

EE 2169 / ECE 2103 – “Lab for EE 2369”
Digital Systems Design I Lab
EE major section

❖ **Lab Description:** Implementation and testing of combinational and sequential digital systems.

Prerequisite: EE 1305 and EE 1105, each with a grade of “C” or better; or CS 1301 and CS 1101, each with a grade of “C” or better; or CS 1401 with a grade of “C” or better.

Co-requisite: EE 2369 (Digital Systems Design I). There are software simulation projects and hardware implementations, performed in this lab, that are associated with this class. The student is responsible for completing the labs and submitting reports and evidence of lab completion through the Blackboard system. Students have to be present and demonstrate their work during an in-person lab session each week, and they have the option to meet with the Teaching Assistant during the scheduled office hours. Please note that the lab is 1 credit hour, and the grade for that lab is calculated separately from the grade in this class.

Course Outcomes:

At the end of this course students will be able to:

- Utilize the standard design sequence outlined below to create Digital Logic Systems
- Use the Xilinx, Altera or LabView development environments to implement designs
- Implement Digital Logic Systems in various forms
- Design via Verilog (HDL) or schematic capture modules found in the development platform.

❖ **Lab Format:**

- The delivery format of EE2169 lab will be **in-person** with online components.
- **Online content and assignments** – Students will be able to access resources (lab assignments, recorded video lectures, and other provided materials) on Blackboard. All lab reference material will be delivered through the lab Blackboard shell. Students are expected to be proactive and complete these online academic activities by diligently keeping track of their own progress. Starting the second week of classes students are expected and required to log into Blackboard and Gradescope and complete the online sections of the weekly assignments.
- **Lab Work** – Each lab will include online assessment problems, design tasks that need to be completed with help of the TA, and demonstration of lab work during in-person sessions. **Starting the second week of classes students are required to be present during an in-person lab session each week and demonstrate their lab work to the TA.**
- **Office Hours** – There will be optional office hours to meet with the TA in person, or through Blackboard Collaborate. TA office hours will be posted on Blackboard.

❖ Technology Requirements:

- **Blackboard (BB) shell and Gradescope access** – Course content is delivered via the Blackboard Learning Management System (LMS), where you will find all our course resources, announcements, virtual offices sessions, etc. Online assignments will need to be completed and uploaded via Gradescope and Blackboard.
- **Internet connection** – that allows accessing documents, videos, and other resources from the Blackboard shell, completing online assignments, as well as uploading and submitting documents and videos.
- **@miners e-mail account** – Official class communication should be using this domain.
- Access to a **laptop/desktop computer** – Device should be enabled with webcam, microphone, and ability to install required software. *Most tablets do not fulfill all the requirements.* The device should be capable of running **Xilinx VIVADO 2017_2 (or newer)**, **LabVIEW 2017 (or newer)** and **ALTERA Quartus** (installed on your device or accessed via VPN to a local workstation in any of the two on-campus Laboratories) – instructions will be posted on Lab Blackboard.
- **Hardware** – Students must have their own **Analog Discover 2** or **ADALM 2000** device used in intro to EE or in Circuits, and other components including breadboard. FPGA boards required later in the semester will be provided to students for use during the lab sessions.
- **PDF files** – Ability to create PDF files to upload assignments (by converting directly from Word to PDF, using a scanner or using a scanning app).

❖ Communication and Collaboration:

- **Teaching Assistant** – The teaching assistant is your main point of contact regarding any lab related queries. Contact information and the office hour schedule of your TA can be found on Blackboard. The TA will hold office hours several days a week and will be present in-person during the weekly lab sessions. You are advised to join the TA office session during office hours if you need any help with lab activities.
- **Classroom Etiquette/ Student Conduct** – Remember that you must be courteous, respectful, and professional in the way you address others; either in writing (email, chat, discussion boards), or during in-person sessions at with lab TAs. Therefore, please be mindful to provide respect and courtesy to classmates, TAs and instructor at all times. No harassment or inappropriate conduct will be tolerated.

❖ Outline of Experiments

Labs with two tasks are to be completed over the course of two weekly sessions.

Lab #	Experiment Name	Summary of Tasks
1	Implementation of Logic Gates	Test circuits for basic logic operations (AND, OR, NOT) using ICs wired on a breadboard.
2	Implementation and Simulation of Logic Expression in Vivado	<ol style="list-style-type: none"> 1) Simulate a given combinational logic equation in Vivado using Verilog code. 2) Implement the logic equation into the Basys-3 FPGA board.
3	Standard Forms and Logic System Design	<ol style="list-style-type: none"> 1) Simulate and Implement a combinational logic system from standard form equations. 2) Design, Simulate, and Implement a minimized combinational logic system for a simple alarm system. <p><i>Extra Credit: Implement the alarm system on a breadboard using logic ICs.</i></p>
4	Decimal Number to Dot System Encoder	Design, Simulate, and Implement a minimized combinational logic system for a Decimal-to-Dot encoder.
5	Binary 4-bit adder with Register	<ol style="list-style-type: none"> 1) Simulate and Implement a modular 4-bit adder. 2) Simulate and Implement a system that uses a 4-bit register and to store the output of the modular 4-bit adder.
6	Counters	Design, Simulate, and Implement a 3-bit counter which loops through a given count sequence.
7	Finite State Machines (FSM)	<ol style="list-style-type: none"> 1) Simulate and Implement a provided design to control traffic lights at a 3-way intersection. 2) Use knowledge of FSMs to expand the given design and Design an FSM for a 4-way intersection. Simulate and Implement this new design.
8	Algorithmic State Machine (ASM) and Register Transfer Level (RTL) design	Simulate and Implement a system to control the lights in a crosswalk from a given ASM chart

❖ Lab Work Guidelines:

Each lab is divided into three important tasks: **Pre-lab, Demonstration, and Lab Report.**

Pre-lab:

- A set of **short questions** that need to be completed and submitted in preparation for a particular lab.
- Reading material and/or video explanations required to successfully complete the pre-lab will be provided on the appropriate lab assignment folder in Blackboard.
- The assignment itself will need to be completed on **Gradescope** by the **due date**.

Demonstration (Design, Simulation, and Hardware Implementation):

- A set of **design, software simulation, and hardware implementation** tasks that need to be completed and documented.
- Instructions for the tasks will be provided through a Lab Assignment document for each lab in Blackboard along with necessary reading material and/or video explanations.
- Students are expected to complete the design task using the reference material and ask for guidance from the TA if required.
- Students are then expected to use the appropriate software tool on their computers (or access the software through Remote Desktop over the UTEP VPN) to complete all the simulations tasks.
- During the in-person labs sessions, students need to complete the hardware implementation tasks and present the design, software simulation, and hardware implementation to the TA for final grading.
- The successful completion of the task(s) needs to be documented through a set of screenshots of intermediate steps and final results (to be included in report).

Lab Report:

- The final assignment for each lab that summarizes the work done and results obtained from the experiment.
- The assignment itself will need to be completed on **Gradescope** by the **due date**. Students will be required to access the relevant Lab Report assignment on Gradescope, fill out all the sections, answer questions and upload documents as needed.

❖ **Course Grading:**

Scale for Letter Grades:	Lab Grading Rubric:
90% - 100% → A	Pre-Lab Quiz 20 pts
80% - 89% → B	Design and Simulation 20 pts
70% - 79% → C	Lab Demonstration 30 pts
60% - 69% → D	Lab Report 30 pts
0% - 59% → F	

❖ **General Course Policies:**

- Students are required to be present in-person during the weekly lab sessions. Consecutive unannounced absences may result in the student being dropped from the lab.
- Any lab work must be completely and successfully completed in order to be eligible for full credit. Make sure to study all resources provided on Blackboard for a particular experiment before attempting the tasks. If you are struggling with a task, consult your TA during lab sessions, office hours, or over email.
- All lab work should be submitted by the deadline indicated (all times are local El Paso–Mountain Standard Time zone). Late submissions might be accepted with special **written** medical, legal, military, or work justification. Special circumstances will be considered if reported in time. Some additional late submissions will be accepted with a late penalty proportional to the delay.
- **Any document or image submitted for this lab must be in the pdf format.** This includes all (scanned) handwritten work, drawings, screenshots, and computer composed documents. If you need help creating pdf documents, please contact the TA.
- Any handwritten/drawn work that is scanned and uploaded must be neatly organized and clearly legible. All diagrams must be uncluttered and appropriately annotated. Any written work must have proper grammar and spelling.
- While collaboration in solving the tasks and troubleshooting problems is accepted and encouraged, any submitted work (written answers, comments, drawings, video, code, software files, etc) must be your own.
- Samples of student work will be collected for quality assurance purposes. Please notify the professor, in writing, if there is any confidentiality requirement about any work that is submitted.
- All work must have good presentation for full credit.

❖ **Copyright statement for course materials:** All materials used in this laboratory (such but not limited to recordings, assignments, handouts, quizzes) are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. **You may not further disseminate (i.e., share, send or post) any class materials/resources outside of this course. Doing so may result in disciplinary action.**

❖ **Academic Dishonesty:** As an entity of The University of Texas at El Paso, the Department of Electrical and Computer Engineering is committed to the development of its students and to the promotion of personal integrity and self-responsibility. The assumption that a student’s work is a

fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in the whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Office of Student Conduct and Conflict Resolution (OSCCR). See the OSCCR homepage at <http://sa.utep.edu/osccr/> for more information.

- ❖ **American Disabilities Act:** If you feel you may have a disability that requires accommodations, contact the Center for Accommodations and Support Services (CASS, <http://sa.utep.edu/cass>) at 747-5148 located in the Union East, Room 106.

- ❖ **COVID-19 Precautions:** If you are experiencing COVID-19 symptoms, wearing a mask during in-person sessions, particularly when in close quarters or crowded settings, is highly encouraged. Details about COVID-19 testing and reporting at UTEP can be found at the following links:
 - <https://www.utep.edu/chs/covid-testing/index.html>
 - <https://www.utep.edu/ehs/covid/>