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Department of Computer Science and Engineering
MIDTERM EXAMINATION Spring 2014

CSE260: Digital Logic Design

Total Marks: 155 **Time Allowed: 2 hours**

- Answer ALL questions

Question No. 1

a) State the range of a ***10 bit 2's complement*** system.

b) Represent +76 and -59 using an ***8 bit 2's complement*** number system.

c) Using the binary numbers found above or otherwise, subtract -59 from -76 using the 2's complement method of subtraction.

d) Using appropriate justifications, comment on whether your answer in part (c) is an overflow or not.

(15 marks)

Question No. 2

a) Simplify the following Boolean functions using Boolean Algebra Simplification:
   i) xyz + xy' + x'yz
   ii) BC + A'C + AB + BCD

(5 x 2 = 10 marks)

b) Perform the following operations in the indicated bases:
   i) 15_{10} x 22_{10} in binary
   ii) $F16CA125_{16}$ - $EFFFFFF_{16}$

(5 x 2 = 10 marks)

c) Write down the equations (A=B, A>B, A<B) for a 6 bit magnitude comparator.

(10 marks)

Question No. 3

a) Construct AND, OR and NOT gates using only NAND gates.

(10 marks)

b) Construct AND, OR and NOT gates using 2:1 MUXes

(10 marks)

c) Use a decoder and encoder pair to construct a full adder.

(5 marks)

d) Use as many full adder blocks as necessary and construct a 4 bit parallel adder.

(5 marks)

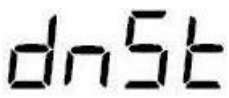
e) Obtain a simplified equation for the following boolean function using Quine McKluskey (Tabulation) Method :

$$F(A,B,C,D) = \sum m(1, 4, 6, 7, 8, 9, 10, 11, 15)$$

(20 marks)

Question No. 4

A company needs to display four letters of the English alphabet using a seven segment display. They have decided to use a 3 variable input, where the **minterms 0,4,6,7** would correspond to each of the output letters (i.e. ***minterm 0*** would give ***d***, ***minterm 4*** would give ***n*** and so on). ***You can assume that there is no output for the rest of the input combinations and can be ignored*****.** The company has decided that the letters should look like the following:



a) Draw a truth table to illustrate how the seven segments of the display would be turned on and off to get the above mentioned output from a 3 variable input.

(5 marks)

b) Using 3 variable Karnaugh-Map method, derive SOP expressions for all of the seven segments.

(20 marks)

Question No. 5

The CSE Department at BRAC University is interested in designing a circuit that will allow them to automate the water dispensing machine in the department. The Chairperson has approved the following specification for the design of the system …

Input (4 variables)

H = 0 indicates the temperature of the hot water compartment is ***within the range***.
C= 0 indicates the temperature of the cold water compartment is ***within the range.***
L = 1 indicates the ***water level*** inside the dispenser is ***adequate.***
F = 1 indicates the ***water filter*** is in ***good condition.***

Output (4 variables)

W = 1 indicates the heater is ***on***.
X = 1 indicates the cooler is ***on***.
Z = 1 indicates ***water in the dispenser is drinkable.***
T = 1 indicates ***the supply tap is open.***

The directors have asked us to consider the following points when designing the system:

1. If the temperature of the hot water compartment is outside the range, the heater should be TURNED OFF.

2. If the temperature of the cold water compartment is outside the range, the cooler should be TURNED OFF.

3. If the water level is ADEQUATE, the supply tap should be TURNED OFF.

4. If the water filter is in GOOD CONDITION, then the water in the dispenser is DRINKABLE.

a) Using the above specification, prepare a truth table for the system.
(15 marks)

b) Using 4 variable Karnaugh-Map method, derive SOP expressions for all of the three outputs.
(20 marks)

THE END