Course Code	DIGITAL LOGIC DESIGN	L	T	P	Credits
		2	0	0	2

Pre-requisite: Basic knowledge of mathematics, number systems, and fundamental computer concepts.

Course Objectives

- Develop a strong foundation in number systems, binary arithmetic, binary codes, Boolean algebra, and basic and universal logic gates used in digital systems.
- Enable students to apply Boolean algebra and Karnaugh map techniques for simplifying Boolean expressions and implementing basic combinational logic circuits.
- Enable students to apply standard combinational logic building blocks such as multiplexers, demultiplexers, encoders, decoders, and magnitude comparators for implementing digital functions.
- Introduce the fundamental concepts and operation of sequential logic, including latches and flip-flops, and their role in storing and transferring binary information.
- Enable students to apply the principles of shift registers and asynchronous, synchronous, up/down, and modulo-N counters for implementing basic sequential circuits.

CO1	**Explain** number systems, binary arithmetic, complements, binary codes, Boolean algebra, and the operation of basic and universal logic gates.	**L2 Understand**
CO2	**Apply** Boolean algebra and Karnaugh map techniques to simplify Boolean expressions and implement basic combinational circuits such as adders and subtractors.	**L3 Apply**
CO3	**Apply** the principles of multiplexers, demultiplexers, encoders, decoders, and magnitude comparators to implement basic combinational logic functions.	**L3 Apply**
CO4	**Explain** the operation and characteristics of latches and SR, D, JK, and T flip-flops using characteristic tables, excitation tables, and timing diagrams.	**L2 Understand**
CO5	**Apply** the principles of shift registers and asynchronous, synchronous, up/down, and modulo-N counters to implement basic sequential circuits.	**L3 Apply**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	–	–	M	–	–	–	–	–	–			

CO 2	H	H	M	M	H	–	–	–	–	–	–			
CO 3	H	H	H	M	H	–	–	–	M	–	–			
CO 4	H	H	M	M	H	–	–	–	–	–	–			
CO 5	H	H	H	H	H	–	–	–	M	–	M			

Mapping of course outcomes with program outcomes:

H = High, M = Moderate, L = Low, – = No significant mapping.

CO–PO Justification

CO	PO	Correlation	Concise Justification
CO1	PO1	H	Provides fundamental engineering knowledge of number systems, Boolean algebra, and logic gates.
	PO2	M	Applies basic logical reasoning to understand and interpret digital-system problems.
	PO5	M	Introduces the use of basic digital logic concepts and tools for solving computational problems.
CO2	PO1	H	Applies Boolean algebra and K-map concepts as core digital engineering knowledge.
	PO2	H	Develops problem-solving skills through Boolean simplification and combinational circuit problems.
	PO3	M	Supports implementation of basic combinational circuits such as adders and subtractors.
	PO4	M	Encourages systematic evaluation of Boolean expressions and circuit outputs.
	PO5	H	Uses digital design techniques and tools for implementing combinational circuits.
CO3	PO1	H	Applies knowledge of standard combinational logic building blocks.
	PO2	H	Applies logical reasoning to implement functions using MUX, DEMUX, encoders, and decoders.
	PO3	H	Develops basic combinational circuit implementations using standard digital components.
	PO4	M	Supports systematic verification of circuit operation using truth tables and outputs.
	PO5	H	Uses digital logic tools and techniques for circuit implementation.
	PO9	M	Combinational circuit activities can involve collaborative implementation and verification.
CO4	PO1	H	Provides engineering knowledge of latches, flip-flops, and sequential logic.
	PO2	H	Develops understanding and interpretation of sequential-circuit behavior using tables and timing diagrams.
	PO3	M	Supports basic implementation of sequential logic using flip-flops.
	PO4	M	Involves systematic interpretation of characteristic, excitation, and timing behavior.

	PO5	H	Uses digital logic techniques and tools to represent and verify flip-flop operation.
CO5	PO1	H	Applies engineering knowledge of registers and different types of counters.
	PO2	H	Develops problem-solving skills through counter sequences and register operations.
	PO3	H	Supports implementation of sequential circuits using registers and counters.
	PO4	H	Requires systematic evaluation of counting sequences and sequential behavior.
	PO5	H	Uses digital design techniques and tools for implementing sequential circuits.
	PO9	M	Sequential-circuit activities can involve collaborative circuit implementation and verification.
	PO11	M	Involves planning and organizing sequential-circuit implementation and related activities.

Syllabus

UNIT	COURSE CONTENT
UNIT-I	Number Systems and Boolean Algebra Number systems (binary, octal, decimal, hexadecimal) and inter-conversions; binary arithmetic; complements (1's and 2's); binary codes (BCD, Gray code, ASCII); Boolean algebra postulates and theorems; logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and universal gates
UNIT-II	Combinational Logic Design I (8 Hours) Minimization using Karnaugh maps (up to 4 variables); Sum-of-Products and Product-of-Sums forms; design of half-adder, full-adder, half-subtractor, full-subtractor
UNIT-III	Combinational Logic Design II: Multiplexers and demultiplexers; encoders and decoders; magnitude comparators. Sequential Logic Fundamentals- Latches and FlipFlops, Difference between combinational and sequential circuits;
UNIT-IV	Sequential Logic Design—-SR latch; clocked SR, D, JK, and T flip-flops; master-slave flip-flop; flip-flop excitation tables; timing diagrams; setup and hold time.
UNIT-V	Registers, Counters, and Sequential Circuit Design (7 Hours) Shift registers (SISO, SIPO, PISO, PIPO); ripple (asynchronous) counters; synchronous counters; up/down and modulo-N counters
Text Books 1. Mano, M. M., Ciletti, M. D. (2018). Digital design (6th ed.). Pearson. **2.** Floyd, T. L. (2015). Digital fundamentals (11th ed.). Pearson.	

Reference Books

1. Hill, F. J., & Peterson, G. R. (2010). Introduction to switching theory and logic design (3rd ed.). Wiley.
2. Wakerly, J. F. (2018). Digital design: Principles and practices (5th ed.). Pearson.
3. Brown, S., &Vranesic, Z. (2014). Fundamentals of digital logic with VHDL design (3rd ed.). McGraw-Hill Education.

Web References

1. NPTEL. (n.d.). Digital circuits and systems. National Programme on Technology Enhanced Learning. https://nptel.ac.in/
2. MIT Open Courseware. (n.d.). Digital systems laboratory. Massachusetts Institute of Technology. https://ocw.mit.edu/courses/6-111-introductory-digital-systems-laboratory-fall-2019/
3. All About Circuits. (n.d.). Digital circuits. https://www.allaboutcircuits.com/textbook/digital/