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**PRESIDENCY  
UNIVERSITY  
BENGALURU**

**School of Engineering**

**Mid-Term Examination - November 2024**

**Semester:** I

**Date:** 04/11/2024

**Course Code:** ECE2007

**Time:** 09.30am to 11.00am

**Course Name:** Digital Design

**Max Marks:** 50

**Program:** B. Tech CSE & allied

**Weightage:** 25%

**Instructions:**

*(i) Read all questions carefully and answer accordingly.*

*(ii) Do not write anything on the question paper other than roll number.*

**Part A**

**Answer ALL the Questions. Each question carries 2marks.**

**5QX2M=10M**

- |          |  |         |    |     |
|----------|--|---------|----|-----|
| <b>1</b> | Write the Truth table and Boolean expression for the output of a NOR gate.   | 2 Marks | L1 | CO1 |
| <b>2</b> | Binary addition is performed considering two binary numbers. Perform binary addition of two numbers $1010+1011=-----$ .  | 2 Marks | L1 | CO1 |
| <b>3</b> | State Idempotent Law in Boolean algebra. What is the significance of the Identity Law in Boolean algebra?                | 2 Marks | L1 | CO1 |
| <b>4</b> | What is the purpose of using a Karnaugh Map (K-map)?   | 2 Marks | L1 | CO1 |
| <b>5</b> | Boolean Algebra is fundamental in the development of digital electronics systems. Complete the Boolean law $A+1=-----$ . | 2 Marks | L1 | CO1 |

**Part B**

**Answer ALL Questions. Each question carries 10 marks.**

**4QX10M=40M**

- |          |  |         |    |     |
|----------|--|---------|----|-----|
| <b>6</b> | <b>a.</b> De Morgan's laws are two transformation rules that relate conjunctions and disjunctions through negation. Explain and verify with the truth table any one De Morgans law for three variables.  | 5 Marks | L2 | CO1 |
|          | <b>b.</b> A Boolean expression is composed of a combination of the Boolean constants (True or False), Boolean variables, and logical connectives. Simplify the given Boolean expression and realize the simplified expression using basic gates. | 5 Marks | L2 | CO1 |

$$Y=ABC + AB'C+ABC'+A'BC$$

or

- a. Boolean algebra is applied in computer electronic circuits. These circuits perform Boolean operations and these are called logic circuits and logic gates. Implement all the basic gates using NOR gates. 5 Marks L2 CO1
- 7 a. A bulb in a stair case has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by any one of the switch irrespective of the state of the other switch. Construct the truth table and write the expression, identify the logic gate and also draw the logic symbol for the same. 5 Marks L2 CO1
- 8 b. You are designing a digital circuit that performs binary subtraction for a system that processes binary numbers. The system must subtract three binary bits. To achieve this, identify the logic circuit and design the system and implement the same using basic gates. 10 Marks L3 CO2
- or
- 9 a. A comparator used to compare two binary numbers each of two bits is called a 2-bit magnitude comparator. Design a combinational circuit that compares two 2-bit binary numbers and implement the same using basic gates only for greater and less than conditions. 10 Marks L3 CO2
- 10 a. A K-map organizes truth table values into a grid format where adjacent cells differ by only one bit. Simplify the expression using K-map and mention the implicants and prime implicants for the same.  $F(A,B,C,D)=\Sigma m(0,2,3,5,7,11,13,14,15)$ . 5 Marks L2 CO1
- b. Product of Sums (POS) is another form of Boolean expression where multiple sum terms (ORed variables) are multiplied together (ANDed). Convert the given function into minimal POS form  $F(A, B, C) = \Pi M (0,1,3)$  and implement using basic gates. 5 Marks L2 CO1
- or
- 11 a. In digital logic design, both SOP and POS forms have two main types: Canonical (or Standard) form and Non-Canonical (or Simplified) form. Convert the given expression into canonical SOP form.  $Y = A'B + BC' + A'C$  5 Marks L2 CO1

- b.** K-map allows easy identification of common terms, leading to the simplification of logic expressions. Simplify the function given using k-map  $Y = \Pi M (0,2,6,7,8,10,12,13)$  5 Marks L2 CO1

- 12** The Half subtractor is a combinational circuit which is used to perform subtraction of two bits. It has two inputs, the minuend and subtrahend and two outputs the difference and borrow out. Design half subtractor circuit and implement using basic gates. Also define combinational circuit. 10 Marks L3 CO2

**or**

- 13** Half adder is a combinational arithmetic circuit that adds two inputs and produces an output of sum bit (s) and carry bit (c) . Design half adder circuit and implement using NAND gates. And also list the steps to design the combinational circuits. 10 Marks L3 CO2