Digital Electronics
Spring, 2025
Workman 113
MWF, 10:00 am-10:50 am

Instructor: Rene Arechiga
Office: Workman 211
Phone: (575) 835 6881
E-mail: rene.arechiga@nmt.edu

Office Hours: MWF 13:00pm –14:00 pm or by appointment.

Course Description: Fundamental concepts of digital logic analysis and design. Topics include: Boolean algebra, logic gates, truth tables, simplification methods, multiplexers, decoders, registers, sequential digital design, finite state machines, hardware description language (HDL), and related topics.

Co-requisite: EE 271
EE 252 is a requirement for the EE major.

Program Educational Objectives for Undergraduate Program in Electrical Engineering

The faculty of the Department of Electrical Engineering strives to continuously improve the undergraduate program in electrical engineering. The educational objectives reflect the needs of, and have been reviewed by, among others, the Advisory Board and faculty. Several years after graduation it is expected that the program's graduates will be:

- recognized leaders in electrical engineering-related fields or other career paths, in the public and private sector;
- valued leaders and participants in diverse teams who boldly discover and apply new knowledge and engineering practices;
- adaptive learners who continue to grow professionally in their organizations, or by earning post-graduate degrees.

Course Learning Outcomes: By the end of this course students should have learned the fundamental concepts in classical digital design, to learn how digital circuits are designed today using CAD tools.

[*By the end of this course, students should … things that students should know or be able to do as a result of instruction (i.e., knowledge and skills).*]

Program Learning Outcomes:
ABET Student Outcome 3: An ability to communicate effectively with a range of audiences**.**

<mark>(Optional)</mark>: [*If syllabus is being given in electronic form, this can be a link to your department's page listing these.*]

Course Requirements:
Textbook: Fundamentals of Digital Logic with Verilog Design, Third Edition
Authors: Stephen Brown and Zvonko Vranesic

Grade distribution proposed is as follows:
Homework (weekly): 20%
Quizzes (Every other Friday): 10%
Mid-term exams (Two or more): 40%
Final exam (Comprehensive): 30%

Digital Circuits Calendar

Week 1: Introduction to Digital Systems

- **Lecture Topics:**
    - Digital Hardware
    - The Design Process
    - Structure of a Computer
    - Logic Circuit Design

Week 2: Fundamentals of Digital Representation

- **Lecture Topics:**
    - Digital Representation of Information
    - Boolean Variables and Functions
    - Truth Tables

Week 3: Logic Circuits and Simplification

- **Lecture Topics:**
    - Logic Gates and Networks
    - Boolean Algebra
    - Synthesis Using SOP and POS

Week 4: Advanced Logic Networks

- **Lecture Topics:**
    - NAND and NOR Logic Networks
    - Design Examples: Multiplexer Circuit, Number Display
    - Introduction to Verilog
-

Week 5: Minimization Techniques

- **Lecture Topics:**
    - Minimization Techniques
    - Karnaugh Maps

Week 6: Number Representation and Arithmetic Circuits

- **Lecture Topics:**
    - Positional Number Representation

Week 7: Arithmetic Circuit Optimization

- **Lecture Topics:**
    - Fast Adders
    - Overview of Subtraction and Arithmetic Operations in Circuits

Week 8: Combinational Circuits (Midterm Review)

- **Lecture Topics:**
    - Multiplexers, Decoders, Encoders
    - Code Converters
    - Verilog for Combinational Circuits

Week 9: Flip-Flops and Storage Elements

- **Lecture Topics:**
    - Basic Latch, Gated SR, and D Latches
    - Edge-triggered D Flip-Flops

Week 10: Advanced Storage Elements

- **Lecture Topics:**
    - T FF, JK FF
    - Registers and Counters

Week 11: Synchronous Sequential Circuits

- **Lecture Topics:**
    - Design of FSM (Finite State Machines)

- o Serial Adder Example
- o State Minimization

Week 12: Digital System Design

- **Lecture Topics:**
  - o Bus Structures (Tri-State Drivers, Multiplexers)
  - o Verilog Code for Buses

Week 13: Timing and Synchronization Issues

- **Lecture Topics:**
  - o Clock Synchronization and Timing Issues
  - o Timing Analysis of Flip-Flop Circuits

Week 14: Digital System Applications

- **Lecture Topics:**
  - o Design Examples (Sort Operation, Shift-and-Add Multiplier)
  - o Introduction to Testing of Logic Circuits

Week 15: Course Wrap-Up and Final Exam

- **Lecture Topics:**
  - o Review of Key Concepts
  - o Discussion on Optimized Implementation of Logic Functions
  - o Asynchronous Sequential Circuits (Introduction)
- **Final Exam:** Comprehensive evaluation.

[*Is there a required textbook? Are other materials needed (e.g., homework software)? Is attendance required? Is late homework accepted? How many tests, what other assignments will there be (presentations, group projects, quizzes, etc.). Also, what about cell phones, computers/calculators on tests, etc. To help make our emergency response as effective as possible, require that cell phones be set on vibrate. Please do not require that they be turned off. The reason: if all phones vibrate at the same time during your class, you will know there is an emergency that must be responded to immediately. If there is such an emergency, you and your students need to know this without delay.*]

Tentative Course Schedule: [*Tentative dates of tests, exams when assignments are due, any days you know you will be gone.*]

End of Semester Study Day: Please note that Friday, May 9 will be a student study day. No classes or exams will be held on this day. In order to maintain overall consistency between MWF and T/TH course meeting times, ***Thursday, May 8th will run on a Friday schedule, i.e., MWF classes will meet on that final Thursday of the semester. The last class meeting for T/TH classes will be on Tuesday, May 6th.***

Grading: [*How will grades be calculated? Weight for tests, homework, etc.*]

Academic Honesty: New Mexico Tech's Academic Honesty Policy for undergraduate and graduate students is found in the catalog (https://www.nmt.edu/registrar/catalogs.php/). Further information about academic honesty can be found on the Academic Affairs website: https://www.nmt.edu/academicaffairs/avpaa/academic_honesty.php
You are responsible for knowing, understanding, and following this policy.

[*Note: Please discuss what constitutes cheating in your class, particularly for homework and laboratory exercises. For example, do you permit students to consult on-line resources, such as Chegg homework solutions? Some faculty do, others do not. Let your students know what your policy is. This is considered when violations of the academic honesty policy occur. For courses in which different faculty teach different sections, the faculty should agree to a uniform policy. Describe your plans for test proctoring and related honesty issues. For distance education courses, will students be monitored via Zoom during tests and if so, inform students that they will be required to enable their video feed. If you plan to verbally quiz selected students on content to verify performance it would be good to let them know this at the outset of the course. Please see "Supplemental Information" for advice on AI statements.*]

Student Resources: Wondering where to go for help? Please see the offices below or visit the "Where NMT Students Should Go for Help" webpage.

Student Success: New Mexico Tech offers numerous services for students in need of academic assistance. This includes someone who can check their work or who could provide friendly advice. Several locations where this assistance is available includes the Office of Student Learning (Skeen Library, https://www.nmt.edu/osl/), Math Helproom (https://www.nmt.edu/academics/math/ugrad/mathhelproom.php), the Writing and Communication Lab (Skeen Library, https://www.nmt.edu/academics/class/center.php), and numerous department-run centers. **These services are free of charge to students!** Students may also consult the Dean for Student Success Initiatives, Elaine DeBrine Howell (Fidel, rm. 237; 575-835-5208; elaine.debrinehowell@nmt.edu) or may receive emails from her if they are

struggling in class. Please visit the [Where NMT Students Should Go For Help](#) webpage for more information.

[*Please feel free to add information on tutoring or other student success services in your department or elsewhere on campus*]

Reasonable Accommodations: New Mexico Tech is committed to protecting the rights of individuals with disabilities and providing access and full participation in the educational experience. Students with disabilities who require reasonable accommodations are invited to make their needs known to the Office for Student Access Services (SAS) as soon as possible. Accommodations are not retroactive and may take some time to implement. The process for requesting accommodations can be found at their website https://nmt.edu/ds/for_students.php.

You can contact SAS in person at the Fidel Center Room 245, call 575-835-6209, email access@nmt.edu, or book through the link on their [website](#).

Counseling Services: The Counseling Center has partnered with UWill, to provide students free, immediate access to teletherapy, a direct crisis connection, and wellness programming. UWill also offers students a direct crisis connection with help available 24/7/365. Students also have free access to on-demand wellness programming through UWill's platform, such as yoga, meditation, and mindfulness. In-person sessions on campus or this virtual healthcare are available for those degree-seeking students currently enrolled. Requests for on-campus counseling and UWill services are available on the counseling website ([https://www.nmt.edu/cds/)](https://www.nmt.edu/cds/). The Counseling Center offers peer support with trained students, 'peer supporters', who understand the challenges of college and how to help navigate them. For more information on services at NMT, please call 835-6619, email counseling@nmt.edu.

Respect Statement: New Mexico Tech supports academic freedom and freedom of expression within the parameters of a respectful learning environment. As stated in the [*Student Code of Conduct Policy*](#): "New Mexico Tech's primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education." Furthermore, "Tech seeks to provide an environment that enables a positive learning experience and maintains an academic atmosphere that is a purposeful, just, open, disciplined, and caring community."

Title IX Reporting: Sexual misconduct, sexual violence, and other forms of sexual misconduct and gender-based discrimination are contrary to the University's mission and core values, violate university policies, and may also violate state and federal law (Title IX). Faculty members are considered "Responsible Employees" and are required to report incidents of these prohibited behaviors. Any such reports should be directed to Tech's Title IX Coordinator (Dr. Peter Phaiah, 238 Fidel Student Center, 575-835-5953 (O), 575-322-0001 (C), titleixcoordinator@nmt.edu) or reports can be filed online to [Tech's Title IX & Sexual Misconduct Report](#). Please visit [Tech's Title IX Website](#) (www.nmt.edu/titleix) for additional information and resources.

Supplemental Information
(Use as needed)

Online or Hybrid Courses

Faculty teaching distance education courses must provide the information listed below:

Delivery Mode: [Identify the delivery mode used for the course and list
- Any additional requirements for distance education students;
- Types of regular and substantive interactions used in the course – at least two are required. The level of interaction should be commensurate with the course (e.g., number of credits, course level);
- Tentative schedule for when these interactions will occur, if applicable].

An example is below:

Course Delivery: This is a synchronous, online course delivered through Zoom with information posted in the course management system Canvas. You are required to have sufficient technology (e.g., computer, webcam and setting to give quality video & audio) and a high-speed internet connection to engage in the course. Regular interaction with the course instructor will be through synchronous lectures & discussions (e.g., responses to instructor questions during class are expected) and weekly assignments. Substantive interaction will be through feedback provided by the instructor on the discussion posts, homework problems, and exams listed in the course schedule, typically within several days of the deadline. During exams, you will be required to have your webcam on (both video and audio).

Technical Support Information: [list of required software/hardware needed; link to distance education web portal]

Verification of Student Identity and Academic Integrity: New Mexico Tech's Student Identity Verification Policy requires that students' identity be verified and that a substantial component of the course's grade be some form of proctored activity, e.g., proctored exam, presentation, oral exam, etc. Therefore, students are required to [turn on camera during specific assignment, schedule video conference for exams, arrange for a proctored exam, …] The Student Identity Verification Policy is on the Academic Affairs website.

Web Etiquette: Other items that may be included in this syllabus is a list of web etiquette for the online course and the schedule of interactions that is planned for the semester. For more information, please visit the Distance Education Resource Guide found on the DEAB webpage.

Use of Artificial Intelligence Statements:

Instructors should be clear with students whether and how (or if) AI programs such as ChatGPT can be used for assignments. In particular, be specific about what types of uses will be penalized and what penalties students might incur. For some misuses of AI programs (e.g., using ChatGPT to generate an essay), instructors should follow the same institutional procedures that they would

for any other instance of academic dishonesty. Below is a sample statement. Faculty can modify this statement to fit their classes and assignments:

The use of generative AI tools (e.g. ChatGPT, Dall-e) is permitted in this course for the following activities with an appropriate citation:

- Brainstorming and refining your ideas;
- Fine tuning your research questions;
- Drafting an outline to organize your thoughts; and
- Checking grammar and style.

The use of generative AI tools is <u>not</u> permitted in this course for the following activities:

- Impersonating you in classroom contexts, such as by using the tool to compose discussion board prompts assigned to you or content that you put into a Zoom chat.
- Completing group work that your group has assigned to you, unless explicitly agreed to by members of your group and the instructor.
- Writing a draft of a writing assignment or writing prompt.
- Writing entire sentences, paragraphs or papers to complete class assignments.

You are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws, or contain misinformation or unethical content). Your use of AI tools must be properly documented and cited in order to stay within university policies on academic honesty. For example, in MLA: "*Text of prompt*" prompt. *ChatGPT*, *Day Month version*, OpenAI, *Day Month Year*, chat.openai.com. Any assignment that is found to have used generative AI tools in unauthorized ways *[insert the penalty here*]*. When in doubt about permitted usage, please ask the instructor for clarification.