MILITARY COLLEGE OF SIGNALS
MIDTERM EXAM
BESE 16 – B
CE 230 Digital Logic Design

Instructor: A/P Dr. Imran Siddiqi

Time: 90 Minutes
Max Marks: 30

(2+2+3)

Question # 1 – Number Systems and Arithmetic

a. What is the decimal equivalent of 10000111 if it represents
   i. An unsigned binary number
   ii. A signed number in 2's complement form
   iii. A signed number in singed-magnitude form
   iv. A number in BCD (8421)

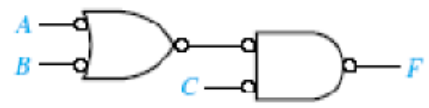
b. Represent the decimal number 37.25 using the following weighted codes.
   i. 6311
   ii. 7321

c. Give short answers to the following
   i. Inserting even parity to the binary number 0101010 gives_____.
   ii. What is the maximum and minimum decimal number that can be represented using *n* bits in signed-magnitude form?
   iii. The 16's complement of C5FA is _____.
   iv. A register with *n* cells can store a number with _____ bits.
   v. Using BCD addition, 8+7 = _____.
   vi. 2421 is a self-complementing code. True/False?

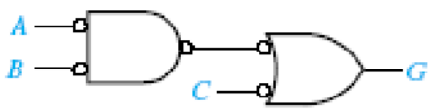
(3+2+3)

Question # 2 – Boolean Algebra

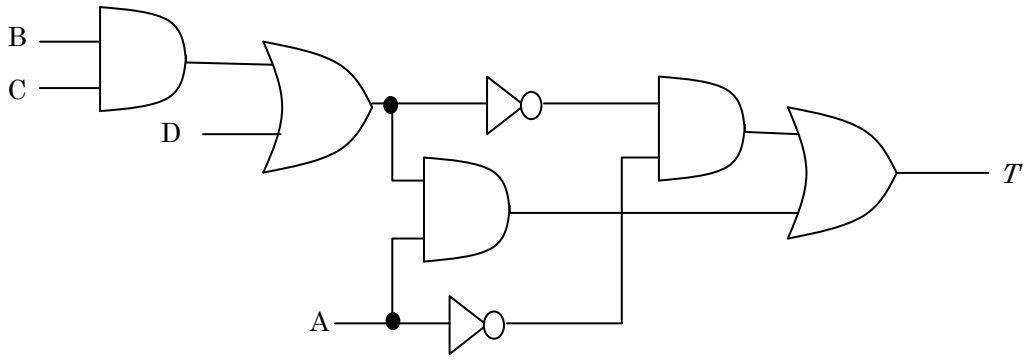
a. Find the Boolean expression for the following circuits.



(i)



(ii)



(iii)

b. Using DeMorgan's law, express the function $F(A,B,C) = \bar{A}BC + A\bar{C} + \bar{A}B$
   i. With only OR & complement operations
   ii. With only AND & complement operations

c. Express the following function as a *sum of minterms* and as a *product of maxterms*.
$$F(A,B,C,D) = \bar{B}D + \bar{A}D + BD$$

(4+3)

Question # 3 – Simplification of Boolean Functions

a. Using 3 variable *K-map*, simplify the following to *sum of products* form.
   i. $F1(X,Y,Z) = XY + \bar{X}Z + YZ$

   ii. $F2(X,Y,Z) = \prod(3,4)$

b. Using 4 variable *K-map*, simplify the following to *product of sums*.
$F(A,B,C,D) = AC\bar{D} + \bar{C}D + A\bar{B} + ABCD$

(3+5)

Question # 4 – Circuit Design

a. In Boolean logic, the *majority function* is a function with *n* inputs and one output. The value of the function is *true* if majority of the input bits are *true* and is *false* otherwise. Show the truth table of *majority function* for *n=3* bits and represent the function as a *product of maxterms*. (You DO NOT need to simplify it).

b. Find a function that detects errors in the representation of a decimal digit in BCD. In other words you need to find a function that gives a value 1 when the inputs are any of the six unused bit combinations in BCD and a value 0 otherwise. Simplify the function using *K-map* and show the circuit diagram of the simplified function.

+++++++ Bon Courage +++++++