigned at one time in the course: for your final letter grade. At all other times, a percentage score based on the total points accumulated out of the total points possible will be used. You can use the mapping between letter grades and percentage scores to give you a rough estimate for how you are faring in the course.

NOTE:

* Percentage scores are not quantized to letter grades until the very end.
* A few points on a single lab report, quiz, etc. will not make a large difference in your final grade. Raw points are preserved right up to the end of the course.

Grades are based upon an overall assessment of your work, and your final grade maybe adjusted ***up or down*** based upon this assessment. Consider each one of the above grading instruments as pieces of evidence. Taken together, they paint an overall picture of your knowledge and understanding. Other factors include your attendance and participation in class and laboratory, and the effort you put into completing your assignments and labs.

#### Academic Honesty

You are allowed (and encouraged) to work with other students in understanding the concepts necessary for completing your lab assignments and project, however,

**maintaining a lab notebook and all pre-lab submissions must be individual work while project reports will be the work of your project team.**

You are responsible for **making sure that your assignment was successfully uploaded** to the Blackboard assignment after clicking on the submit button. If it is not readable, or if it is of excessive size**, it will not be accepted**. We don’t want to overload Blackboard file space, so experiment with readability vs. scan resolution, about 100 KB per scanned page should produce adequate results if image is in focus.

This course is subject to the GVSU policies listed at <https://www.gvsu.edu/coursepolicies>

**Attendance**

Given the numerous in-class examples and instructor interaction in the labs, it is expected that students will miss class or lab only in the case of ***documented*** illness or valid emergency.

**Special Needs**

If there is any student in this class who has special needs because of a learning, physical, or other disability, please contact Disability Support Services (DSS) at (616) 331-2490. If you have a physical disability and think you will need assistance evacuating this classroom and/or building in an emergency situation, please make me aware so I can develop a plan to assist you.

**COVID-19**

* This course will follow COVID-19 protocols.
* Should you have symptoms, stay home. Email the Instructor on exam days for alternative options.

**In Case of Fire Emergency**

Immediately proceed to the nearest exit during a fire alarm. Do not use elevators.

More information is available on the University’s Emergency website located at <http://www.gvsu.edu/emergency>