

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: 200, 501-512, 601-612, 700
Time: MW 4:15pm – 5:05pm (200, 501-506, 601-606)
MW 7:20pm – 8:10pm (507-512, 607-612)
Location: Zoom (ID 909 909 9190, password 909)
Credit Hours: 3

Instructor Details:

Instructor: Sunil P Khatri
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Office Hours: MW 5:30pm – 7:00pm

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 18%
- Lab 28% (equally divided among the number of lab sessions). Lab reports must be turned in individually.
- Test1 and Test 2 (2 hours each) 50% (25% for each test)
 - Both tests will be open notes, and have lab related questions
- Class participation 2%
- Cameras turned on during class 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.

Attendance to class is optional, but you will be able to ask questions during the live classes via chat or audio. My recommendation is to attend the synchronous Zoom lectures. All the synchronous Zoom lectures are also being recorded, and they are available to watch at your convenience.

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/>)

Please do your best to be present for the exams and the final exam. 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, **for Spring 2021 only, students may use the Explanatory Statement for Absence from Class form in lieu of a medical confirmation. Students must submit the Explanatory Statement for Absence from Class within two business days after the last date of absence.** Please review the Student Rule on attendance <http://student-rules.tamu.edu/rule07>.

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>.

COVID-19 Temporary Amendment to Minimum Syllabus Requirements:

The Faculty Senate temporarily added the following statements to the minimum syllabus requirements in Spring 2021 as part of the university's COVID-19 response.

Campus Safety Measures. To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, Texas A&M University has adopted policies and practices for the Spring 2021 academic term to limit virus transmission. Students must observe the following practices while participating in face-to-face courses and course-related activities (office hours, help sessions, transitioning to and between classes, study spaces, academic services, etc.):

- Self-monitoring—Students should follow CDC recommendations for self-monitoring. Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.
- Face Coverings—Face coverings (cloth face covering, surgical mask, etc., see <https://rulesaps.tamu.edu/PDFs/34.99.99.M0.03.pdf>) must be properly worn in all non-private spaces including classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource and support offices, and outdoor spaces where 6 feet of physical distancing is difficult to reliably maintain. Description of face coverings and additional guidance are provided in the Face Covering policy (see <https://rulesaps.tamu.edu/PDFs/34.99.99.M0.03.pdf>) and Frequently Asked Questions (FAQ), see <https://provost.tamu.edu/Menu/News/TAMU-Face-Covering-FAQs>) available on the Provost website.
- Physical Distancing—Physical distancing must be maintained between students, instructors, and others in course and course-related activities.
- Classroom Ingress/Egress—Students must follow marked pathways for entering and exiting classrooms and other teaching spaces. Leave classrooms promptly after course activities have concluded. Do not congregate in hallways and maintain 6-foot physical distancing when waiting to enter classrooms and other instructional spaces.
- To attend a face-to-face class, students must wear a face covering (or a face shield if they have an exemption letter). If a student refuses to wear a face covering, the instructor should ask the student to leave and join the class remotely. If the student does not leave the class, the faculty member should report that student to the Student Conduct office (see <https://studentlife.tamu.edu/sco/face-covering-violations/>) for sanctions. Additionally, the faculty member may choose to teach that day's class remotely for all students.

Personal Illness and Quarantine. Students required to quarantine must participate in courses and course-related activities remotely and must not attend face-to-face course activities. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities.

Students experiencing personal injury or illness that is too severe for the student to attend class qualify for an excused absence (See Student Rule 7, Section 7.2.2, <https://studentrules.tamu.edu/rule07/>). To receive an excused absence, students must comply with the documentation and notification guidelines outlined in Student Rule 7. While Student Rule 7, Section 7.3.2.1, indicates a medical confirmation note from the student's medical provider is preferred, **for Spring 2021 only, students may use the Explanatory Statement for Absence from Class form in lieu of a medical confirmation. Students must submit the Explanatory Statement for Absence from Class within two business days after the last date of absence.**

Operational Details for Spring 2021 Courses. For additional information, please review the FAQ (<https://provost.tamu.edu/CampusMessages/Spring-2021-Courses-at-TAMU>) on Spring 2021 courses at Texas A&M University.

Lab Safety and Logistics:

While in the laboratory, students must wear long pants, closed shoes, safety glasses, and university approved face covering.

COVID-19 safety requires six feet of separation, face covering, physical distancing, and cleaning of laboratory equipment between uses. Each lab section of up to 16 students will be split into four cohorts (A, B, C, and D) of four or five students each. Each cohort will have the opportunity to attend 50 mins of the normal face-to-face laboratory time every other week (A and B first, and C and D the following week). TA's will also be doing demo check off and managing virtual assistance for online students during the face-to-face lab periods. There will be 10 minutes for the two cohorts to swap during the middle of the three-hour lab period.

There will be a designated area where students can store their bags. Students will meet with TA's in this area prior to proceeding to individual laboratory stations.

Only one Open Access Workstation is available in each of the support rooms (i.e., 354A and 330D). Students are only permitted to make a reservation within certain time slots. Each time slot has a maximum of a three-hour reservation with a 30-minute break for cleaning by lab staff.

For Spring Semester 2021, all ECEN 449 students are being 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. While you are welcome to attend scheduled, face-to-face lab sessions with your cohort, the ECEN 449 labs can all be entirely performed remotely.

Prepared by Sunil P Khatri on 1/18/2021