Department of Electrical and Computer Engineering
Texas A&M University

ECEN 449/749
Microprocessor Systems Design

Course Information:
Course Number: ECEN 449/749
Course Title: Microprocessor System Design
Section: 449-507 through 512, 749-607 through 612, 749-700
Time: MW 5:45 pm – 6:35 pm
Lecture location: ZACH 341, and also simultaneously on Zoom (ID 909 909 9190)
Credit Hours: 3

Instructor Details:
Instructor: Sunil P Khatri
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Office Hours: Tuesday 5:30pm – 6:30pm on zoom
Office hours location: Zoom (ID 909 909 9190)

Catalog Description:
449. Microprocessor Systems Design. (2-2). Credit 3. Introduction to microprocessors; 16/32 bit single board computer hardware and software designs; chip select equations for memory board design, serial and parallel I/O interfacing; ROM, static and dynamic RAM circuits for no wait-state design; assembly language programming, stack models, subroutines and I/O processing.

Course Designation: Elective

Prerequisite(s): ECEN 248 – Introduction to Digital Systems Design

Required Text(s): None, the course is taught from a set of class notes. These notes are derived from multiple contemporary sources.

Course Learning Objectives: At the end of this class, the student should:

1. Obtain an in-depth knowledge of digital circuit design using a microprocessor-based single-board embedded platform as an implementation method for digital systems.
2. Understand hardware and software co-design, using a commercial FPGA (for hardware implementation) with an embedded on-chip microprocessor (for software implementation).
3. Understand and become familiar with using the Verilog HDL (Hardware Description Language) as a means of implementing digital designs.
4. Become familiar with a FPGA hardware platform to implement reconfigurable designs, including a single-board computer running the Linux operating system
5. Understand and gain expertise in interfacing to on-chip RAM memory, and gain knowledge of memory-mapped parallel I/O.
6. Understand and implement different methods of serial I/O using pulse code modulation (PCM) techniques.
7. Implement I/O drivers to interface hardware with software running on a single-board computer running Linux
8. Learn and implement display drivers to manipulate a VGA display, including timing signals for the display.

9. At the end of the course the student should be able to view the design of digital systems from an embedded hardware/software perspective and obtain a set of fundamental concepts and design skills that can be applied to a wide variety of digital design problems.

Course Topics and Hours

Lecture Unit	Lecture Content	Number of Lectures
1	Verilog Programming – Syntax and Semantics	6
2	C Programming	3
3	FPGAs and reconfigurable computing	3
4	Pulse Modulation	2
5	Linux Introduction	4
6	Hardware-software communication	2
7	Displays	2
8	Reconfigurable Computing Frameworks	2
9	Transmission Lines	2
10	Memories	2
11	Introduction, Exam review discussions	2
TOTAL		30

The total number of lectures is 30. Each lecture is 1 hours, for a total of 30 hours of classroom instruction.

Lecture Schedule: 2 meetings per week, 1 hours each.

Laboratory Schedule: 1 meeting per week, lasting 2 hours.

Honors Section:

ECEN 449 honors students will perform an extra design task which will be assigned by the instructor at around the halfway point in the course. This additional task makes up the Honors requirement. It is the responsibility of the honors students to approach the instructor in a timely manner to receive the design task details, logistics, and due dates.

ECEN 749 and ECEN 449 differences:

ECEN 749 students will be assigned at least one additional question in each homework assignment, as well as in each test.

Student Evaluation: Students will be evaluated as follows

- Homework 20%
- Lab 28% (equally divided among the number of lab sessions). Lab reports must be turned in individually.
- Test 1 and Test 2 (2 hours each) 50% (25% for each test)
  - Both tests will be open notes, and may have lab related questions
  - Test 2 will be comprehensive
- Class participation 2%
- ECEN-449 and ECEN-749 will be graded on separate curves.

Attendance Policy:

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7, https://student-rules.tamu.edu/rule07/, in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy:

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, https://studentrules.tamu.edu/rule07/, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor (Student Rule 7, Section 7.4.1).

The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24, https://student-rules.tamu.edu/rule24/)

If you miss an exam or the final and have a university excused absence, you will need to schedule a makeup exam. If you do not have an excused absence, you will receive a zero unless there are extenuating circumstances. Please contact me before the scheduled time for the exam if possible. I will expect written confirmation of a visit to a health care professional, affirming the date and time of the visit, for an injury or illness that requires you to be absent from an exam or the final

Academic Integrity Statement and Policy:

"An Aggie does not lie, cheat, or steal or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at http://aggiehonor.tamu.edu.

It is acceptable to discuss homework problems with your classmates, but the work you submit should be your own and not a team effort.

Americans with Disabilities Act (ADA) Policy:

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit http://disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Title IX and Statement on Limits to Confidentiality:

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1 https://rules-saps.tamu.edu/PDFs/08.01.01.M1.pdf):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention– including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS), https://caps.tamu.edu/.

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage, https://titleix.tamu.edu/.

Statement on Mental Health and Wellness:

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at https://suicidepreventionlifeline.org.

Lab Logistics:

For students in the distance sections (ECEN 749-700), you are required to purchase a Zybo Z7-10 Field Programmable Gate Array (FPGA) development board and some parts as listed in the parts list file. You will also need a Mac or PC on which to run the Xilinx Vivado FPGA software (there is no cost for the Vivado software). This requirement will allow students to do all the ECEN 449 labs at home. To run the software on a Mac, you will have to use BootCamp to run the Windows-based software (remember, the software will not run on the new Apple M1 silicon Macs). More instructions on this will be provided on the course webpage.

While in the laboratory, students must wear long pants which cover the shoe opening, closed shoes, and sleeved shirts. Long hair needs to be tied back. Wearing a face mask is optional.

COVID statement:

To help protect Aggieland and stop the spread of COVID-19, Texas A&M University urges students to be vaccinated and to wear masks in classrooms and all other academic facilities on campus, including labs. Doing so exemplifies the Aggie Core Values of respect, leadership, integrity, and selfless service by putting community concerns above individual preferences. COVID-19 vaccines and masking — regardless of vaccination status — have been shown to be safe and effective at reducing spread to others, infection, hospitalization, and death.

Prepared by Sunil P Khatri on 1/12/2022