Digital logic Design (Mid Paper).

ID:

15434

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Subject:-

Digital logic Design

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Department:-

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Q1) Convert each of following.

(a) $(45.25)_{10} = (101101.01)_2$.

Sol:.

2	45
2	22 - 0
2	11 - 1
2	5 - 1
2	2 - 0
	1 - 1

for .25 multiply by 2

$2 \times 0.25 = 0.50$

$0.50 \times 2 = 1.00$.

(b) $10000000.1010_2 = (128.625)_{10}$.

$2^0 \times 0 + 2^1 + 0 + 2^2 \times 0 + 2^3 \times 0 + 2^4 \times 0 + 2^5 \times 0 + 2^6 \times 0 + 2^7 \times 1$

$= 128$.

Now,

$(1010) = 2^{-3} \times 1 + 2^{-2} \times 0 + 2^{-1} \times 1 + 2 \times 0^0$

$=$ ~~8+2~~, 0.625.

as

$(128.625)_{10}$.

(c) $(4D7F)_{16} = (19839.)_{10}$.

A = 10

B = 11

C = 12

D = 13.

$= 4 \times 16^3 + 13 \times 16^2 + 7 \times 16^1 + 15 \times 16^0$

$16,384 + 3,328 + 112 + 16$.

$= (19839)_{10}$

(2)

(d) $(128)_{10} = (80)_{16}$

16	128
16	8 - 0

(e) $(3A6F)_{16} = (11101001101111)_2$

Convert it into decimal first.

$3 \times 16^3 + 10 \times 16^2 + 6 \times 16^1 + 15 \times 16^0$

$= (14959)_{10}$

Now to binary

2	14959
2	7479 - 1
2	3739 - 1
2	1869 - 1
2	934 - 0
2	467 - 1
2	233 - 1
2	116 - 0
2	58 - 0
2	29 - 1
2	14 - 0
2	7 - 1
2	3 - 1
2	1 - 1

$(11101001101111)_2$

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(f) $(1100001111100101)_2 = (C3E5)_{16}$.

Sol:

$2^{15}\cdot 1 + 2^{14}\cdot 1 + 2^{13}\times 0 + 2^{12}\times 0 + 2^{11}\times 0 + 2^{10}\times 0 + 2^{9}\times 1 + 2^{8}\times 1$
$+ 2^{7}\times 1 + 2^{6}\times 1 + 2^{5}\times 1 + 2^{4}\times 0 + 2^{3}\times 0 + 2^{2}\times 1 + 2^{1}\times 0 + 2^{0}\times 1$

$= (50149)_{10}$.

We convert it into decimal, now in hexadecimal.

~~16~~	~~50149~~
~~16~~	~~3134 - 14~~
~~16~~	~~195 - 3~~
~~16~~	~~12 -~~

16	50149
16	3134 - 5
16	195 - E
16	12 - 3

$(C3E5)_{16}$.

(g) $(6173)_8 = (3195)_{10}$.

$6\times 8^3 + 1\times 8^2 + 7\times 8^1 + 3\times 8^0$

$= (3195)_{10}$

(h) $(169)_{10} = (251)_8$.

8	169
8	21 - 1

(4).

(i) $(2A7D)_{16} = (25175)_8$.

$16 \times 2^3 + 16 + 10^2 + 16 \times 7^1 + 13 \times 16^0$

$= (10877)_{10}$.

Convert to decimal first,

Now decimal to octal.

$$\begin{array}{r|l}
8 & 10877 \\ \hline
8 & 1359 - 5 \\
8 & 169 - 7 \\
8 & 21 - 1 \\
8 & 2 - 5
\end{array}$$

(j) $(11111111)_2 = \pm(255)_{10}$.

$2 \times 1^7 + 2 \times 1^6 + 2 \times 1^5 + 2 \times 1^4 + 2 \times 1^3 + 2 \times 1^2 + 2 \times 1^1 + 2 \times 1^0$

$= \pm(255)_{10}$

(K) $(-12)_{10} = (-1100)_2$.

$$\begin{array}{r|l}
2 & 12 \\ \hline
2 & 6 - 0 \\ \hline
2 & 3 - 0 \\ \hline
2 & 1 - 1
\end{array}$$

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(L) $(198) = (001\ 1001\ 1000)$ BCD.

1 9 8

001 1001 1000

(m) $10000\ 111\ 0000_{BCD}$ to $(870)_{10}$

$\underbrace{1000}_{8}\ \underbrace{0111}_{7}\ \underbrace{0000}_{0}$

(n) $(10010100)_{BCD}$ = ~~(1000111001010 1 001011) Gray~~ $(000100111100)_{Gray}$

Sol:

$\underbrace{0001}\ \underbrace{0010}\ \underbrace{1000}$

0001 0011 1100

(o) $(10101111)_{Gray} = (11111000)_2$.

$\underbrace{1010}\ \underbrace{1111}$

1111 1000

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(P) 01000001 = (A)ASCII

By looking from table

(q) (111000) = (? 111000) even parity.

$\boxed{0}$111000

Q2). Calulate each of following

(a) $01111111 - 00000111_2$.

```
  01111111
- 00000111
  01111000   -> (120)10.
```

(b) 01101010 * 11110001

```
          0 1 1 0 1 0 1 0   -> 106
        * 1 1 1 1 0 0 0 1   -> 241
          0 1 1 0 1 0 1 0
        0 0 0 0 0 0 0 0 x
      0 0 0 0 0 0 0 0 x x
    0 0 0 0 0 0 0 0 x x x
  1 0 1 0 1 0 0 1 0 1 x x x x
0 0 0 1 0 1 0 1 0 1 0 x x x x x
1 1 0 0 0 1 1 1 1 0 0 1 0 1 0   -> (25546).
```

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(c) $10001000_2 \div 00100010_2$

$$\begin{array}{r|l} & 4 \\ 34 & 136 \\ & 136 \\ \hline & X \end{array}$$

$$\begin{array}{r|l} & 01000000 \\ \rightarrow 00100010 & 10001000 \\ & 1000100 \\ \hline & X \end{array}$$

(d) $6D_{16} - 3F_{16}$.

Method 3:

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

92 (+1) = 93

C0 +1 = C1

Convert to decimal.

$13 \times 16^0 + 6 \times 16^1 = (109)_{10}$.

$15 \cdot 16^0 + 3 \cdot 16^1 = (63)_{10}$.

$$\begin{array}{r} 109 \\ -\ 63 \\ \hline 46. \end{array}$$

(e) $0010110_{BCD} + 00010101_{BCD} = (31)_{10}$

$\downarrow$ 16 $\quad\quad$ $\downarrow$ 15

$$\begin{array}{r} 0010110 \\ +\ 00010101 \\ \hline 0011001 \end{array}$$

Q3) Apply CRC to data bits 11010011_2 using generator code 1010_2 to produce transmitted CRC code.

Sol:-

D: 11010011

G: 1010.

Since it's four data bits, add four to data byte'

D' = 11010011 $\boxed{0000}$

Now divided D' by G.

```
110100110000
1010
1110
1010
 1000
 1010
  1011
  1010
    1000
    1010
     100.
```

R = 0100, and not 0. So add more 4 zero

110100110100

```
110100110100
1010
 1110
 1010
  1000
  1010
   1011
   1010
   1.8 18
```

Remainder = 0.

Q4) Assume that code produced in Q3 incurs an error in most significant bit during transmission. Apply CRC to detect error

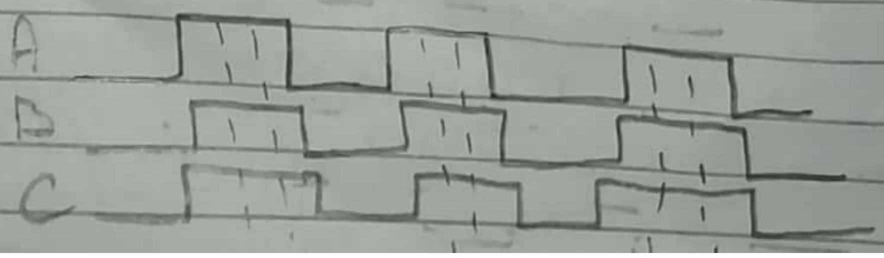
D' : 100100110100.

Apply CRC same process to detect error

```
100100110100
1010
 1100
 1010
  1101
  1010
   1111
   1010
    1010
    1010
      0100
```

Remainder = 0100 since not 0, an error is indicated.

Q5) The input waveforms in fig(1) is applied to a 3-input AND gates. Show output waveform in proper relation with timing diagram.



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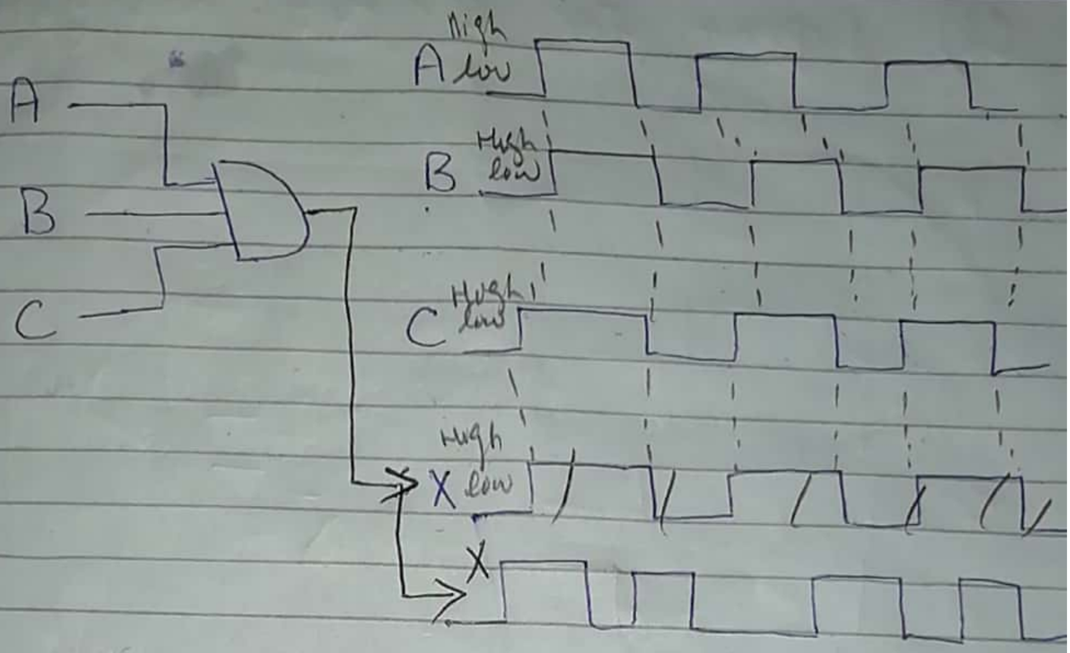
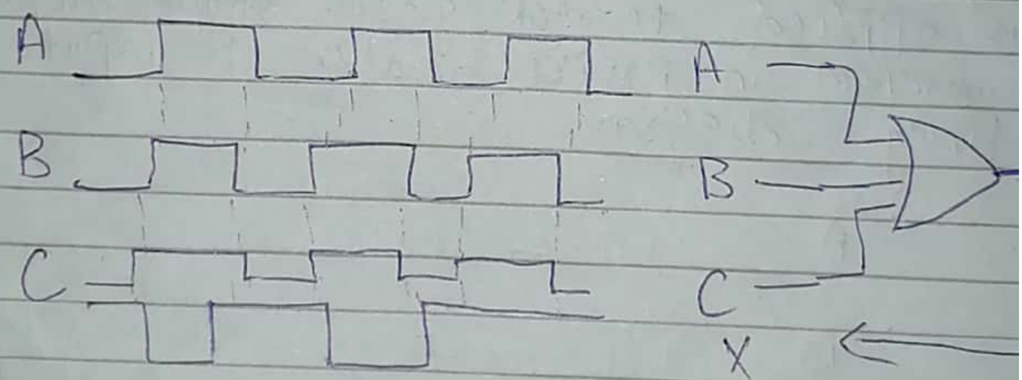
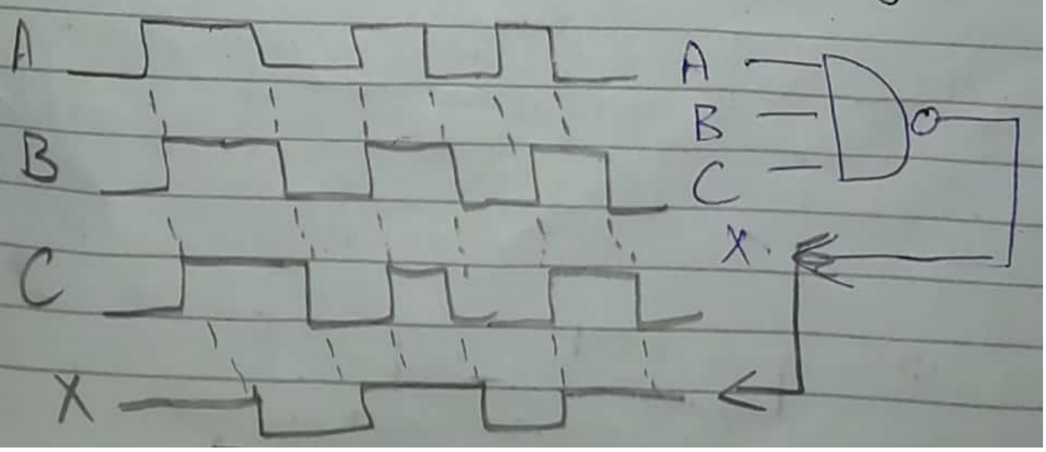


Q6) Repeat for 3 input OR gate.



Q7) Repeat for 3input NAND gate.



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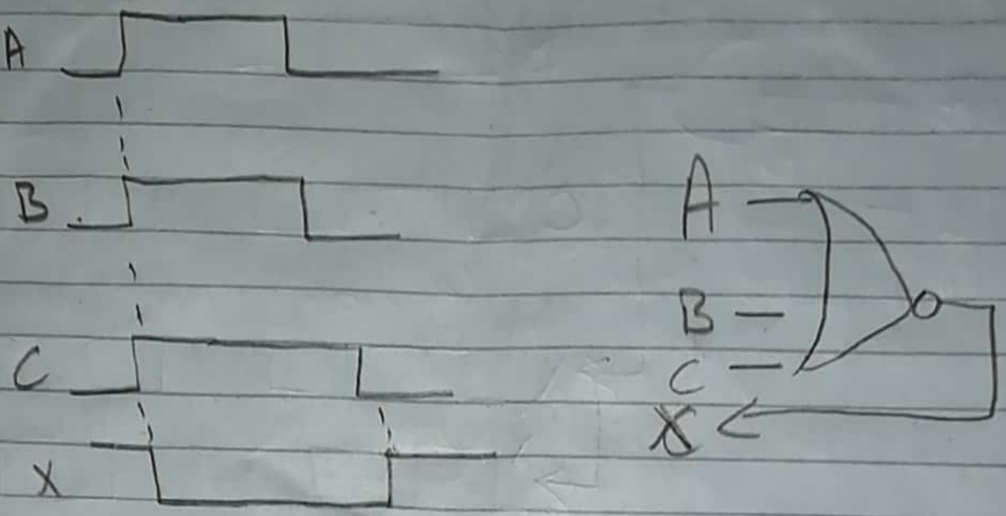
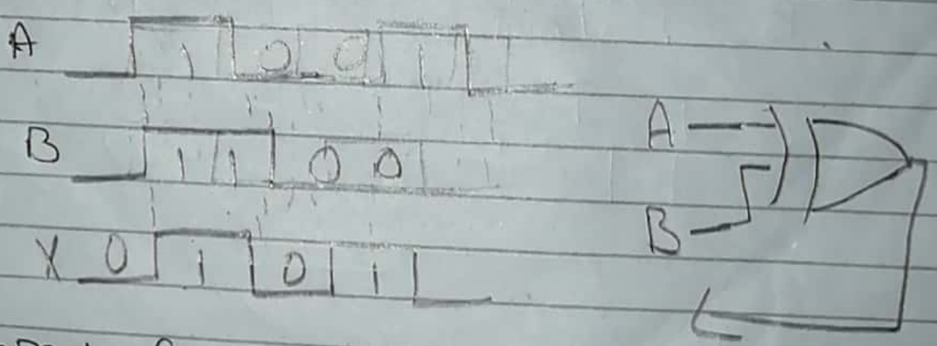
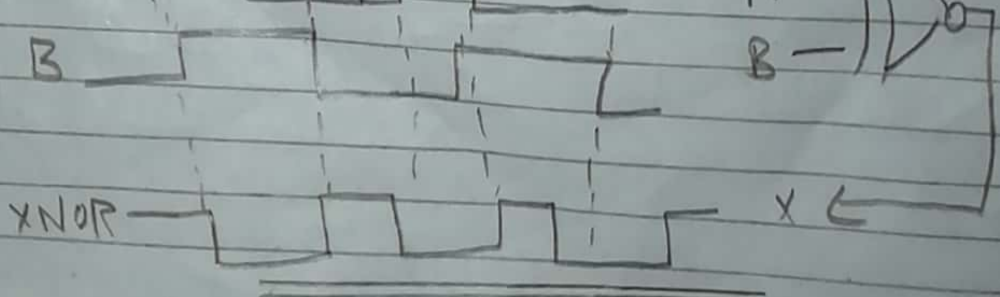
Q8) Repeat for 3 input. NOR gate



Q9) The input waveforms in figure (2) is applied to XOR gate. Show output waveform in proper relation to input with timing diagram.



Q10. Repeat for XNOR.



Q11) Using boolean algebra techniques, simplify following expressions as much as possible.

$$AB + A\bar{B}C + A\bar{B}CD + A\bar{B}CDE$$

Sol:

Using boolean Algebra rules

$$= A\bar{B} + A\bar{B}C + AB\,CD + A\bar{B}CDE$$

$(A + AB = A)$

Work.

$$A\bar{B} + ABCD + ABCDE$$

$A + AB = A$

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

$$A\bar{B}C(1+C)$$

$A+1=1$

$A\bar{B} = (1)$

(AB)

$$AB + A\bar{B}\,CD + AB\,CDE$$

$A + AB = A$

$$A\bar{B} + A\bar{B}\,CDE$$

$A + AB = A$

$(A\bar{B})$ Answer.

Q12) Convert following expressions into standard SOP form.

Sol:

Convert into SOP form.

$$(C+D)(\bar{A}+D)$$

Now distributing

$$= C\bar{A} + CD + D\bar{A} + DD$$

$$= CA + CD + D\bar{A} + DD.$$

Q12) Convert following expressions to standard SOP form $(C + D)(\bar{A} + D)$.

Sol:

Domain of SOP is ACD.

Term CA is missing D.

$CA = CA(D + \bar{D}) = C\bar{A}D + C\bar{A}\bar{D}$

Term CD is missing A.

$CD = CD(A + \bar{A}) = CDA + CD\bar{A}$

Term $D\bar{A}$ is missing C.

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

Term D missing A and C.

$D = D(A + \bar{A}) = DA + D\bar{A}$

DA missing $D\bar{A}$ missing C.

$DA = DA(C + \bar{C}) = DAC + DA\bar{C}$

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

output is.

$(C\bar{A}D + C\bar{A}\bar{D} + CDA + D\bar{A}C)$.

Answer.

Q13) write standard POS expression using standard SOP expression from Q12.

$C\bar{A}D + C\bar{A}D + DA\bar{C} + ACD$

Sol:
Evaluation of POS is.

(101) + (100) + (110) + (111).

domain $2^3 = 8$; possible combinations are 4.

000, 010, 011, 001. POS expression.

$(ACD)(A+\bar{C}+1)(A+\bar{C}+\bar{D})(A+C+\bar{D})$.

Q14) Draw single Truth Table for both POS and SOP expression in Q12 and Q13.

A	C	D	X	POS/SOP
0	0	0	0	$(A+C+D)$
0	0	1	0	$(A+C+\bar{D})$.
0	1	0	0	$(A+\bar{C}+D)$
0	1	1	0	$(A+\bar{C}+\bar{D})$
1	0	0	1	$(A\bar{C}D)$
1	0	1	1	$(A\bar{C}D)$
1	1	0	1	(ACD)
1	1	1	1	ACD

POS expression

$(A+C+D)(A+\bar{C}+D)(A+\bar{C}+\bar{D})+$

$(A+C+D)$

SOP expression.

$(C\bar{A}D) + C(C\bar{A}\bar{D}) + (CDA) + DAC.$

Q15) Use Kanaugh map to simplify following expression to minimum SOP form.

$\bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C}$

000   011   101   110

AB \ C	0	1
00	1	
01		1
11	1	
01		1

$\bar{A}\bar{B}\bar{C}$

$\bar{A}BC$

$(AB\bar{C})$

$(A\bar{B}C).$

$(\bar{A}\bar{B}\bar{C}) + (\bar{A}BC) + (AB\bar{C}) + (A\bar{B}C)$ is minimum SOP.

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Q16). Obtain minimum POS expression from Karanguh map used in Q15.

AB \ C	0	1
00	1	0
01	0	1
11	1	0
10	0	1

$(A + B + \bar{C})$

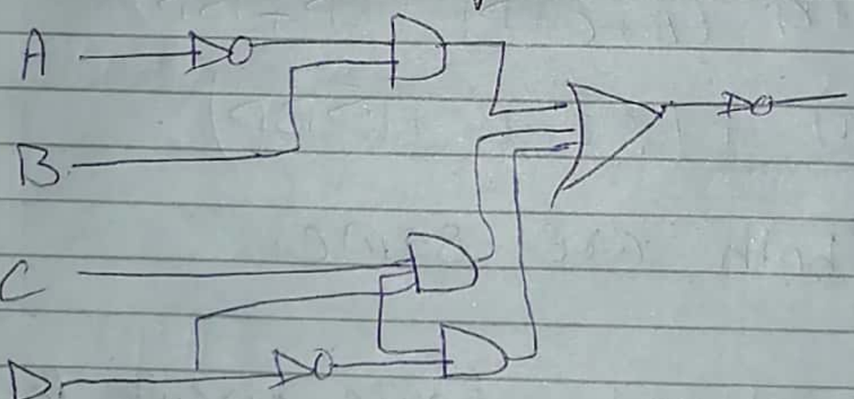
$(A + \bar{B} + C)$

$A + B + \bar{C})$

$\bar{A} + B + C)$

Since $(A + B + \bar{C})(A + \bar{B} + C)(A + B + \bar{C})(A + B + C)$ is minimum POS expression.

Q17) write output expression for circuit in figure



$X = (\bar{A}B) + (\bar{A}CD) + (BD\bar{D})$

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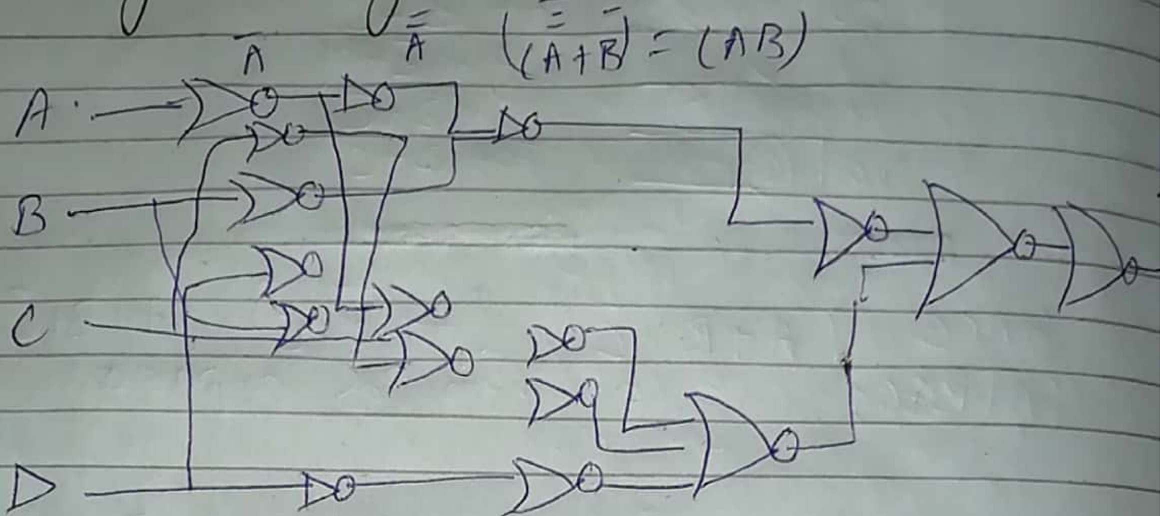
Q18). Implement logic circuit only NOR gates.



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

$= (\bar{A}B) + (\bar{A}CD) + (\bar{D}BD)$

Q19) both are same

Q20). Implement logic circuit for Truth Table 1.

Sol:
we obtained from Truth Table is

$(\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}CD) + (\bar{A}BC\bar{D}) + (\bar{A}\bar{B}C\bar{D}) +$
$(A\bar{B}\bar{C}D) + (A\bar{B}CD) + (\bar{B}CD) + (ABC)D$

using the boolean law,

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