

DISCIPLINE SPECIFIC ELECTIVE COURSE – PHYSICS DSE 15b: DIGITAL ELECTRONICS

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Digital Electronics PHYSICS DSE – 15b	4	2	0	2	Class XII pass with Physics and Mathematics as main subjects	NIL

LEARNING OBJECTIVES

The objective of the course is to introduce digital electronics and its simple applications to physics program students. The course is designed to familiarize the students with the different number systems (binary, octal and hexadecimal), laws of Boolean algebra, logic gates and combinational and sequential logic circuits utilised in designing counters and registers.

LEARNING OUTCOMES

After studying this paper students will become familiar with,

- Digital signals, positive and negative logic, Boolean variables, truth table, various number system codes and their inter-conversions.
- Students will be able to learn to minimise a given Boolean function using laws of Boolean algebra and Karnaugh map to minimise the hardware requirement of digital logic circuits
- Understand the working mechanism of data processing circuits, arithmetic circuits, sequential logic circuits, register and their applications.

SYLLABUS OF PHYSICS DSE 15b

THEORY COMPONENT

Unit – I - Integrated Circuits (qualitative treatment only) (2 Hours)

Advantages and drawbacks of ICs, 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 and Boolean Aalgebra (13 Hours)

Binary numbers, decimal to binary and binary to decimal conversion, octal and hexadecimal numbers, NAND and NOR gates as universal gates, XOR and XNOR gates and their application as parity checkers

Boolean algebra: De Morgan's theorems, Boolean laws, idea of minterms, simplification of logic circuit using Boolean algebra and Karnaugh map

Unit – III - Combinational logic Circuits (7 Hours)

Data processing circuits: Multiplexers and its applications, de-multiplexers, decoders, encoders
Arithmetic circuits: Binary addition, binary subtraction using 2's complement, half and full adders, half and full subtractor

Unit – IV - Sequential Circuits (8 Hours)

Flip Flops: SR, D, and JK, clocked (edge triggered) flip-flops, race-around conditions in JK flip-flop, application of flip flops in designing shift register (serial -in- parallel out) and 2- bit (MOD-4) up-down asynchronous counter

References:

Essential Readings:

- 1) Digital Principles and Applications, A. P. Malvino, D. P. Leach and Saha, 7th edition, 2011, Tata McGraw
- 2) Fundamentals of Digital Circuits, A. Kumar, 2nd edition, 2009, PHI Learning Pvt. Ltd.
- 3) Digital Fundamentals, T. L. Floyd, 1994, Pearson Education Asia
- 4) Digital Principles and Applications, D. P. Leach and A. P. Malvino, 1995, Tata McGraw Hill
- 5) Digital Design, M. M. Mano and M. D. Ciletti, 2007, Pearson Education Asia
- 6) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- 7) Digital Electronics, G. K. Kharate, 2010, Oxford University Press

Additional Readings:

- 1) Logic circuit design, S. P. Vingron, 2012, Springer
- 2) Digital Principles, Schaum's Outline Series, R. L. Tokheim, 1994, Tata McGraw-Hill
- 3) Solved Problems in Digital Electronics, S. P. Bali, 2005, Sigma Series, Tata McGraw-Hill
- 4) Digital Electronics: An Introduction To Theory And Practice, W. H. Gothmann, 2000, Prentice Hall of India
- 5) Modern Digital Electronics, R. P. Jain, 2003, Tata McGraw-Hill
- 6) Digital Electronics, S. Ghoshal, 2012, Cengage Learning.
- 7) Digital Electronics, S. K. Mandal, 2010, 1st edition, McGraw Hill

PRACTICAL COMPONENT

(15 Weeks with 4 hours of laboratory session per week)

Either (I) At least 6 experiments or (II) 4 experiments and one project equivalent to two experiments and all designing should be done on the bread boards.

- 1) Study of truth tables of basic logic gates, universal logic gates XOR and XNOR logic gates
- 2) (a) To design a combinational logic system for a specified truth table.
(b) To convert Boolean expression into logic circuit and design it using basic logic gate ICs
- 3) To minimize a given logic circuit using K-map and design using NAND gates.
- 4) Designing of Half Adder and Half Subtractor using NAND gates.
- 5) Designing of Full adder/Full Subtractor using NAND gates
- 6) Designing of 4-bit binary adder using adder IC.
- 7) To build Flip-Flop (RS, Clocked RS) circuits using NAND gates.
- 8) To build Flip-Flop (D-type and JK) circuits using NAND gate
- 9) To build a 2-bit Asynchronous Counter using D-type/JK Flip-Flop ICs and study timing diagrams.
- 10) To make a 3-bit Shift Register (serial in- and parallel out) using D-type/JK Flip-Flop ICs.

References for laboratory work:

- 1) Digital Fundamentals, T. L. Floyd, 1994, Pearson Education Asia
- 2) Digital Principles and Applications, D. P. Leach and A. P. Malvino, 1995, Tata McGraw

Hill

- 3) Digital Design, M. M. Mano and M. D. Ciletti, 2007, Pearson Education Asia
- 4) Digital Circuits and Systems, Venugopal, 2011, Tata McGraw Hill.