ECE 251 Digital Design

Fall 2025 Syllabus

Instructor Information

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Teaching assistant: None

Course Description

The design of combinational and sequential logic circuits used in digital processing systems and computers. Basic register transfer operations are covered. Topics include Boolean algebra, minimization techniques and the design of logic circuits such as adders, comparators, decoders, multiplexers, counters, arithmetic logic units, and memory systems.
Prerequisite: PHYS 122
Main text: A. B. Marcovitz, Introduction to Logic Design, 3rd edition. New York, NY, U.S.A.: McGraw-Hill, 2010. ISBN: 978-0073191645

Course Learning Outcomes

By the end of the course students are supposed to being able to perform the following tasks. The exams questions will be mostly based on the course learning outcomes items.

1. Knowledge of the number systems and its conversion processes.
2. Use Boolean Algebra and minimize Boolean functions.
3. Construct various digital circuits using logic gates, latches, and flip flops.
4. Design and implement basic combinational and sequential logic circuits.
5. Design and implement digital logic systems.
6. Knowledge of various digital electronic circuit parameters.
7. Familiarity with the various logic families (TTL, CMOS, ECL, etc.).
8. Analyze digital circuits in a multitude of possible applications.
9. Use Multisim circuit modeling and analysis software.

Course Topics

Week	Topic	Topic details
1-2	Introduction	• Lecturer introduction and course syllabus. • Introduction to digital design. • Number systems. • Converting between number systems. • Arithmetic in the different number systems. • Signed integer representation. • BCD and other coding methods. • Floating point.
2-4	Combinational Systems	• Design process for combinational systems. • Truth tables. • Boolean/Switching Algebra. • Logic gates. • From truth table to logic function. • Simplifying logic functions.
5-6	Karnaugh Map	• Introduction to Karnaugh Maps. • 5-6 variable K-maps. • Multiple output K-maps.
7	Minimization Algorithms	• Quine-McCluskey Method. • Prime imolicant tables.
		Midterm
8-9	Combinational Systems	• Clock signals, timing diagrams, propagation delay, and hazards. • Adders, subtractors, and comparators. • Binary decoder, encoder, multiplexer, and demultiplexer. • Gate Arrays • Simulating designs
10-11	Sequential Systems (Analysis)	• Introduce sequential systems • State tables and diagrams. • Latches and flip-flops • Race conditions. • Analysis of sequential systems. • Mealy and Moore state machines.
12	Sequential Systems (Design)	• Flip-flop design techniques • Design of synchronous and asynchronous counters • Design of sequence pattern detector. • State reduction and assignment. • Simulating sequential systems.
13-14	Sequential Systems++	• Shift registers ◦ Bidirectional ◦ Universal • Counters ◦ Ripple ◦ Synchronous ◦ 3/4-bit asynchronous up and down counters.
15		FINAL EXAM

Changes in the course outline are possible and will be announced in the class and on Canvas.

Quiz Policy

Quizzes will be given during the recitation classes. The quizzes will be worth 10 points each and the six highest grades will count towards your final grade.

Grading Policy

Your course grade will be based on the midterm, final, and quizzes.

	Points	Percentage
Midterm	100	27.8%
Final	200	55.6%
Quizzes	60	16.7%
Total	360	100.0%

Exams

All exams are closed books and notes. Exams are based on the lectures, quizzes, and textbook problems.

Test grading: Full credit — for detailed correct solution showing all steps. Partial credit — for partially correct answers. Answers with no work/explanation (even if correct) will receive minimal credit. Critical errors will significantly lower your score.

Make-up exams are possible only under extenuating circumstances confirmed by the Dean of Students. See https://www.njit.edu/dos/student-absence-verification for instructions for absence verification.

NJIT Honor Code

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf*.*

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.** *If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at* dos@njit.edu

Letter Grade

Grades	Signifigance	Final Grade Precentage
A	Superior	TBD
B+	Excellent	
B	Very Good	
C+	Good	
C	Acceptable	
D	Minimum	
F	Inadequate	