United International **University (UIU)**

Department of Computer Science and Engineering

CSE 1325: DIGITAL LOGIC DESIGN, Midterm Spring 2025

Total Marks: **30,** Duration: 1 hour 30 minutes

[Any examinee found adopting unfair means including copy from another examinee will be expelled from the trimester/program as per UIU disciplinary rules.]

Answer <u>All</u> Questions

1. i. Convert $(123)_7$ and $(123)_8$ to BCD binary format. Add them performing the BCD addition showing necessary steps. **[3]**

ii. Find the values of the radix p and radix q from the following equations. **[3]**

$(41)_q + (83)_p = (1210)_4$

$(44)_p + (55)_q = (1023)_4$

2. i. For a 4-input control system the following system function is derived. Simplify the Boolean expression using Boolean algebra. Keep your work clean. **[3]**

$$F(A,B,C,D) = A'B'C'D + A'B'CD + A'BC'D + A'BCD + AB'CD$$

ii. Find the Product-of-Maxterms (POM) for the following function and optimize it into sum-of-products (SOP) form using K-Map. **[3]**

$$F(X,Y,Z) = (X+Y)(X+Z)(Y+Z)$$

3. Let ***F*** and ***G*** be two boolean functions of four variables such that,

$$F(A,B,C,D) = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + A\bar{B}\bar{C}\bar{D}$$

F and ***G*** produce the same result for every input **except one.**

i. Simplify F using K-Map and find the SOP. **[3]**

ii. The simplified expression of G contains two literals. Find the optimized SOP for G. [Hint: In F's K-map, you might have to flip the value of a cell that will bring a two literal expression for G.] **[3]**

4. Optimize the following Boolean function F using K-Map

$F\ (A,B,C,D) = \sum m(0,1,3,4,7,9,10,15)$

And find the following:

i. Simplified sum-of-products (SOP) and **[3]**

ii. Simplified product-of-sums (POS) form. **[3]**

5. Design a four input security system for Fantasy Kingdom. It outputs 1 if in the input binary code there are consecutive 0's only and outputs 0 if there are consecutive 1's only in the input. Otherwise, it outputs X (don't care). Consecutive zeros/ones mean if two or more zeros/ones are side by side.

Example:

- For 1001 input, output is 1 because there are consecutive zeros.
- For 0111 input, output is 0 because there are consecutive ones.
- For 1010 input, output is X because no zeros or ones are consecutive.
- For 1100 input, output is X because both ones and zeros are consecutive.

You have to

i. Draw the truth table. **[2]**

ii. Find the simplified expression for the output bit in Sum-of-Product (SOP) form using K-map. **[2]**

iii. Draw the circuit diagram using basic gates. **[2]**