Digital Logic Design

Course Syllabus

Amirkabir University of Technology
Faculty of Engineering
Department of Electrical and Computer Engineering

Fall 2024 | Undergraduate Course | Digital Systems | Logic Design

» Course Information

Course Title:	Digital Logic Design
University:	Amirkabir University of Technology
Faculty:	Faculty of Engineering
Department:	Department of Electrical and Computer Engineering
Semester:	Fall 2024
Instructor:	Dr. Ahmad Shabani
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» Catalog Description

This course introduces the principles of digital logic design and switching theory. It covers number systems, arithmetic operations, decimal codes, alphanumeric codes, Boolean algebra, Karnaugh maps, NAND and NOR gates, exclusive-OR gates, integrated circuits, combinational circuits, decoders, encoders, multiplexers, adders, subtractors, multipliers, sequential circuits, latches, flip-flops, sequential circuit analysis, registers, counters, RAM and ROM memories, and programmable logic technologies including PLA, PLD, CPLD, and FPGA.

» Course Objectives

A student who successfully fulfills the course requirements will demonstrate the ability to:

- Perform arithmetic operations in different number systems.
- Manipulate Boolean algebraic structures.
- Analyze and design various combinational logic circuits.
- Analyze and design clocked sequential circuits.

» Main Course Topics

Topic Area	Covered Material
Number Systems	Digital circuits, number systems, arithmetic operations, decimal codes, and alphanumeric codes.
Boolean Algebra	Axiomatic definition of Boolean algebra, theorems and properties, canonical forms, and standard forms of Boolean functions.
Logic Gates	NAND, NOR, exclusive-OR, integrated circuits, and logic operations.
Logic Simplification	Karnaugh maps, product-of-sums simplification, two-level NAND/NOR implementations, multilevel logic, and the tabulation method.
Combinational Circuits	Analysis and design procedures, code conversion, adders, subtractors, multipliers, comparators, decoders, encoders, priority encoders, and multiplexers.
Sequential Circuits	Latches, flip-flops, triggering, analysis of clocked sequential circuits, state reduction and assignment, excitation tables, and design of counters.
Memories and Programmable Logic	Registers, counters, RAM, ROM, PLA, PLD, CPLD, and FPGA.

» Course Outline and Organization

Week	Hours	Description
1–2	8	Binary systems: digital circuits, number systems, arithmetic operations, decimal codes, and alphanumeric codes.
3–5	10	Boolean algebra and logic gates: axiomatic definition of Boolean algebra, theorems and properties of Boolean algebra, canonical and standard forms of Boolean functions, other logic operations, digital logic gates, and integrated circuits.
5–7	8	Simplification of Boolean functions: the map method, product-of-sums simplification, two-level NAND and NOR implementations, and other two-level forms.
8	4	Logic implementations: multilevel NAND and NOR circuits, the tabulation method, and exclusive-OR function.
9	–	**Midterm Exam**
10	4	Multilevel NAND and NOR circuits, the tabulation method, and exclusive-OR function.
11–13	12	Combinational logic: analysis procedure, design procedure, code conversion, binary adder-subtractor, 4-bit parallel adder-subtractor, and carry propagation.
14–15	10	Magnitude comparator, decoders and encoders, priority encoders, multiplexers, and combinational logic implementation.
16–17	8	Synchronous sequential circuits: flip-flops, triggering of flip-flops, analysis of clocked sequential circuits, state reduction and assignment, flip-flop excitation tables, design procedure, and design of counters.
18–19	–	**Final Exams**

» Grading System

Assessment Component	Weight
Midterm Exam	**30%**
Quizzes	**10%**
CAs & HWs	**15%**
Final Exam	**40%**
Attendance	**5%**

» Textbook and References

Main Textbook

M. M. Mano and M. D. Ciletti, *Digital Design*, Fifth Edition, Prentice-Hall, 2012.

Other References

- Fredrick J. Hill and Gerald R. Peterson, *Introduction to Switching Theory & Logical Design*, John Wiley & Sons, 1981.
- Thomas L. Floyd, *Digital Fundamentals*, Merrill, imprint of Macmillan Publishing Company, New York, 1994.
- M. M. Mano and C. R. Kime, *Logic and Computer Design Fundamentals*, Prentice-Hall, 2001.
- Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, McGraw-Hill, 2000.

» Skills Developed

Number Systems | Boolean Algebra | Karnaugh Maps | Logic Gates | Combinational Design | Sequential Logic | Flip-Flops | Counters | Memory Design | FPGA Basics

» Course Policy

Students are expected to attend lectures regularly, prepare course material in advance, participate in class activities, complete quizzes and assignments on time, and comply with academic integrity rules in all course assessments.