

Digital Electronics

(Semester VI)

Course Code - PHY060204

Credits 4: (Theory: 3 + Practical: 1) **(Total Marks 100: Internal-25+External-75)**

Total Lectures: 45

Course Objectives:

1. To introduce the students to the basics of digital electronics and applications with hands-on experience in implementing some hardware.
2. To help students develop a digital logic and apply it to solve real-life problems
3. To analyze, design and implement various combinational and sequential logic circuits
4. To classify different semiconductor memories.

Course Outcome: After successful completion of the course student will be able to develop, implement and analyze digital logic circuits and apply them to solve real-life problems and classify different semiconductor memories.

Unit I: Integrated Circuits (qualitative treatment only) (Lectures 03)

Active & Passive Components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. The scale of integration: SSI, MSI, LSI, and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs.

Unit II: Digital Circuits (Lectures 10)

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal, and Hexadecimal numbers. AND, OR, and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

Unit III: Boolean Algebra (Lectures 10)

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. The idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Unit IV: Arithmetic Circuits (Lectures 05)

Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.

Unit V: Timers: IC 555 (Lectures 03)

Block diagram and applications: Astable multivibrator and Monostable multivibrator.

Unit VI: Sequential Circuits (Lectures 04)

SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race- around conditions in JK Flip-Flop. M/S JK Flip-Flop.

Unit VII: Shift Registers (Lectures 04)

Serial-in-Serial-out. Serial-in-Parallel-out. Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Unit VIII: Computer Organization (Lectures 06)

Input/Output Devices. Data storage (the idea of RAM and ROM). Computer memory. Memory organization & addressing.

Laboratory

A minimum of four experiments are to be done.

1. To design a switch (NOT gate) using (i) a PNP transistor and (ii) an NPN transistor.
2. To verify and design AND, OR, NOT, and XOR gates using NAND gates.
3. To design a combinational logic system for a specified Truth Table.
4. To convert a Boolean expression into a logic circuit and design it using logic gate ICs.
5. To design a Half Adder and Full Adder
6. To design a 4-bit binary Adder.
7. To design Half Subtractor and Full Subtractor
8. To design Adder-Subtractor using Full Adder IC.

9. To design an astable multivibrator of given specifications using 555 Timer.
10. To design a monostable multivibrator of given specifications using 555 Timer.
11. To build a D flip-flop circuit using NAND gates.
12. To build a JK flip-flop circuit using NAND gates.
13. To build JK Master-slave flip-flop using flip-flop ICs.
14. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
15. To build SR flip-flop circuit using NAND gates

Suggested Books

1. Digital Principles and Applications, A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics G. K. Kharate ,2010, Oxford University Press
5. Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI Learning
6. Logic circuit design, Shimon P. Vingron, 2012, Springer.
7. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
8. Digital Electronics, S. K. Mandal, 2010, 1st edition, McGraw Hill
9. Electronics Fundamentals and Applications, D. Chattopadhyay and P. C. Rakshit, 17th Ed, 2023, New Age International Publishers