Tutorial – 4

Q1. Determine the dual of the following expressions:

(a) $A.B + \overline{A.C} + A.\bar{B}.C$

(b) $\bar{X}.Z + \bar{X}.Y + X.\bar{Y}.Z + Y.Z$

(c) $(A + B + E + F)\,.\,(A + B + \bar{E} + \bar{F})\,.\,(\bar{A} + \bar{B} + E + F)$

(d) $(\bar{X} + Y + Z)\,.\,(X + \bar{Y} + \bar{Z})\,.\,(X + Y + Z).\,(X + Y + \bar{Z})$

Q2. Reduce the following expressions using the Laws of Boolean Algebra:

(a) $f_1 = A[B + \bar{C}\,.\,\overline{(A.B + A.\bar{C})}]$

(b) $f_2 = \overline{(A + \overline{B.C})}\,.\,(A.\bar{B} + A.B.C)$

Q3. Prove the following:

(a) $A\bar{B}C + B + B\bar{D} + AB\bar{D} + \bar{A}C = B + C$

(b) $AB + A\bar{B}C + B\bar{C} = AC + B\bar{C}$

Q4. Prove the following using truth table:

(a) $A + BC = (A + B)(A + C)$

(b) $(A + B)\,.\,\overline{AB} = A \oplus B$

Q5. Design the logic circuit for the following Boolean expression (**use only basic gates – AOI logic**):

$$\overline{AB} + A + \overline{B + C}$$

Q6. Covert the following logic diagram (Fig. 1) to its equivalent Boolean expression (X):

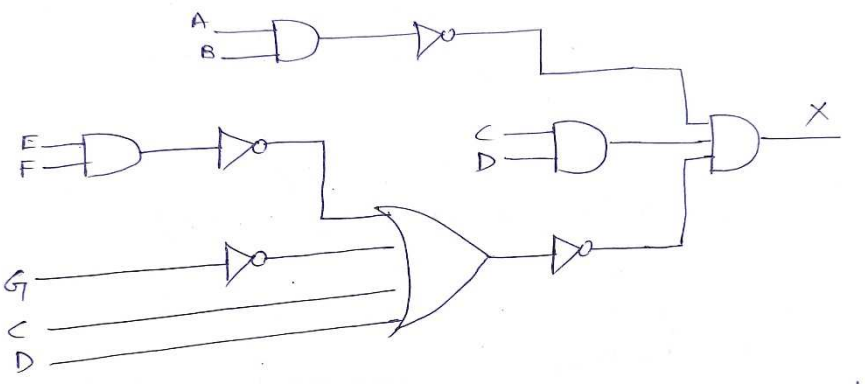

Fig. 1: Logic Diagram with output X

Q7. Reconstruct the following logic diagram (Fig. 2) using universal gates:

(a) Only NAND Gates.

(b) Only NOR Gates.

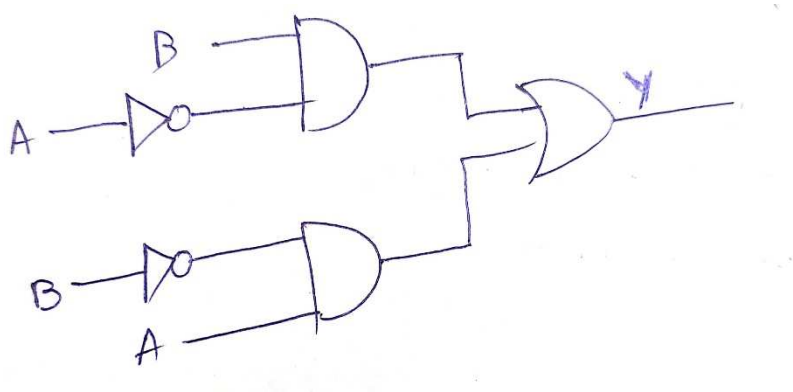

Fig. 2: Logic Diagram with output Y

Q8. Realize the X-OR function for the following scenarios:

(a) Only NAND logic.

(b) Only NOR logic.

Q9. Calculate the number of gate inputs required to realize the following expressions:

(a) $f_1 = ABC + A\bar{B}CD + E\bar{F} + AD$

(b) $f_2 = A(B + C + \bar{D})\,.\,(\bar{B} + C + \bar{E})\,.\,(A + \bar{B} + C + E)$

Also, compute the number of two-input **AND** and **OR** gates required to implement the same.