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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **SUMMER SEMESTER, 2021-2022**

DURATION: 1 HOUR 30 MINUTES **FULL MARKS: 75**

CSE 4205: Digital Logic Design

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

Necessary intermediate steps, examples, and figures must be provided if required.

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1. a) Design a combinational circuit that compares two 2-bit binary numbers A and B following a standard procedure. This circuit must satisfy the following constraints to produce three outputs X, Y and Z: — 10 (CO5) (PO3)
   - X is 1 only when only when A > B
   - Y is 1 only when A < B
   - Z is 1 only when A = B
   - Circuits must be implemented with at most two-level NOR gates

   b) Simplify the following Boolean expressions into both SOP and POS format using K-map: — 10 (CO1) (PO1)
   i. $G(a,c,b,d) = m(6,9,11,12,14) + d(0,1,2,4,8)$
   ii. $H(a,c,b,d) = M(0,1,2,5,7,9,11) \cdot D(4,10,13)$

   c) Draw a Karnaugh-map of 6 Boolean variables. Determine whether m_{26} and m_{58} are adjacent in this Karnaugh-map or not. — 5 (CO1) (PO1)

2. a) Can we increase the number of inputs to more than two for XOR and XNOR gate? Justify your answer. Implement these logic gates with any of the universal gates. — 5 (CO2) (PO2)

   b) Analyze the logic circuit shown in Figure 1 and explain its operation following a standard procedure: — 10 (CO3) (PO2)

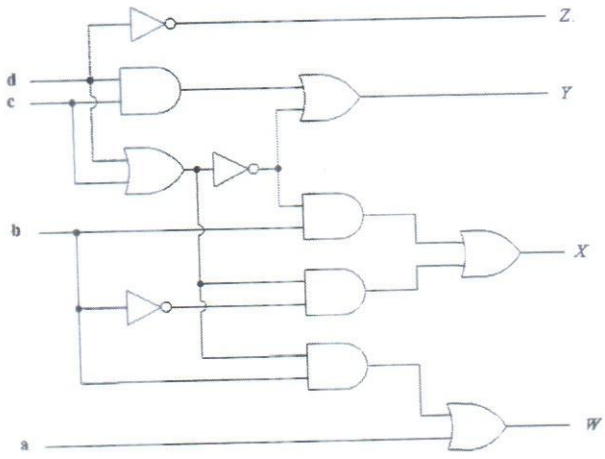

Figure 1: A logic circuit for Question 2.b)

   c) Simplify the following Boolean expressions using the *cut and try* method: — 10 (CO1) (PO1)
   i. $X = (C + D)' + A'CD' + AB'C' + A'B'CD + ACD'$
   ii. $Y = AB' + AB'C + AB'CD + AB'CDE$
   Mention corresponding postulates and theorems for each step.

3. a) Simplify the following Boolean expressions into a POS format following *Quine-McCluskey* method and implement those expressions with at most two-level NOR gates. 10 (CO4) (PO1)

$$F\ (A, B, C, D) = ABC + A'B'CD' + A'BC'D$$
$$d\ (A, B, C, D) = B'D + A'BD' + AB'D'$$

b) Differentiate between: 5 (CO3) (PO2)
   i. Boolean algebra and ordinary algebra
   ii. Canonical form and Standard form of Boolean function
   iii. Flat and dual line IC
   iv. Combinational and Sequential circuit.
   v. Carry and Borrow in MSB

c) Define '*number*' and '*algebra*' under any mathematical system with required constraints. 5 (CO1) (PO1)

d) Draw a full-adder and a full-subtractor using corresponding half-adder and half-subtractor respectively. 5 (CO2) (PO2)