

Sheet 2 Logic Gates

1. For the Boolean function F given in the truth table, do the following:

- List the minterms of F.
- List the minterms of \bar{F} .
- List the maxterms of F.
- List the maxterms of \bar{F} .
- Obtain the Boolean function of F (as SoP and PoS).
- Obtain the Boolean function of \bar{F} (as SoP and PoS).
- Draw the logic diagram of F.
- Draw the logic diagram of \bar{F} .

a)

L	M	F
0	0	0
0	1	0
1	0	1
1	1	1

b)

A	B	F
0	0	0
0	1	1
1	0	1
1	1	1

e)

W	X	Y	Z	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

c)

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

d)

X	Y	Z	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

2. For the following Boolean function do the following:

- Obtain its truth table.
 - Express the function in sum of minterms.
 - Express the function in product of maxterms.
 - Draw its logic diagram.
- a. $F(A, B, C) = A\bar{B} + CB + \bar{A}\bar{C}$
 - b. $F(X, Y, Z) = XY + YZ + X\bar{Y}Z$
 - c. $F(A, B, C) = (A + \bar{B})(\bar{A} + B)\bar{C}$
 - d. $F(A, B, C) = (A + \bar{B})(\bar{B} + C)$
 - e. $F(A, B, C, D) = ABC + \bar{B}\bar{D} + \bar{A}BD$
 - f. $F(A, B, C, D) = (A + \bar{B})(\bar{C} + D)(\bar{A} + B + D)$
 - g. $F(W, X, Y, Z) = W(X + Y + Z) + X\bar{Y}Z$
 - h. $F(A, B, C, D, E) = A\bar{B} + C\bar{D} + DE$

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3. For the following boolean function do the following:

- Convert it to the other canonical form.
 - Obtain its Boolean function (as SoP and PoS)
 - Draw its logic diagram.
 - Draw its input - output signals.
- a. $F(A,B,C)=\sum_m(2,3,6,7)$
 - b. $F(X,Y,Z)=\sum_m(1,3,5,7)$
 - c. $F(A,B,C,D)=\sum_m(0,1,14)$
 - d. $F(A,B,C,D)=\sum_m(2,3,5,7,8,12,14)$
 - e. $F(X,Y,Z,W,T)=\sum_m(3,10,28,29,30)$
 - f. $F(A,B,C)=\prod_M(1,2,3,6)$
 - g. $F(X,Y,Z)=\prod_M(1,3,4,7)$
 - h. $F(X,Y,Z,W)=\prod_M(3,5,8,9)$
 - i. $F(A,B,C,D)=\prod_M(0,2,3,4,6,10,11)$
 - j. $F(A,B,C,D,E)=\prod_M(3,10,12,17,22,31)$
 - k. $F(X,Y,Z)=X\bar{Y}+XYZ$
 - l. $F(A,B,C)=(\bar{A}+B)(\bar{B}+C)$

4. Using truth table, prove the following using:

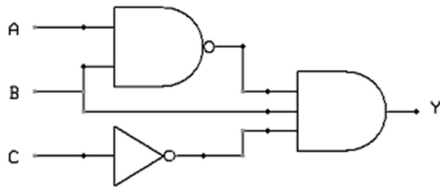
- a. $X(\bar{X}+Y)=XY$
- b. $AB+(\bar{B}+\bar{C})+\bar{A}C=1$
- c. $(X+Y)(\bar{X}+Z)(Y+Z)=(X+Y)(\bar{X}+Z)$
- d. $\bar{X}\bar{Y}Z+\bar{X}Y\bar{Z}+X\bar{Y}Z+XY\bar{Z}=Y\oplus Z$
- e. $XY+XYZ+\bar{X}Z+\bar{X}YZ=XY+\bar{X}Z$
- f. $\overline{\overline{A(A+B)}+\bar{A}B}=A$
- g. $\overline{X(\bar{Y}\bar{Z}+YZ)}=\bar{X}+Y\bar{Z}+\bar{Y}Z$
- h. $(X+Y)(\bar{X}\bar{Z}+Z)(\bar{Y}+XZ)=\bar{X}Y$
- i. $\overline{(\bar{A}B)}+(\bar{A}\bar{B})+\bar{B}=AB$
- j. $\overline{(A+\bar{B}+AB)(AB+\bar{A}C+BC)}=\bar{A}\bar{B}\bar{C}$
- k. $\overline{ABC+\bar{A}\bar{B}+AC}=\bar{A}\bar{B}$
- l. $(B+\bar{C})(\bar{B}+C)+\bar{A}+B+\bar{C}=\bar{B}\oplus\bar{C}+A\bar{B}$
- m. $\overline{AB\bar{C}+\bar{A}B(\bar{A}\bar{B}\bar{C}+(\bar{A}+\bar{B}+C))}=B(A\oplus C)$
- n. $\overline{((\bar{A}+\bar{B}+C)(\bar{A}\bar{B}+\bar{C}\bar{D})+(\bar{A}\bar{C}\bar{D}))}=ACD$
- o. $[(C+\bar{C}D)(C+\bar{C}\bar{D})][AB+\bar{A}\bar{B}+A\oplus B]=C$

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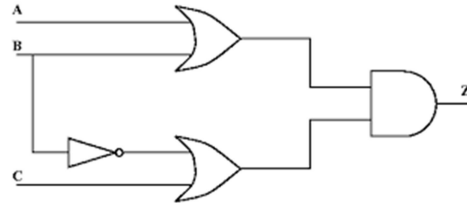
5. For the logic diagram, do the following for the output:

- Obtain the Boolean function
- Obtain the truth table.
- List the minterms.
- List the maxterms.
- Obtain the Boolean function (as SoP and PoS).
- Draw its input - output signals.
- Calculate the propagation delay of the circuit, known the propagation delay of the following gates: NOT gate = 3 nsec
 OR gate = 10 nsec AND gate = 10 nsec NOR gate = 13 nsec
 NAND gate = 13 nsec XOR gate = 20 nsec XNOR gate = 23 nsec

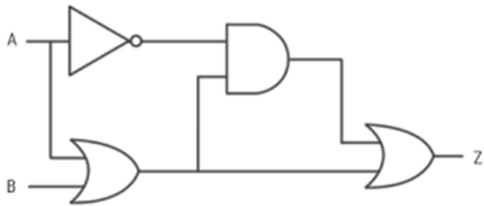
a.



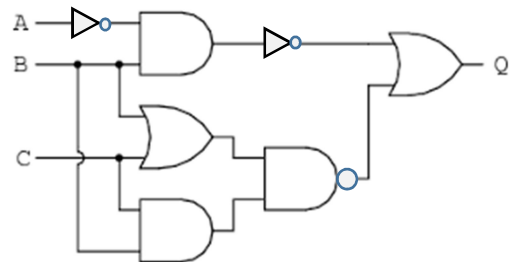
b.



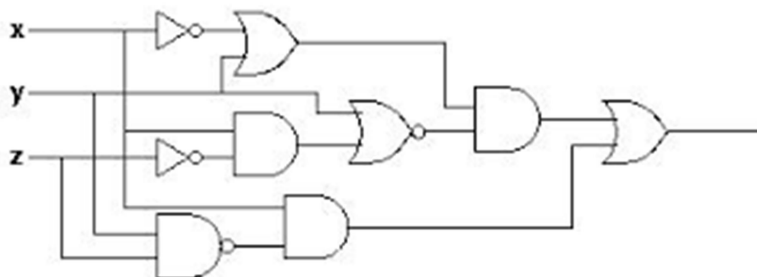
c.



d.

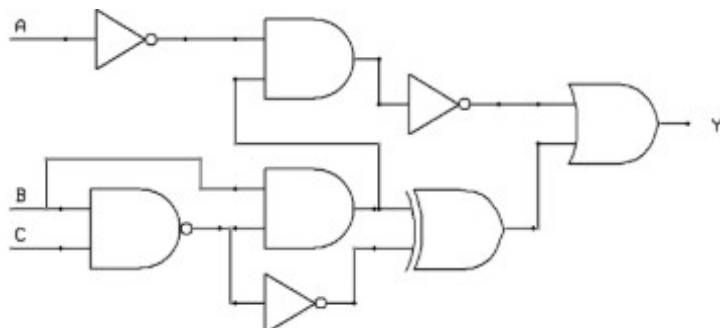


e.



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f.



6. TTL SSI come mostly in 14-pin packages. Two pins are reserved for power and the other 12 pins are used for input and output terminals. Determine the number of gates that can be enclosed in one package if it contains the following type gates:
- Inverters.
 - Buffers.
 - Two inputs AND.
 - Three inputs OR.
 - Four inputs NAND.
 - Five inputs NOR.
 - Six inputs XOR.
 - Seven inputs XNOR.