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Semester : 3rd

Exam : Mid Assignment

Subject : DLD

Q1/ Convert each of the following:

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

For the whole decimal number, repeated division by 2 will be used.

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

Now for the frictional part, we will use repeated multiplication by 2.

$0.25 \times 2 = 0.50$ — 0

$0.50 \times 2 = 1.00$ — 1.

hence,

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

Answer.

b/ $10000000.1010_2 = (?)_{10}$

We will use weighted notation to convert the given binary to decimal number.

$= 1\times2^7 + 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3} + 0\times2^{-4}$

$= 1\times128 + 0.5 + 0.125$

$= (128.625)_{10}$

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

Answer

c/ $4D7F_{16} = (?)_{10}$

Using weighted notation.

$= 4\times16^3 + 13\times16^2 + 7\times16^1 + 15\times16^0$

$= 16384 + 3328 + 112 + 15$

$= (19839)_{10}$

Answer

d/ $128_{10} = (?)_{16}$.

Using repeated division by 16.

16	128	
16	8	0

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

Answer

e/ $3A6F_{16} = (?)_2$

Using Hexa-Binary table

3	A	6	F
0011	1010	0110	1111

So,

$\{ \cancel{(3A6F)_{16} = (1110101101111}) \}$ X

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

Answer

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

making groups of four

$\underline{1100}\ \underline{0011}\ \underline{1110}\ \underline{0101}$

C 3 E 5

so,

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

Ans

Q. $6173_8 = (?)_{10}$

Using weighted notation

$= 6\times8^3 + 1\times8^2 + 7\times8^1 + 3\times8^0$

$= 3072 + 64 + 56 + 3$

$= (3195)_{10}$

so,

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

Answer.

h, $169_{10} = (?)_8$

Using repeated division by 8.

$$\begin{array}{c|ll} 8 & 169 & \\ \hline 8 & 21 & 1 \\ \hline & 2 & 5 \end{array}$$

so,

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

Ans

i, $2A7D_{16} = (?)_8$

First we will convert it to binary with the help of table.

2	A	7	D
0010	1010	0111	1101

now convert the binary number to octal by making groups of 3

$$\underbrace{000}_{0}\ \underbrace{010}_{2}\underbrace{101}_{5}\ \underbrace{001}_{1}\ \underbrace{111}_{7}\ \underbrace{101}_{5}$$

so,

$(2A7D)_{16} = (25175)_8$ Ans//

J/ $11111111_2 = \pm(?)_{10}$

Using weighted notation of magnitude bits.

$= 1\times2^6 + 1\times2^5 + 1\times2^4 + 1\times2^3 + 1\times2^2 + 1\times2^1 + 1\times2^0$

$= 64 + 32 + 16 + 8 + 4 + 2 + 1$

$= (127)_{10}$

So, the sign-bit is 1.

hence

$(11111111)_2 = (-127)_{10}$

Ans

K/ $-12_{10} = (?)_2$

Using repeated division.

2	12	
2	6	0
2	3	0
	1	1

$(12)_{10} = (1100)_2$ or $(00001100)_2$

Now taking 2's complement of obtained number

$$\begin{array}{r} 00001100 \\ \hline 11110011 \\ +\quad\quad\quad 1 \\ \hline 11110100 \end{array}$$

1's complement

2's complement.

so

$(-12)_{10} = (11110100)_2$

Ans

Q. $198_{10} = (?)_{BCD}$

Using Decimal - BCD table.

1	9	8
0001	1001	1000

so

$(198)_{10} = (000110011000)_{BCD}$.

Ans

M/ $1000011100000_{BCD} = (?)_{10}$

Using BCD- Decimal table

1000	0111	0000
8	7	0

so

$(100000011100000)_{BCD} = (870)_{10}$

Ans

n/ $(1001010)_2 = (?)_{Gray}$.

Solution:

$$
\begin{array}{ccccccc}
1 \rightarrow & +0 \rightarrow & +0 \rightarrow & +1 \rightarrow & +0 \rightarrow & +1 \rightarrow & +0 \\
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
1 & 1 & 0 & 1 & 1 & 1 & 1
\end{array}
$$

$(1001010)_2 = (1101111)_{Gray}$.

Ans

O. $(10101111)_{Gray} = (?)_2$

Sol:

$$\begin{array}{cccccccc} 1 & 0 & 1 & 0 & 1 & 1 & 1 & 1 \\ \downarrow & + & + & + & + & + & + & + \\ 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \end{array}$$

so

$(10101111)_{Gray} = (11001010)_2$

Ans

P. $01000001 = (?)_{ASCII}$

Using ASCII table

$= 1 \times 2^6 + 1 \times 2^0$

$= 64 + 1$

$= 65_{(10)}$.

$(64)_{10} = (A)_{ASCII}$.

Ans

Q! $111000 = (?111000)_{\text{Even parity}}$.

Since in an even parity there should be even amount of 1's, so we add 1 to the given number.

$= (1111000)_{\text{Even parity}}$

Ans

Q2. Calculate each of the following:

a. $01111111_2 - 00000111_2$

Taking 2's complement on

$$
\begin{array}{r l}
00000111 & \\
\hline
11111000 & \text{1's complement} \\
+ \qquad\quad 1 & \text{2's complement.} \\
\hline
11111001 &
\end{array}
$$

Now,

$$
\begin{array}{r}
01111111 \\
+\ 11111001 \\
\hline
101111000
\end{array}
$$

discarded bit

so,

$(01111000)_2$

Answer

b/ $0110101O_2 \times 11110001_2$.

Using 2's complement.

11110001

00001110   1's complement.

       1   2's complement.

00001111

Now,

```
          00001111
          01101010
          --------
          00000000
         00001111x
        00000000xx
       00001111xxx
      00000000xxxx
     00001111xxxxx
    00001111xxxxxx
   00000000xxxxxxx
   ---------------
   000011000110110
```

so,

$(11000110110)_2$

Ans

c) $1001000_2 \div 00100010_2$

Quotient = 0000000

Using 2's complement.

$$
\begin{array}{r}
\underline{00100010} \\
1101101 \\
\underline{1} \\
1101110
\end{array}
$$

1's complement

2's complement.

Now,

$$
\begin{array}{r}
1001000 \\
+\ \underline{1101110} \\
1\ 0110110
\end{array}
$$

discarded bit

Adding 1 to the quotient.

so, 0000001

Subtracting divisor from 1st remainder using 2's complement.

$$
\begin{array}{r}
0110110 \\
+\ \underline{1101110} \\
1\ 0100100
\end{array}
$$

discard

Adding 1 to the quotient = 00000010

Again

$$\begin{array}{r} 01000100 \\ +\ 11011110 \\ \hline \end{array}$$

Discard ← 1 00100010

Adding 1 to quotient

= 00000011

Now again

$$\begin{array}{r} 00100010 \\ +\ 11011110 \\ \hline \end{array}$$

discard ← 1 00000000

Adding 1 to quotient
= 00000100

Answer.

d: $6D_{16} - 3F_{16}$.

First converting both hex numbers to binary numbers.

3	F
0011	1111

now,

6	D
0110	1001

$(6D)_{16} = (01101001)_2$

Taking 2's complement of 3F.

$$\begin{array}{r l} 00111111 & \\ \hline 11000000 & \text{1's complement} \\ 1 & \text{2's complement} \\ \hline 11000001 & \end{array}$$

1100	0001
e	1

$$\begin{array}{r} 6D \\ + \; e1 \\ \hline 12E \end{array}$$

80

= 12E Answer

e.g. $00010110_{BCD} + 00010101_{BCD} = (?)_{10}$.

$$
\begin{array}{r}
0001\ 0110 \\
0001\ 0101 \\
\hline
0010\ 1010
\end{array}
$$

invalid due to (>9).

Add 6 to the invalid code.

$$
\begin{array}{r}
0010\ 1010 \\
+ \qquad 0110 \\
\hline
0011\ 0001
\end{array}
$$

$$
\underbrace{0011}_{3} \quad \underbrace{0001}_{1}
$$

Ans

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

D: 11010011

G: 1010

since, the generator code has four data bits, add four 0's to the data byte. The appended data is

$D' = 110100110000$

Divide the appended data by the generator code using the modulo-2 operation until all bits are used.

$$\frac{D'}{G} = \frac{110100110000}{1010}$$

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

P-T-O.

Remainder = 0100. Since the remainder is not 0, append the data with the four remainder bits. Then divide by the generator code. The transmitted CRC is 110100110100.

```
110100110100
1010
----
 1110
 1010
 ----
  1000
  1010
  ----
   1011
   1010
   ----
      1010
      1010
      ----
        00
```

Remainder = 0.

110100110100 is CRC code.

Ans

Q4 Assume that the code produced in problem Q.3 incurs an error in the most significant bit during transmission. Apply CRC to detect error.

D' = 010100110100

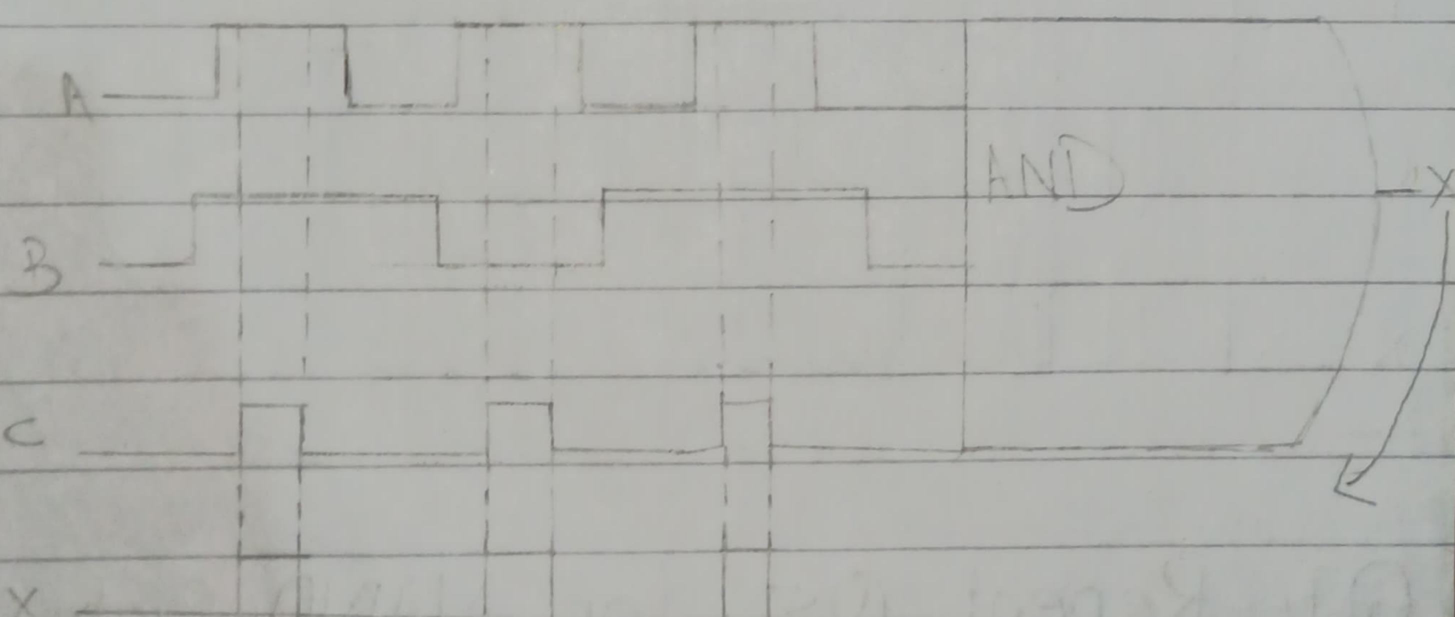
G = 1010

```
010100110100
1010
----
1111
1010
----
01010
  1010
---------
000000110
      1010
      ----
      1100
      1010
      ----
      01101
        1010
       -----
       01110
         1010
        -----
        01000
          1010
        ------
          0010
```

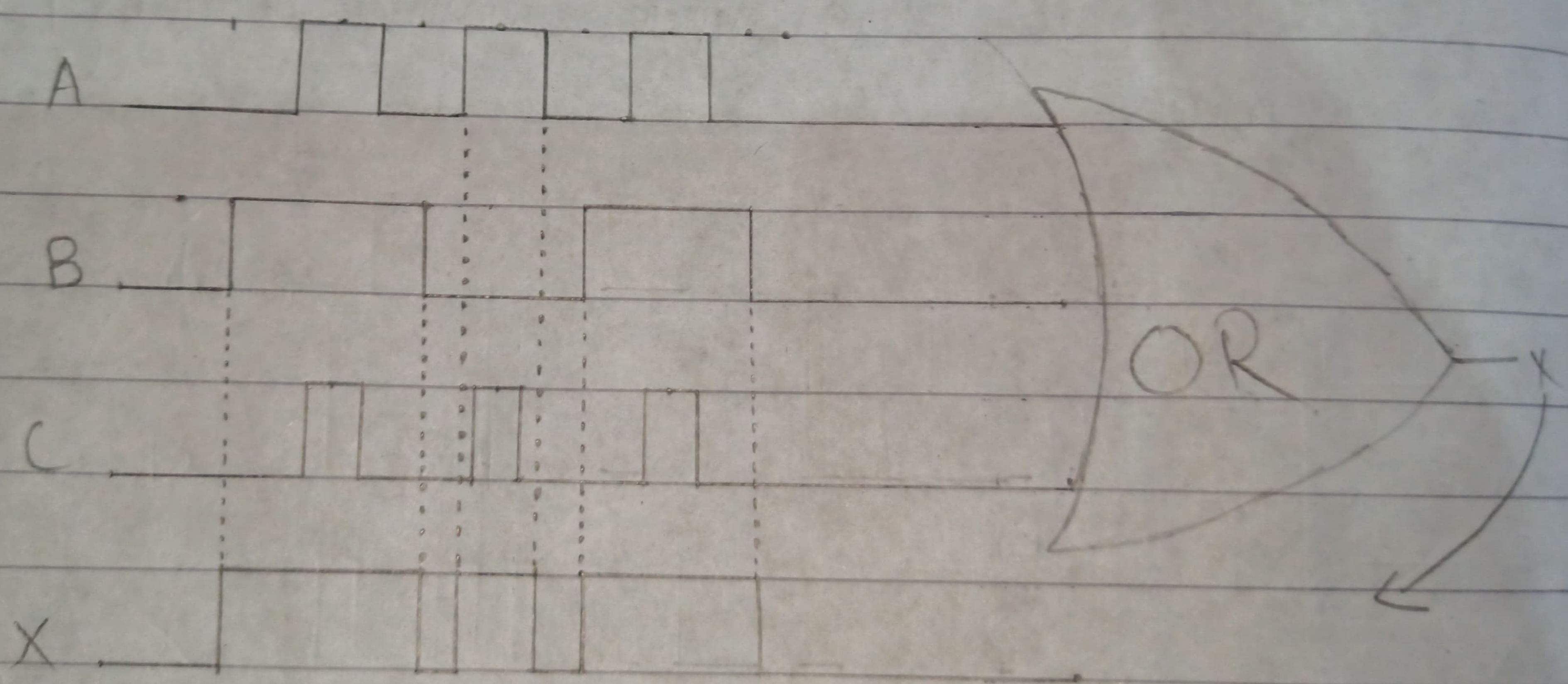
Remainder $\neq 0$

hence, Error ( ) is detected.

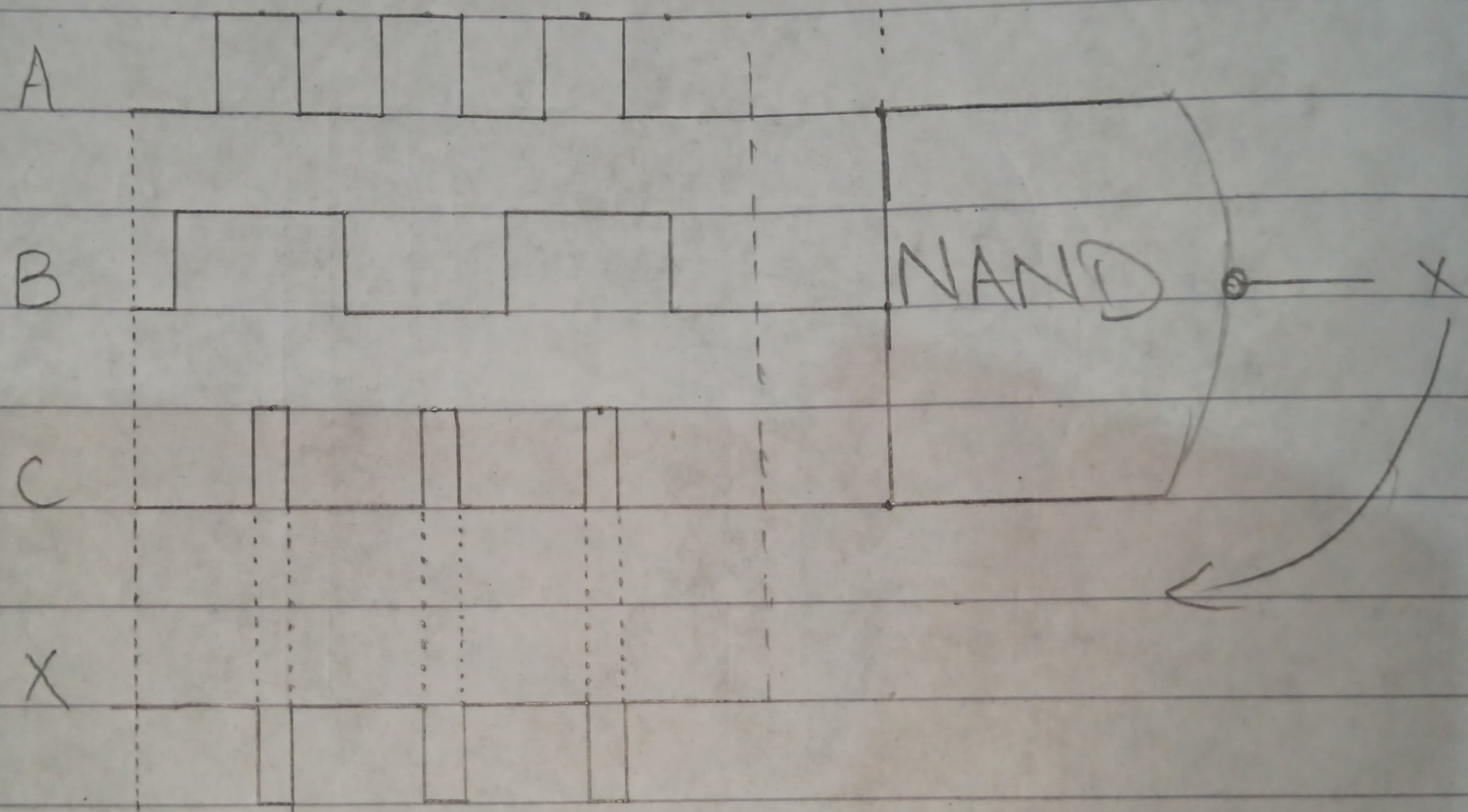
Q5. The input waveforms in Fig 1 is applied to a 3-input AND gate. Show the output waveform in proper relation to the inputs within a timing diagram.



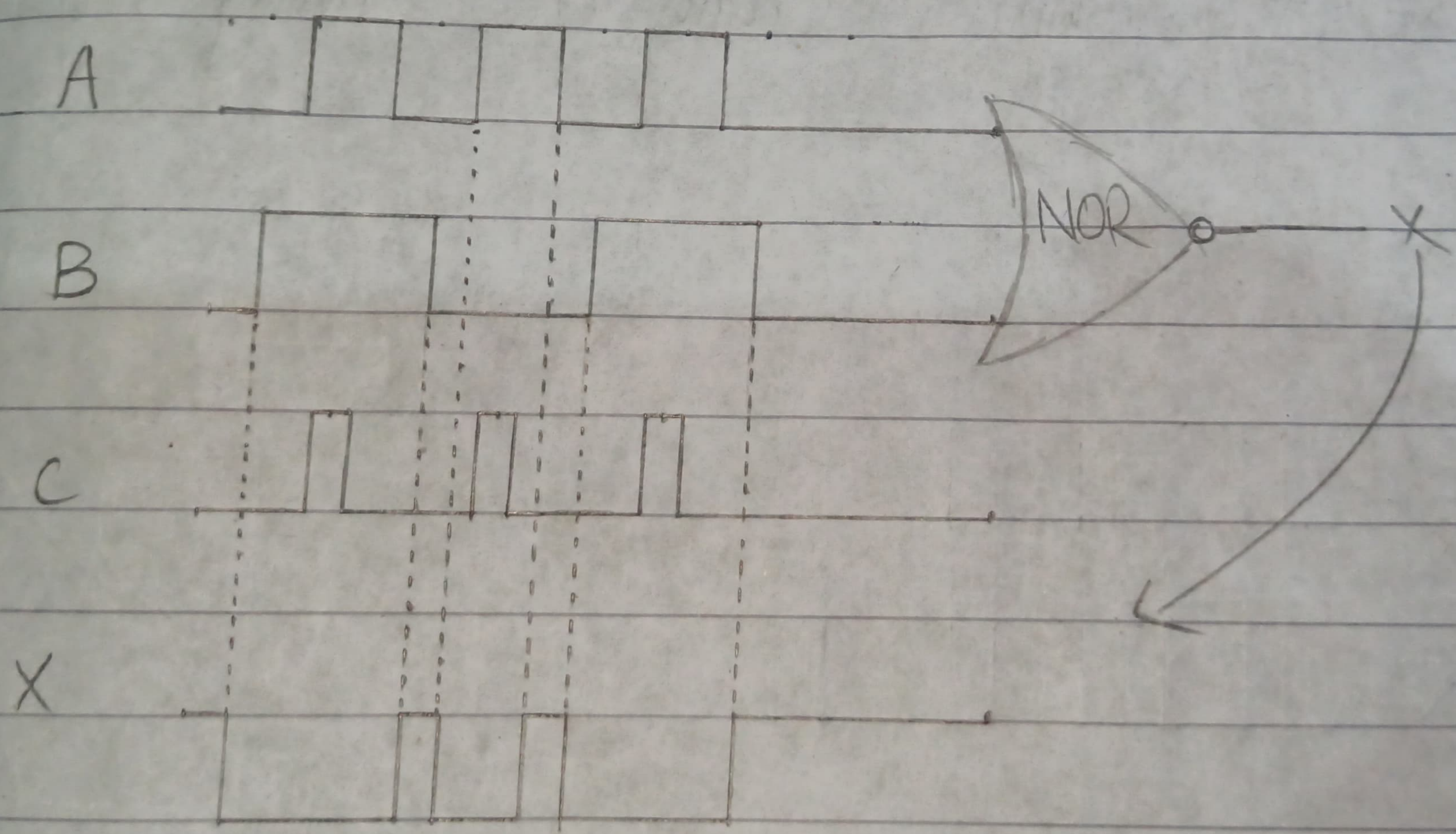
Q6: Repeat Q.5 for a 3-input OR gate.



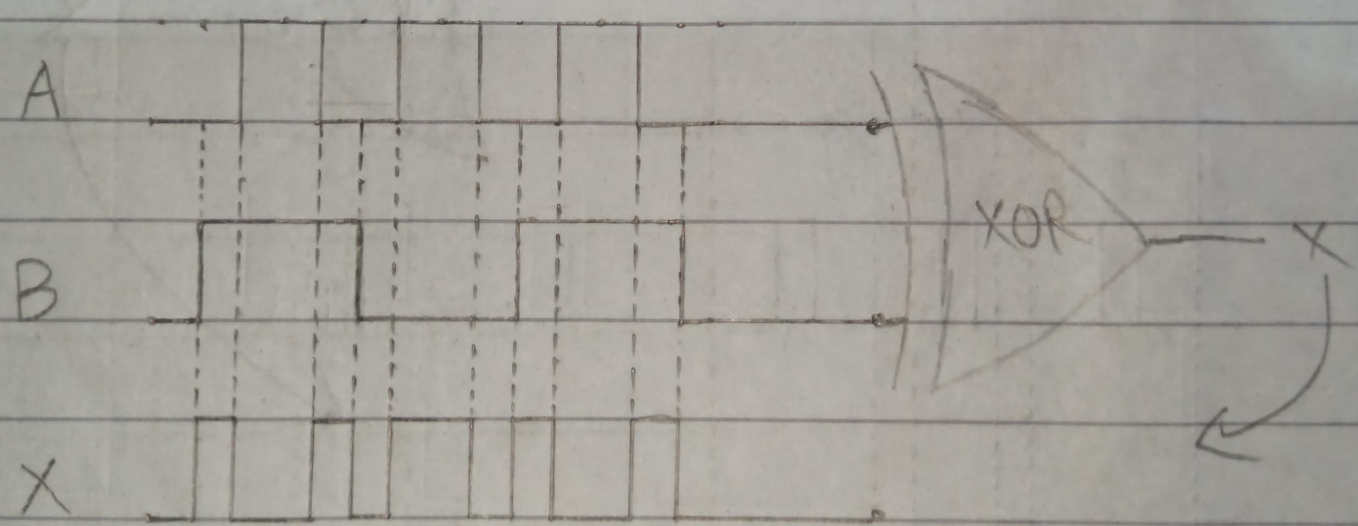
Q7/ Repeat Q.5, for NAND Gate.



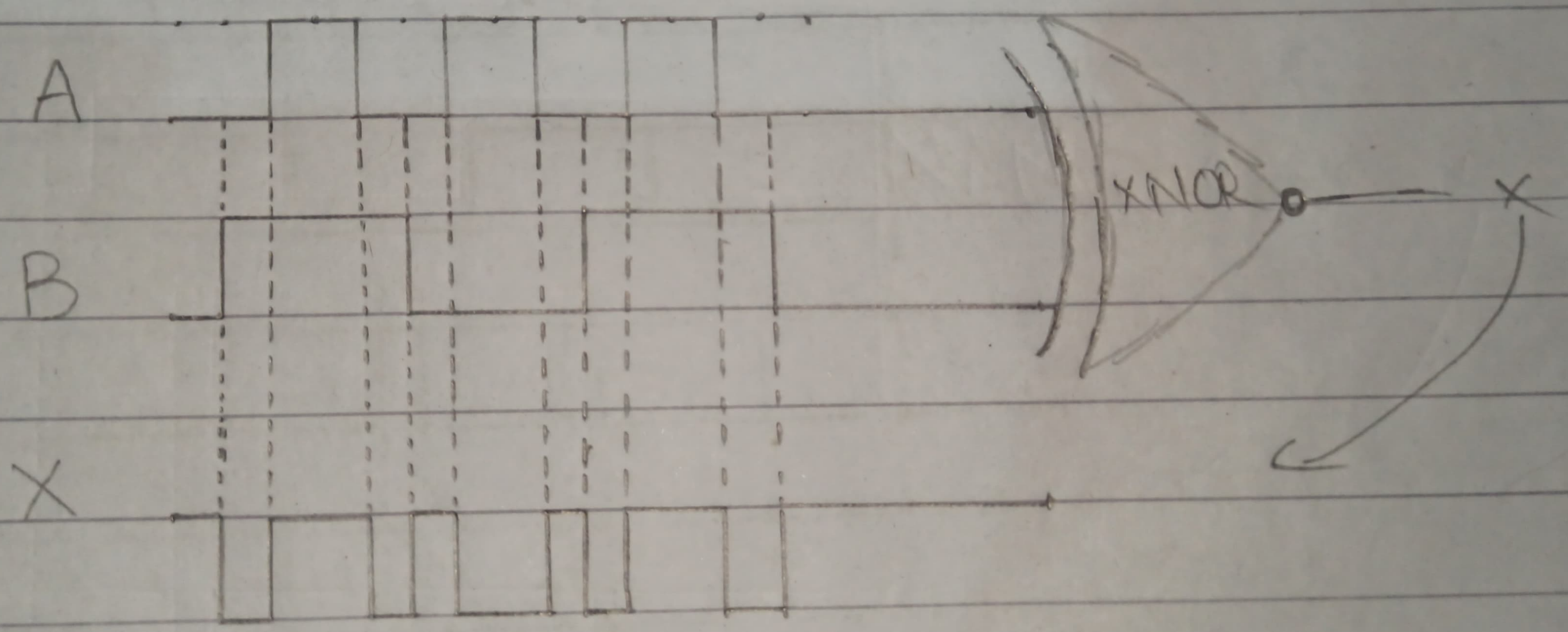
Q8/ Repeat Q.5, for NOR Gate.



Q9, The input waveforms in Fig 9 is applied to a XOR gate. Show the output waveform in proper relation to the inputs with a timing diagram.



Q10, Repeat Q.9 for XNOR gate.



Q11. Using Boolean algebra techniques, simplify the following expressions as much as possible.

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

Using Boolean Algebra Rules:

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

$= A\bar{B} + A\bar{B}CD + A\bar{B}CDE$

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

$= A\bar{B}$

Ans

RAF Work

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

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

$A+1=1$

$A\bar{B}(1)$

$(A\bar{B})$

Q12: Convert the following expressions to standard SOP forms: $(C+D)(\bar{A}+D)$

First convert the given expression to SOP form

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

Distributing.

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

Domain of this SOP is ACD

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

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

Term CD is missing A

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

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

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

Term DD is missing A & C.

$\Rightarrow DD = DD(A+\bar{A}) = DDA + DD\bar{A}$

Term DDA & $DD\bar{A}$ is missing C

$\Rightarrow DDA = DDA(C+\bar{C}) = DDAC + DDA\bar{C}$

$\Rightarrow DD\bar{A} = DD\bar{A}(C+\bar{C}) = DD\bar{A}C + DD\bar{A}\bar{C}$

hence resulting SOP form is:

$(C\bar{A}D + C\bar{A}\bar{D} + CDA + CD\bar{A} + D\bar{A}C + D\bar{A}\bar{C} + DDAC + DDA\bar{C} + DD\bar{A}C + DD\bar{A}\bar{C})$.

Ans

Q13. Wrtie the standard POS expression using the standard ~~the~~ SOP expression obtained in Q.12.

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

Evolution of the POS expression is

$$(101)+(100)+(110)+(111)$$

In the domain of this expression there are three variables, there are $2^3=8$ possible combinations. Four of which are contained by this expression the rest are:

000, 010, 011, 001

hence, the equivalent POS expression is

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

Q14/ Draw a single truth for both the standard POS and SOP expression obtained in Q.12 & Q.13.

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	$(A\bar{C}\bar{D})$
1	0	1	1	$(A\bar{C}D)$
1	1	0	1	$(AC\bar{D})$
1	1	1	1	(ACD)

POS Expression:

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

SOP Expression:

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

Q15. Use a karnaugh map to simplify the following expressions to a 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		$\rightarrow (\bar{A}\bar{B}\bar{C})$
01		1	$\rightarrow (\bar{A}BC)$
11	1		$\rightarrow (AB\bar{C})$
10		1	$\rightarrow (A\bar{B}C)$

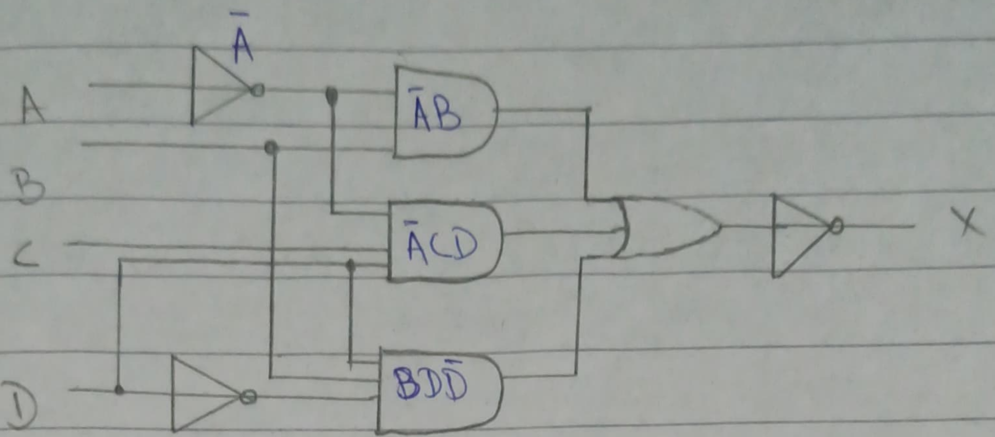
$(\bar{A}\bar{B}\bar{C}) + (\bar{A}BC) + (AB\bar{C}) + (A\bar{B}C)$ is the minimum SOP.

Q16. Obtain the minimum POS expression from the karnaugh map used in Q.15.

AB \ C	0	1	
00	1	0	$\rightarrow (A+B+\bar{C})$
01	0	1	$\rightarrow (A+\bar{B}+C)$
11	1	0	$\rightarrow (A+B+\bar{C})$
10	0	1	$\rightarrow (\bar{A}+B+C)$

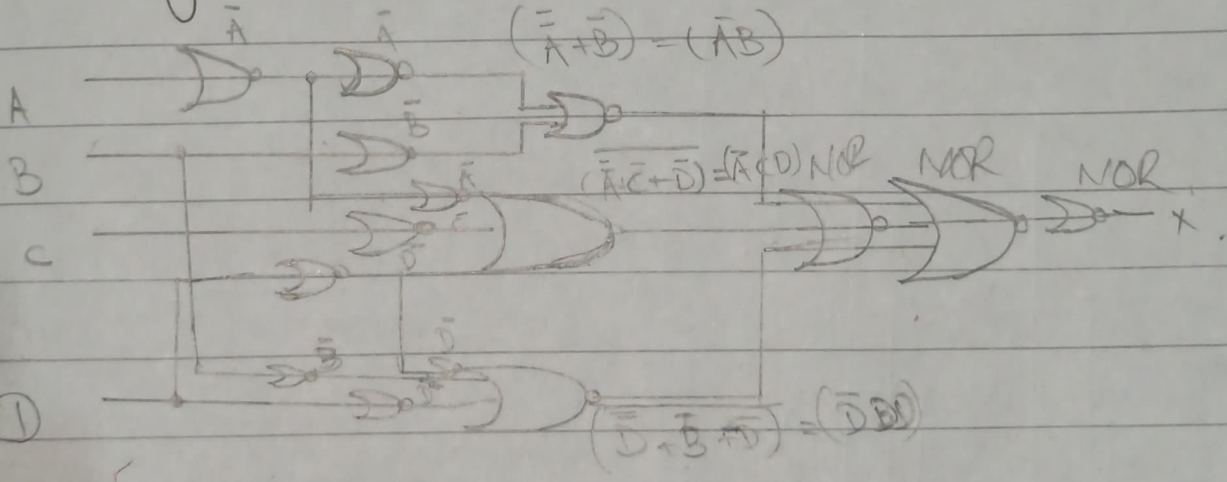
$(A+B+\bar{C})(A+\bar{B}+C)(A+B+\bar{C})(\bar{A}+B+C)$ is the minimum POS expression.

Q17, Write the output expression for circuit in Figure 3.



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

Q18, Implement the logic circuits in Fig3 using only NOR gates.



$$x = \overline{(\bar{A}+B)}\cdot\overline{(\bar{\bar{A}}+\bar{C}+\bar{D})}\,\overline{(\bar{\bar{D}}+\bar{B}+\bar{D})} = (\bar{A}B)+(\bar{A}CD)+(\bar{D}BD)$$

Ans

Q.19 is also the same X.. Solved on the last page.

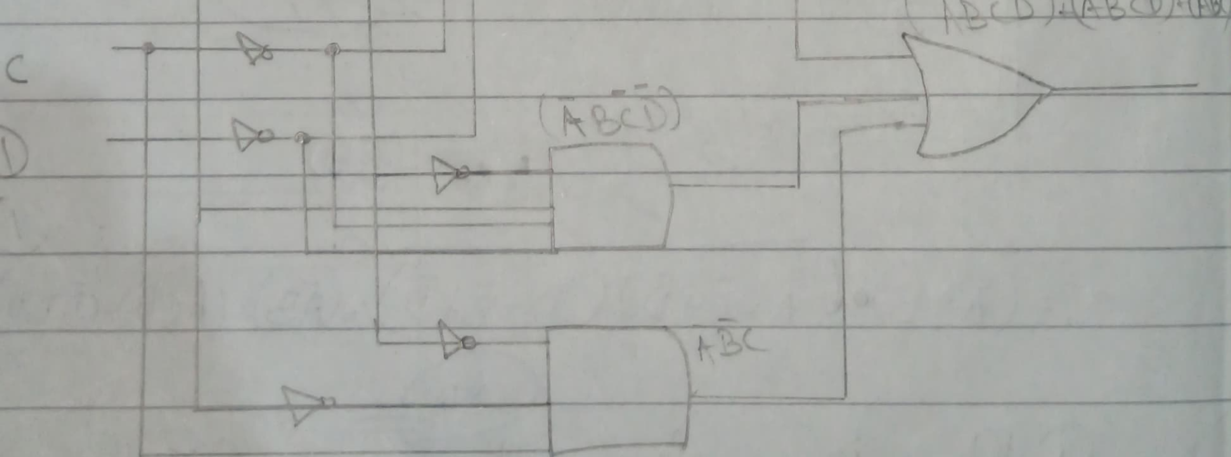
Q20. Implement a logic circuit for the truth table in Table 1.

Obtained expression from the truth table is

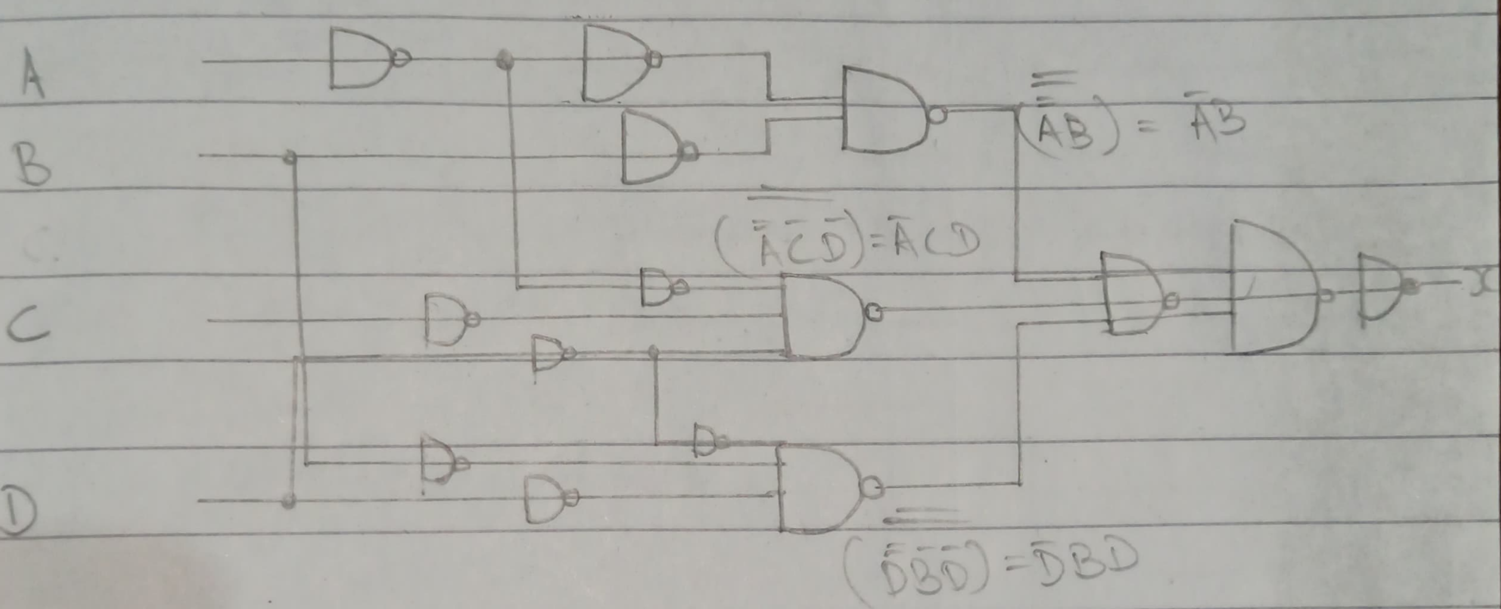
$$(\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}CD) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}D) + (A\bar{B}C\bar{D}) +$$
$$(A\bar{B}CD) + (ABCD).$$

By reducing the expression using boolean laws and rules we get

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



Q19. Implement the logic circuits in Fig 3 using only NAND gates.



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