UC San Diego
EXTENDED STUDIES

Embedded Systems Hardware Design Syllabus

Course Number:	ECE-40292
Section ID:	168584
Course Start Date:	01/10/2023
Course End Date:	03/11/2023

Welcome to Embedded Systems Hardware Design!

Greetings to all hardworking students starting this difficult journey. To make it easier please dedicate at least 30 minutes of your time every day for the next 9 weeks for studying.

I look forward to working with you this semester.

Instructor Information

Name: Victor K. Kolesnichenko, PhD, Prof. EE

Email: vkolesnichenko@ucsd.edu

Communication Policy

You may contact me by email during my office hours. Outside of office hours, I will try to answer your emails within 48 hours of receiving them. Phone calls (858-500-6088) should be arranged ahead of time via Canvas email.
Please communicate with me in advance if you are experiencing challenges in completing course assignments on time. The earlier you communicate with me about a potential issue, the more likely we are to find a good solution.
Read the Canvas Orientation for Students (in your Canvas Dashboard) for UC San Diego Extension's expectations of appropriate communication etiquette in all exchanges between students and instructors in the digital space (messages and discussion board postings).

Course Information

Embedded systems can be found in many industries including consumer electronics, automotive, aviation, transportation, agriculture, medical devices, and scientific research. They are also widely used in industrial automation including robotics, motion control systems, and Supervisory Control and Data Acquisition (SCADA) systems.

Short Description

The overall goal of this course is to provide students with practical knowledge of designing embedded systems.

This course is intended for **technical professionals** looking to acquire solid foundational knowledge necessary to design embedded systems. Students will learn definition and main components (modules) of embedded systems, hardware design aspects, Commercial Off The Shelf (COTS) embedded modules, microcontrollers (DSP/DSC) used in embedded systems, I/O and communication interfaces and memory types.

The on-line course was designed to be a flexible and open learning environment. The main principals of Embedded Systems Hardware Design will be presented and demonstrated on a practical design of such a system using modern components and modules. Grading is based on your individual assignments, quizzes and project. The project is due in one week after the last class session.

Course Prerequisites

The purpose of the course is teaching students to design embedded systems performing dedicated function(s).This course covers architecture of a typical embedded system and its interfaces. Real-life examples included and analyzed.

The focus of the project is designing, assembling and testing an Embedded System based on the Requirements Specification.

The material is covered at a basic to intermediate level.

Mandatory prerequisites: ECE-40153 Introduction to Embedded Systems or equivalent knowledge and experience; familiarity with electronic components and modules; ability to read, understand and calculate the electrical schematics.

Objectives:

By the end of this course, the student will be able to:

- Define the requirements and construct a block diagram of the required Embedded System,
- Analyze characteristics and select appropriate microcontroller, memories and sensors.
- Design proper interfaces between modules of the Embedded System,
- Build, program and test his/her Embedded System.

Course Materials/Textbooks

Project Kits:

Students should buy and use Discovery Kit B-L475E-IOT01A from Internet (http://www.st.com/en/evaluation-tools/b-l475e-iot01a.html) or bought from distributors such as Mouser, Digikey, and so on; and FRAM Kit (https://www.adafruit.com/product/1897) from Adafruit - for their class assignments and project.

The schematic, user manuals, BOM and software should be downloaded from ST Microelectronics (see the link above).

Links to other S/W and required documents will be provided in the lessons' materials.

Textbooks:

No specific testbook is required – all materials will be provided or referenced.

Course Schedule

Wk	Topic	Reading	Assignments	Points
1	**Course Description; Introduction to Embedded Systems; Definitions; Specifications**	Materials for Lesson 1 (L1); Att: pp 1 - 27	Purchase parts for the project. Download docs and S/W from ST.com. See the Assignment 1.	5
2	**Architecture of Embedded System and Its Internal Communication Channels**	Materials for L2	Create a Block Diagram of an Embedded System See Assignment 2	10
3	**Hardware Design Aspects, COTS Modules**	Materials for L1 - L3	Quiz Week 3	10 - quiz
4	**Selecting Appropriate Microcontroller (DSC)**	Materials for L4; Datasheet of STM32L475	Select the best bus of STM32L475VG for external FRAM module. See Assignment 4	10
5	**Designing Memories for Embedded System; DMA, Interrupts**	Materials for L5; DS for STM32L475	Design an external FRAM Data Storage for 20Mbps transfer rate. Assignment 5	5
6	**Selecting Sensors, Design of Conditioning Circuits, ADC**	Materials for L1 – L6.	Quiz Week 6	10 - quiz
7	**Embedded System External Communication Interfaces**	Materials for L7; Wikipedia	See the attached Assignment 7	10
8	**Printed Circuit Board: Specification of Requirements**	Materials L8	See the attached Assignment 8	10 10 - quiz
9	**Downloading Firmware and Testing the System** **Final Quizzes**	All previous materials	Project Report with all considered aspects, pictures and other staff specified in Requirements to Project Report	20 – project
	Extra Work During Semester			5 max
	Publishing on Internet			5 max
		TOTAL POINTS POSSIBLE		**110**

Requirements to Submission of Assignments and Quizzes

In order to satisfy course requirements, class participants must complete all course assignments and quizzes on time (on or before the due date), and use graduate level writing/presentation for all written assignments.

Assignments and quizzes must be submitted in **pdf format** before Sunday midnight (you have 5 days to complete the assignment). A form for your assignments is included in Lesson 2.

Please name them as **weekX-lastname.pdf** or **WX-XX (XX-initials)** and submit to Canvas.

Source Codes, schematics and other files for assignments should be submitted as compressed (.zip or .7z) files. If you cannot submit them to Canvas, send them to me on my e-mail: vkolesnichenko@UCSD.edu

Assignments sent with the wrong naming convention or in the wrong format will be considered late until they are sent correctly. NO HANDWRITING!

Late Work

Please contact me in advance via email if you are going to submit an assignment late because you experience circumstances that will affect your course work.

Late assignments will be accepted at the discretion of the instructor and cannot be accepted more than one-week after the due date.

Late assignments (anything posted or sent after the due date) will be graded -1 point for each day late unless due to a verifiable medical or family emergency.

Expect and plan for contingencies and technical problems (they WILL happen!).

Discussion Board Participation

A regular presence is expected in discussions and substantial contribution about class topics and discussion questions. What this means, essentially, is answering regularly the questions asked during the lesson and posting your thoughts about the topic. Here are the attributes of effective discussion board participation:

- start a discussion in Discussions page (click on +Discussion button)
- respond thoughtfully to a topic or another person's post
- provide links and resources related to the topic
- pose a thought-provoking question related to the topic
- provide pros and cons
- thoughtfully rebut another person's comments
- make your postings in a timely manner
- take a leadership role for weekly postings, be the one to start the discussion and encourage others.

Note: fruitful Discussion Board participation can bring up to 5% (5 points) to your grade.

Grades:

Grades are based on points and the letter grades are given as follows:

A+	97-100	C+	77-79
A	94-96	C	74-76
A-	90-93	C-	70-73
B+	87-89	D+	67-69
B	84-86	D	65-66
B-	80-83	F	0-64

You may check your grade in Canvas any time by clicking Grades. This will show you the points you have earned so far in this course.

Final grades are posted no later than 10 business days from the end of the course. You can view your final course grade on UCSD My Extension.

In grading, quality and quantity are considered. Regular contributions that add to the knowledge base of other students, links to additional resources, and providing substantive thought receive points. If you don't know a lot (yet!) about the topics, feel free to share some questions to others and/or search the Internet and share what you find with the class.

Grades are lowered for less-than-optimal (non graduate level) grammar, spelling, and presentation. Make sure all references are correctly cited and follow **APA** (American Psychological Association) or MLA (Modern Language Association) guidelines.

In general, the performance criteria for an A grade for assignments is listed below: The assignment:

- Demonstrates a high level understanding of issues, including complexities.
- Is well focused and sequenced. Has a clear sense of purpose. Thoughts are clearly developed and easily understandable.
- Expresses views clearly. Provides specific examples, details, illustrations, etc. to support positions taken.
- Does more than repeat what the text says or what was said in class. Draws out additional important implications.
- Shows originality of thought.
- Has no punctuation, grammar, spelling errors. Style, formatting, and appearance add to quality of final product.

Weighted Grades

Extra work during semester:	5%
Publishing on Internet:	5%
Assignments:	50%
Quizzes:	30%
Project:	20%
TOTAL	110%

Grading Policies

This course can be taken as part of the Embedded Engineering certificate. In order for the class to count towards your certificate it must be taken for a Letter Grade or as Pass/No pass. Classes that are taken as NFC(redit) cannot count towards a certificate. You can change your grading option any time BEFORE the last day of class through .My Extension

Student Resources

On any Blackboard screen, there are tabs across the top and one is called the Student Tab. There is information on how to get started as a student and who to contact if you encounter any problems. There are also videos and written instructions on how to do some of the most common things in Canvas.

Another one of these tabs is called FAQ (Frequently Asked Questions). If you click on the Students Category (on the left), you can find step-by-step directions for everything from sending email to uploading your assignments to posting a reply on the discussion board.

UC San Diego Extension Policies and Resources

Academic Policies and Procedures

Please refer to UC San Diego Extension's website (Student Resources tab) for specific details about academic policies and procedures: Student Resources.

MyExtension

Your MyExtension account is your student records portal. Log into MyExtension (https://myextension.ucsd.edu/) to enroll in a course, drop a course, request verification of enrollment, request official transcripts and more.