

COE 200, Term 042
Fundamentals of Computer Engineering
HW# 4

Q.1. A majority gate is a digital circuit whose output is equal to 1 if the majority of inputs are 1's. The output is 0 otherwise.

- (i) By means of a truth table, find the Boolean function implemented by a 3-input majority gate.
- (ii) Express the 3-input majority gate as a sum of minterms and a product of maxterms.

Q.2. Express the following functions in a sum of minterms and a product of maxterms :

- (i) $F(X,Y,Z) = (XY + Z)(Y + XZ)$
- (ii) $F(A,B,C,D) = D(A' + B) + B'D$
- (iii) $F(A,B,C) = AB + AC + A'B' + B'C'$
- (iv) $F(A,B,C) = (A+B+C)(A'+B')$

Q.3. Find the minterms and maxterms of the complement of the functions specified below:

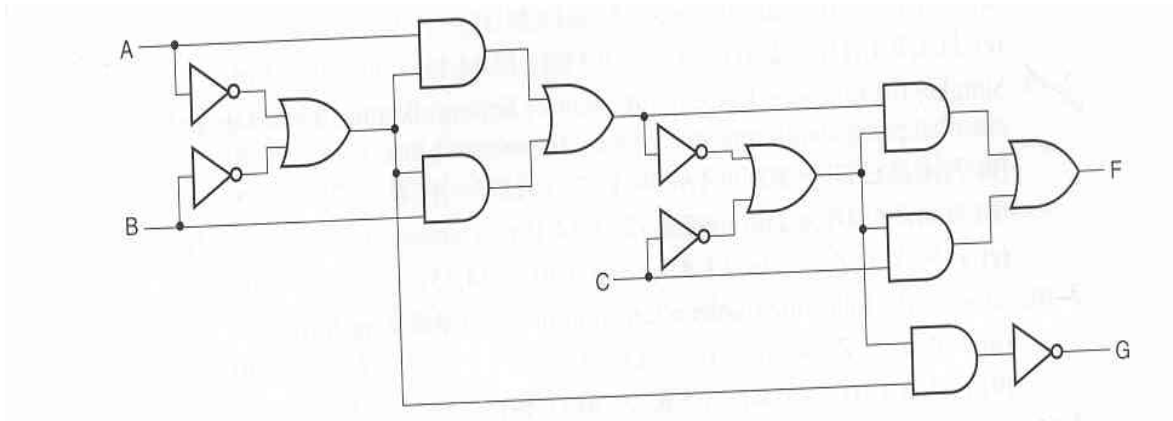
- (i) $F(X,Y,Z) = \sum(0,2,4)$
- (ii) $F(A,B,C,D) = \Pi(1,7,9,13,15)$

Q.4. 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

- (i) List the minterms and the maxterms of each function.
- (ii) List the minterms of E' and F'.
- (iii) List the minterms of E + F and E . F.
- (iv) Express E and F in sum-of-minterms and product-of-maxterms algebraic form.

Q.5. Consider the circuit shown below:



- (i) Assuming that the propagation delay of an INVERTER is 1ns, a 2-input AND gate is 2ns and a 2-input OR gate is 2ns. Compute the largest propagation delay in this circuit and determine the critical path i.e. the path that has the largest propagation delay.
- (ii) Determine the smallest propagation delay in this circuit and the input conditions under which this delay occurs.
- (iii) What is the fanout of the first OR gate in the circuit. What is the smallest and largest fanout in the circuit.
- (iv) Assume that you have initially $A=0$, $B=0$, $C=1$. Draw the timing diagram showing the change in F and G as a result of changing A from 0 to 1 while keeping the assignment of B and C.