3.3 DIGITAL ELECTRONICS

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RATIONALE

This course has been designed to make the students know about the fundamental principles of digital electronics and gain familiarity with the available IC chips. This subject aims to give a detailed exposure of number systems and various codes. The students will understand various logic gates and their logic simplification. It will help the students to design various combinational, sequential circuits, converters and memories.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:
CO1: Understand various types of number systems and digital codes.
CO2: Describe the logic gates and able to perform logics simplification.
CO3: Design various combinational circuits
CO4: Develop various sequential circuits.
CO5: Analyze A/D & D/A converters and various memories.

DETAILED CONTENTS

UNIT I
Number Systems and Codes

1.1 Introduction to analog and digital signal
1.2 Binary, octal and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa.
1.3 Binary addition and subtraction including binary points. 1's and 2's complement method of addition/subtraction.
1.4 Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code.
1.5 Concept of parity, single and double parity and error detection.

UNIT II

Logic Gates and Logic Simplifications

2.1 Concept of negative and positive logic

2.2 Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates.

2.3 Introduction to TTL and CMOS logic families

2.4 Postulates of Boolean algebra, De Morgan's Theorems. Implementation of Boolean

2.5 Karnaugh map (upto 4 variables) and simple application in developing combinational logic circuits

UNIT III

Combinational Circuits

3.1 Half adder, Full adder circuit, design and implementation.

3.2 4 bit adder circuit

3.3 Four bit decoder circuits for 7 segment display and decoder/driver ICs.

3.4 Basic functions and block diagram of MUX and DEMUX with different ICs

3.5 Basic functions and block diagram of Encoder

UNIT IV

Sequential Circuits

4.1 Concept and types of latch with their working and applications

4.2 Operation using waveforms and truth tables of RS, T, D, Master/Slave JK flip flops. Difference between a latch and a flip flop

4.3 Introduction to Asynchronous and Synchronous counters. Binary counters, Divide by N ripple counters, Decade counter, Ring counter

4.4 Introduction and basic concepts including shift left and shift right.

4.5 Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out.

4.6 Universal shift register

UNIT V

Converters and Memories

5.1 Working principle of A/D and D/A converters

5.2 Brief idea about different techniques of A/D conversion and study of :

a) Stair step Ramp A/D converter

b) Dual Slope A/D converter

c) Successive Approximation A/D Converter

5.3 Detail study of :

a) Binary Weighted D/A converter

b) R/2R ladder D/A converter

5.4 Applications of A/D and D/A converter.

5.5 Memory organization, classification of semiconductor memories (RAM, ROM, PROM, EPROM, EEPROM), static and dynamic RAM, introduction to 74181 ALU IC

PRACTICAL EXERCISES

1. Verification and interpretation of truth tables for AND, OR, NOT NAND, NOR and Exclusive OR (EXOR) and Exclusive NOR(EXNOR) gates
2. Realisation of logic functions with the help of NAND or NOR gates
3. To design a half adder using XOR and NAND gates and verification of its operation
4. To design of a full adder circuit using XOR and NAND gates and verify its operation
5. To design circuit for 7 segment display ICs.
6. Verification of truth table for positive edge triggered, negative edge triggered, level triggered IC flip-flops (At least one IC each of D latch, D flip-flop, JK flip-flops).
7. Verification of truth table for encoder and decoder ICs.
8. Verification of truth table for Multiplexers and x and De-Multiplexers
9. To design a 4 bit SISO, SIPO, PISO, PIPO shift registers using JK/D flip flops and verification of their operation.
10. To design a 4 bit ring counter and verify its operation.
11. Use of Asynchronous Counter ICs (7490 or 7493)
12. To design and verification of A/D converter
13. To design and verification of D/A converter
14. To design and verification of 74181 ALU IC

RECOMMENDED BOOKS

1. Malvino Leach, “Digital Electronics and Applications”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 8th Edition, 2015.
2. Morris Mano, “Digital Logic Designs”, Prentice Hall of India, New Delhi, 6th Edition, 2018.
3. Soumitra Kumar Mandal, “Digital Electronics”, Tata McGraw Hill Education Pvt. Ltd., 2010.
4. V K Sangar, “Digital Electronics”, Raj Publishers, Jalandhar, 2017.

5. Tokheim, "Digital Electronics", Tata McGraw Hill Education Pvt. Ltd, 4th Edition, 2007.
6. Thomas Floyds, "Digital Fundamentals", Universal Book Stall, 11th Edition, 2017.
7. RP Jain, "Digital Electronics", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 4th Edition, 2010.
8. KS Jamwal, "Digital Electronics", Dhanpat Rai and Co., New Delhi, 2010.
9. Yashpal and Sanjeev Kumar, "Digital Electronics", North Publication, Ambala City, 1st Edition, 2020.
10. BR Gupta, "Digital Electronics", Dhanpat Rai & Co., New Delhi, 2020.
11. RJ Tocci, "Digital Systems: Principles and Applications", Prentice Hall of India, New Delhi, 2000 Edition.
12. V. Rajaraman, "Digital Electronics by Prentice Hall of India", New Delhi, 5th Edition, 2007.
13. Naresh Gupta, "Fundamentals of Digital Electronics", Jain Brothers, New Delhi, 2005.
14. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age. All experiments may preferably be done on Bread Boards.