United International University
Department of Computer Science and Engineering
CSE 225 / CSE 1325: Digital Logic Design, Mid Exam, Spring 2020
Total Marks: 30, Time: 1:45 Hours

Section A: Answer all of the questions from Q1 to Q2

1. For the following function: i) Find all the Prime Implicants, ii) Find all the Essential Prime Implicants and iii) Find a simplified expression in Sum of Products. [6]

$$F(A,B,C,D) = \prod M(2,5,9,10,11,15) + \sum d(0,4,8,12)$$

2. For the following function find both minimized Product of Sums expression and Sum of Products expression and decide which one you will prefer and why. [6]

$$F(P,Q,R,S) = (P+\overline{Q}+R).(\overline{P}+\overline{Q}+\overline{R})(\overline{Q}+\overline{S})$$

Section B: Answer any one question from Q3 to Q4

3. You have to design a digital system with 4-bit binary number as input. This system produces an output of 1 if the input is divisible by 3 or 5 and outputs 0 if the input is divisible by 4. For example the circuit outputs 1 if the input is 1010 and outputs 0 if the input is 0100. Find a minimized expression for the output function and draw the logic diagram. [6]

4. Suppose a digital circuit is required that outputs the unsigned difference between two 2-bit binary numbers. So the input of the circuit is 4-bits and the output of this circuit is 2-bits. For example, if the numbers are 01 and 10 the output is 01 regardless of the orders of the numbers in input. Find a minimized expression of the output bits and draw the logic diagram. [6]

Section C: Answer any two questions from Q5 to Q7

5. (a) Perform BCD addition between the following two numbers $(657)_{10}$ and $(789)_{10}$ using their BCD represntation. Show all the necessary steps to get full marks. [2]

   (b) Convert the following number $(513.AE)_{16}$ to a number in base-8. [1.5]

   (c) Convert the number $(101101.1011)_2$ to a decimal number. [1.5]

   (d) There are two numbers, $4022_x = 878_y$. Which is true about x and y and why? [1]

i. $x = y$

ii. $x > y$

iii. $x < y$

6. (a) Convert the following expression into sum of minterms. [2]

$$\mathrm{F(A,B,C)} = \mathrm{AB} + \mathrm{B}C' + \mathrm{CA}$$

(b) Convert the following expression into product of sum(POS) format. [2]

$$\mathrm{F(X,Y,Z)} = X' + \mathrm{X}(\mathrm{X} + Y')(\mathrm{Y} + Z')$$

(c) Determine the (i) Dual and (ii) Complement of the following expression: [2]

$$\mathrm{F(A,B,C,D)} = \mathrm{A}(BC + D)' + \mathrm{C} + \mathrm{AB}C' + 1$$

7. (a) a) Reduce the following Boolean expression to four literals: [3]

$$\mathrm{F(A,B,C,D)} = (\mathrm{AB} + (A + B)')((C + D)' + \mathrm{CD}) + A' + C'$$

(b) Use boolean algebra to minimize the following Boolean expression to a minimum number of literals: [3]

$$\mathrm{F(A,B,C,D)} = (\mathrm{A} + \mathrm{BC})(D' + \mathrm{BC})(A' + D')$$