# United International University (UIU)

## Department of Computer Science and Engineering

**CSE 1325/225: DIGITAL LOGIC DESIGN, Midterm Fall 2021**

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

**Answer Any Two Questions from Q1 to Q3**

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| **1.** | a) Represent the numbers $(911)_{10}$ and $(119)_{10}$ in BCD, and then show the steps necessary to form their sum.<br><br>b) Determine the radix $r$ in the following case:<br>$(911)_r = (1101)_{10}$ | [3]<br><br>[3] |
| **2.** | a) Simplify the following Boolean Expression (using algebraic manipulation) to an expression containing a minimum number of literals:<br>$A + B\,(C + \overline{A + C}\,)$<br>b) Convert the following expression into both canonical SoP and canonical PoS forms:<br>$G\,(L, M, N) = (L + MN)(M + LN)$ | [2]<br><br>[4] |
| **3.** | a) Prove that the following Boolean Function is self-dual. Then find its complement.<br>$H(P, Q, R) = (\bar{P} + \bar{Q})(\bar{Q} + \bar{R})(\bar{R} + \bar{P})$<br>b) Reduce the following Boolean Expression (using algebraic manipulation) to three literals:<br>$\overline{(\bar{X}\,\bar{Y} + Z)} + Z + XY + WZ$ | [3]<br><br>[3] |

**Answer Any Two Questions from Q4 to Q6**

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| **4.** | Optimize the following Boolean functions F together with the don't-care conditions d. Find all prime implicants and essential prime implicants, and apply the selection rule.<br>$F(W, X, Y, Z) = \Sigma_m(4, 6, 7, 8, 12, 15)$<br>$d(W, X, Y, Z) = \Sigma_m(2, 3, 5, 10, 11, 14)$ | [6] |
| **5.** | Optimize the following Boolean functions using K-map in (i) product-of-sums form, (ii) sum of products form<br>$H(A, B, C, D) = \Pi_M(0, 2, 6, 7, 8, 9, 10, 12, 14, 15)$ | [6] |
| **6.** | Optimize the following expressions using K-map in (1) sum of products and (2) product of sums forms. Which one will you choose to implement the circuit diagram considering cost criteria?<br>$G(A, B, C, D) = A\bar{C} + \bar{B}D + \bar{A}CD + ABCD$ | [6] |

**Answer Any One Question from Q7 and Q8**

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| **7.** | You have to design a combinational circuit that will take a 4-bit binary number as input and give output 1 if the number is **greater than 4 but less than 14**. You have to (i) find the simplified expression for the output bit in Sum-of-Products form, and (ii) draw the circuit diagram using basic gates.<br>For example,<br>a. Input: 0000, Output: 0 (Input<4)<br>b. Input: 0100, Output: 0 (Input=4)<br>c. Input: 1001, Output: 1 (Input>4)<br>d. Input: 1110, Output: 0 (Input=14) | [6] |

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| **8.** | You have to design a combinational circuit that will take a 4-bit binary number as input and give output 1 if the **number of '0's is even or equal to 3**. You have to (i) find the simplified expression for the output bit in Sum-of-Products form, and (ii) draw the circuit diagram using basic gates.<br><br>For example,<br>a. Input: 0110, Output: 1 (2 zeroes, even)<br>b. Input: 1111, Output: 1 (0 zeroes, even)<br>c. Input: 0001, Output: 1 (3 zeroes, 3)<br>d. Input: 0111, Output: 0 (1 zeroes, odd) | [6] |