

Embedded Systems – ENGR 422, Section 01

Abilene Christian University

Credit Hours: 3

Semester and Year: Spring 2016

Pre-requisites/co-requisite: ENGR 210/211 (Digital Logic/Lab), ENGR 423 is a co-requisite.

Class Meeting Times and Location

This class meets Monday, Wednesday, and Friday from 8:00 a.m. to 8:50 a.m. in Foster Science Building 350 and for laboratory sessions on Wednesdays from 2:00 pm to 4:50 pm in Foster Science Building 327. The final exam is scheduled for 10:00 to 11:45 am on Friday, May 6, 2016.

Required Text and Software

The text for this course is *ARM Assembly Language: Fundamentals and Techniques*, 2nd edition, by William Hohl and Christopher Hinds, CRC Press, 2015, ISBN 9781482229851.

Catalog Description

This course introduces fundamental concepts of embedded systems including C and assembly language programming, debugging, power supply considerations, and interfacing sensors, displays, and motors to microcontrollers. Prerequisites: ENGR 210/211. Concurrent enrollment in ENGR 423 is required. (3 hours)

Intended Audience

This is an elective course for engineering majors and intended to be completed during the junior or senior year. Non-majors interested in developing technical skills in embedded systems may also enroll in the course. Competency in advanced mathematics and calculus-based physics is required for all students.

Contact Information

Name:

Office:

Phone:

Email:

Office Hours

MWF 9:00 am to 11:00 am

TR 8:00 am to 10:00 am

TEACHING PHILOSOPHY

Engineering is a well-respected profession. The public entrusts engineers to be honest, competent, and ethical. Many codes of ethics for these fields indicate that the commitment to protecting the health, safety, and welfare of the public is of paramount importance. These values are in harmony with Christian principles and ideals. Christian engineers should be honest (Matthew 5:37), work hard to ensure competency (Colossians 3:23), and put the public's interest ahead of his or her own (Luke 6:31). In light of these principles, this course will be taught such that you will gain an appreciation for the professional nature of engineering. It will be taught so as to give you every opportunity to begin to develop competency in these fields. This will require homework, quizzes, test, and group discussion. The instructor especially encourages the discussion of topics that would bear on integrating faith and professional responsibilities (cheating on licensure exams, weapons design and manufacture, environmental laws and employment opportunities in developing nations, etc.)

Learning Objectives

The activities of the course support the assessment of the following ABET Outcomes:

Criterion 3

3(a) an ability to apply knowledge of mathematics, science, and engineering

3(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

3(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

ABET Learning Objectives	Course Competencies	Measurement
3(a) an ability to apply knowledge of mathematics, science, and engineering	Understand battery profiles and performance characteristics. Use battery characteristics to calculate runtime.	Homework, Quizzes, and Exam I, II
	Convert between signed and unsigned binary representations, floating point numbers, and other variable formats.	Homework, Quizzes, Exam II, III, and Final Exam
3(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	Design algorithms and implement them in C or assembly language code.	Homework, Quizzes, Exam I, II
	Create power supply designs to meet requirements for runtime and low battery indicator status.	
3(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Use an integrated development environment such as Eclipse, Keil, or Code Composer to program and debug microcontroller code.	Homework
	Model electrical circuits in software such as Multisim to validate performance characteristics.	Homework

ACADEMIC INTEGRITY POLICY

Academic integrity is defined as academic work completed as assigned for each class by the individual or group responsible for the work. Violations of academic integrity and other forms of cheating involve the intention to deceive, mislead, or misrepresent and therefore, are a form of lying. Such actions are contrary to behavioral norms that flow from the nature of God. Academic misconduct includes, but is not limited to, the following: 1) Failure to give credit to sources used in a work in an attempt to present the work as one's own, 2) Submission of papers or projects obtained from another source (e.g., research service or club paper file) as one's own, and 3) Falsifying information orally or in writing. Academic misconduct may result in, but is not limited to, a zero on the assignment and/or an F in the course. Additionally, the department chair, Dean of the College of Arts and Sciences, and the Dean of Student Life will be notified. See the full university policy, including how to appeal a decision, by following this link:

<http://www.acu.edu/campusoffices/studentlife/judicialDocuments/AcademicIntegrityPolicy.pdf>.

ATTENDANCE

Attendance is expected at all class sessions. It is also expected that you arrive promptly. If you are absent or tardy it will negatively affect your homework, and quiz grades.

GRADING POLICY

-Attendance

Attendance is expected at all lectures. Pre-excused absences will be granted for official representations of Abilene Christian University, bona fide illness, death in the family, or other reasons deemed appropriate by the professor. Excessive absenteeism, defined as more than three unexcused absences, may result in a grade reduction or withdrawal from the course with a grade of F. Because ENGR 422 and ENGR 423 are co-requisites of one another, withdrawal from one will require withdrawal from the other.

-Homework

Unless notified to the contrary, you are highly encouraged to work together on the homework assignments. Homework is intended to be a learning tool. Students are encouraged to attempt each homework assignment on their own, and then get together with other students to compare approaches. Because the purpose of homework is to help students learn, students are permitted to work together and come up with a group answer, as long as everyone understands the answers they submit. In order to encourage individual accountability for understanding the material, it is not permitted for students to simply copy another student's work, even if they work together. Every student must turn in his/her own written solutions.

Homework is due each Monday at the beginning of class on the due date. To get full credit, the homework must be turned in on time, show all work in the solution process, be neat and logically arranged, and clearly show the final answer with the correct units. Late homework will be accepted for 75% credit if turned in by the beginning of the next class period. No credit will be given for homework turned in after one class period following the due date.

-Quizzes

Quizzes will be given frequently and usually at the beginning of class. Thus, it is important that you be in class and on time to complete the quiz. No makeup quizzes will be given except in the rare circumstances of pre-approved absences. However, the lowest quiz grade will be dropped in calculating the quiz portion of your final grade. Quiz material will cover previous lecture material, recent homework assignments and/or the text reading assignment for that day. All assignments, quizzes, and exams are considered to be comprehensive. That is, it will be likely that you will need to sufficiently know and understand previously covered material to adequately solve currently covered problems on quizzes or exams. No unauthorized help may be given or received on the quizzes.

-Exams

Three regular exams and one final exam will be given during the semester. All exams are comprehensive. Calculators may be used during the exams. Exams will be closed book and no unauthorized help may be given or received on the exams. Exams will be scheduled outside of normal class meeting times (e.g. evenings or weekends) to provide ample time for completion. Spring, 2016 exam dates are Tuesday, February 9; Thursday, March 3; and Tuesday, April 26. Each regular exam will run 5:30pm to 8:30pm.

-Calculation of Final Course Grade

The final course grade will be weighted and assigned as follows*:

Lecture Grade for Course

Homework	20%
Quizzes	15%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Exam	20%
90% and above	A
80% - 89%	B
70% - 79%	C
60% - 69%	D
59% and below	F

ADA COMPLIANCE STATEMENT

“Abilene Christian University is dedicated to removing barriers and opening access for students with disabilities in compliance with ADA and Section 504 of the Rehabilitation Act. The Alpha Scholars Program facilitates disability accommodations in cooperation with instructors. In order to receive accommodations, you must be registered with Alpha Scholars Program, and you must complete a specific

request for each class in which you need accommodations. If you have a documented disability and wish to discuss academic accommodations, please call our office directly at 325-674-2667.”

THE MISSION OF ACU:

To educate students for Christian service and leadership throughout the world.

THE MISSION OF THE COLLEGE OF ARTS AND SCIENCES:

The College of Arts and Sciences engages students with humanity’s greatest ideas to create understanding, apply insights, and serve the world as Christian thinkers and problem solvers.

THE MISSION OF THE ENGINEERING AND PHYSICS DEPARTMENT:

The ACU engineering program strongly supports the university's mission of educating students for Christian service and leadership throughout the world. In support of this mission, ACU engineering graduates will attain:

- a deep and broad understanding of engineering principles and practices as evidenced by professional employment, continued professional development, and graduate study in engineering or other professional fields.
- an extensive knowledge of the innovative design processes unique to engineering professionals as demonstrated by using critical thinking skills to contribute to the scientific and technical literature, patents and intellectual property, professional societies, and creative designs.
- a thorough understanding of Christian service and leadership as shown in their commitments to professionalism, ethics, and service and leadership within the engineering profession, the church, and society.

COURSE SCHEDULE

Week	Date	Topics/Activities	Assignment Due Date
1	1/11/2016	Syllabus, Course Introduction	None
	1/13/2016	Programming Fundamentals 1	
	1/15/2016	Programming Fundamentals 2	
2	1/18/2016	Martin Luther King Jr. Day	
	1/20/2016	Programming in C 1	Weekly HW 1
	1/22/2016	Programming in C 2	
3	1/25/2016	Programming in C 3	Weekly HW 2
	1/27/2016	Linear Voltage Regulators	
	1/29/2016	Switching Voltage Regulators	
4	2/1/2016	Battery Fundamentals	Weekly HW 3
	2/3/2016	Runtime Calculations	

	2/5/2016	Ni-Cd/NIMH Batteries	
5	2/8/2016	Exam I Review	Weekly HW 4
	2/10/2016	Lead Acid/Alkaline Batteries	
	2/12/2016	Li-ion/Li-ion polymer Batteries	
6	2/15/2016	Binary, Two's complement numbers	Weekly HW 5
	2/17/2016	Hexadecimal, Floating Point numbers	
	2/19/2016	Integrated Development Environments	
7	2/22/2016	Debugging Code 1	Weekly HW 6
	2/24/2016	Debugging Code 2	
	2/26/2016	Assemblers/Compilers	
8	2/29/2016	Introduction to the ARM architecture	Weekly HW 7
	3/2/2016	Exam II Review	
	3/4/2016	ARM Programmer's Model	
9	3/7/2016	ARM Instruction Set 1	Weekly HW 8
	3/9/2016	ARM Instruction Set 2	
	3/11/2016	ARM Instruction Set 3	
10	3/21/2016	Thumb Instruction Set	Weekly HW 9
	3/23/2016	Thumb-2 Instruction Set	
	3/25/2016	Loads/Stores/Addressing Modes	
11	3/28/2016	Constants and Literal Pools	Weekly HW 10
	3/30/2016	Integer Logic and Arithmetic	
	4/1/2016	Status Flags in the CPSR	
12	4/4/2016	Data Processing Operations	Weekly HW 11
	4/6/2016	DSP Extensions	
	4/8/2016	Branches and Loops	
13	4/11/2016	Working with Floating Point Data 1	Weekly HW 12
	4/13/2016	Working with Floating Point Data 2	
	4/15/2016	Working with Floating Point Data 3	
14	4/18/2016	Subroutines	Weekly HW 13
	4/20/2016	Stack Pointer/Link Register	
	4/22/2016	Exception Handling	
15	4/25/2016	Exam III Review	Weekly HW 14
	4/27/2016	Memory Mapped Peripherals	
	4/29/2016	Final Review	
16	5/2/2016	No Class Dead Day	
	5/6/2016	Final 8:00 - 9:45 am	

Instructor reserves the right to modify the course schedule as necessary