



United International University

Department of Computer Science and Engineering

CSE 1325: Digital Logic Design

Mid Exam: Spring 2022 Time: 1 hour and 45 Minutes Marks: 30

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Answer Any Two Questions from Q1 to Q3

1. (a) Represent the numbers $(145)_8$ and $(245)_{10}$ in BCD, and then show the steps necessary to form their sum in BCD. [4]

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- (b) Suppose there is number system with base x . In that number system the following is true.

$$\frac{(144)_x}{(31)_x} = (4)_x$$

$x=8$

Find out the value of x .

[2]

2. For the Boolean function E and F , as given in the following truth table:

X	Y	Z	E	F
0	0	0	1	0
0	0	1	1	0
0	1	0	1	1
0	1	1	0	0
1	0	0	1	0
1	0	1	0	0
1	1	0	0	1
1	1	1	0	1

- (a) List the minterms and the maxterms of each function. [2]
(b) List the minterms of \overline{E} and \overline{F} . [1]
(c) Express E and F in sum-of-minterms algebraic form. [1]
(d) Simplify E and F to expressions with a minimum number of literals. [2]
3. (a) Simplify the following Boolean Expression (using algebraic manipulation) to an expression containing a minimum number of literals. [2]

$$F(W, X, Y, Z) = WX + \overline{W}YZ + \overline{W}XZ + \overline{W}Y\overline{Z} + WXYZ$$

- (b) Convert the following expression into both canonical SOP and canonical POS forms. [4]

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

Answer Any Two Questions from Q4 to Q6

4. Find the optimized sum-of-products (SOP) 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. [3+2+1]

$$F(A, B, C, D) = \sum m(0, 2, 5, 8, 9, 12) + \sum d(1, 4, 10, 11, 14)$$

5. Optimize the following function in i) simplified sum-of-products (SOP) and ii) simplified product-of-sums (POS) form. Between simplified SOP and POS, which one should you implement? Justify your answer. [2.5+2.5+1]

$$F(A, B, C, D) = \sum m(1, 2, 3, 7, 8, 9, 11, 13)$$

6. Optimize the following function using K-map. You have to show your answer in simplified sum-of-products (SOP) form. [6]

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

Answer Any One Question from Q7 to Q8

7. You have to design a combinational circuit named LT6 that will take a 4-bit BCD code as input and give output 1 if the number represented by the code is Less Than 6. You have to (i) Show the truth table (ii) Find the simplified expression for the output bit in Sum-of-Products form considering don't cares (iii) Draw the circuit diagram using basic gates. [3+2+1]

Few example inputs and outputs are given below:

Input : 0001, Output: 1, Reason: $1 < 6$

Input : 0101, Output: 1, Reason: $5 < 6$

Input: 0110, Output: 0, Reason: $6 = 6$

Input: 0111, Output: 0, Reason: $7 > 6$

Input: 1010, Output: x, Reason: 10 isn't BCD, don't care

Input: 1111, Output: x, Reason: 15 isn't BCD, don't care

8. You have to design a combinational circuit named GEO that will take a 4-bit binary number as input and give output 1 if the number of zeroes is Greater than or Equal to number of Ones. You have to (i) Show the truth table (ii) Find the simplified expression for the output bit in Sum-of-Products form (iii) Draw the circuit diagram using basic gates. [3+2+1]

Few example inputs and outputs are given below:

Input: 0001, Output: 1, Reason: 3 zeroes, 1 one, $3 > 1$

Input: 0101, Output: 1, Reason: 2 zeroes, 2 ones, $2=2$

Input: 0111, Output: 0, Reason: 1 zeroes, 3 ones, $1 < 3$

Input: 1111, Output: 0, Reason: 0 zeroes, 4 ones, $0 < 4$