United International University (UIU)
Department of Computer Science and Engineering
CSE 1325: DIGITAL LOGIC DESIGN, Midterm Summer 2023

Total Marks: **30** Duration: 1 hour 45 minutes

Answer All Questions

1. A) Find the value of the radix r for this statement where x = 2r + 3. [2]

$$(234)_r + (12)_x = (66)_x$$

B) Using Boolean algebra convert the following function into Sum-of-Products (SOP) and Product-of-Sum (POS) [3]

$$\bar{X} + X(X + \bar{Y})(XY + \bar{Z})$$

2. A) Perform BCD addition between the two numbers $(11101100)_2$ and $(10100100)_2$ using their BCD representations. You need to show the detailed steps of number system conversion if needed. [2]

B) Prove that $AB + B\bar{C}\,\bar{D} + \bar{A}BC + \bar{C}D = B + \bar{C}D$ [3]

3. Find the optimized product-of-sums (POS) of the following function considering don't-care conditions. In your solution, you have to show (i) all prime implicants, (ii) essential prime implicants, and (iii) apply the selection rule. [5]

$$F(A, B, C, D) = \sum_m(1,3,9,11,15) + \sum_d(0,2,14)$$

4. Optimize the following Boolean function F in [5]

i) Simplified sum-of-products (SOP) and
ii) Simplified product-of-sums (POS) form.
iii) Between minimized SOP and POS, which one will be easy to implement and why?

$$F(A, B, C, D) = \sum m(0, 2, 3, 4, 8, 9, 10, 14)$$

5. Optimize the following function using K-map. You have to show the minimized sum-of-product (SOP) form. [5]

$$F(A, B, C, D) = (A' + B).(A' + C').(A' + B' + D).(A + C + D).(C + D).(A + C' + D)$$

6. Design a system that takes decimal numbers in *Excess3* encoding and determines if that decimal number is even (output will be '1') or odd (output will be '0'). Note that zero is an even number. Following are some example inputs and corresponding outputs.

Input: Decimal number in *Excess3* encoding	Output
0110	0
1001	1
0011	1
0010	'x'

i) Show the truth table and write it in SOP (sum of product) form. [2]
ii) Simplify the expression form (i) and draw the circuit diagram using basic gates. [3]