Date: 20-Aug-20

DATA LOGIC & DESIGN
(Mid Term Major Assignment)

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Date :- 20th-Aug-2020
Subject :- Data Logic & Design

Q1: Convert each of the following.

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

Solution:

Base 10 to base 2 conversion:

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

So $45_{10} = (101101)_2$

Now Remainder in -ive

2	0.25	0.
2	5	0
2	2	1
	1	

So;

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

D.L.D (Major Assignment)

Date: 20th Aug

Q1 (b) $10000000.1010_2 = (128.625)_{10}$

Solution:-

$$10000000.1010_2 = 1(2)^7+0(2)^6+0(2)^5+0(2)^4+0(2)^3+0(2)^2+0(2)^1+0(2)^0+1(2)^{-1}+0(2)^{-2}+1(2)^{-3}+0(2)^{-4}$$

$$= 128+0+0+0+0+0+0+0+0.5+0+0.125+0 = \boxed{128.625_{10}}$$ Ans

Q1 (c) $(4D7F)_{16} = (19839)_{10}$

Solution:

$$4D7F_{16} = 4(16)^3+13(16)^2+7(16)^1+15(16)^0$$

$$= 16384+3328+112+15 = \boxed{(19839)_{10}}$$ Ans

Q1 (d) $(128)_{10} = (80)_{16}$

Solution:

		Remainder
16	128	0
	8	

$(128)_{10} = \boxed{80_{16}}$ Ans

ID: 12290

Date 20th Aug-20

DLD (Major Assignment)

(e) $(3A6F)_{16} = (1110100110111)_2$

Solution:-

Step 1 = Conversion do decimal

$(3A6F)_{16} = 3(16)^3 + 10(16)^2 + 6(16)^1 + 15(16)^0$

$= 12288 + 2560 + 96 + 15 = (14959)_{10}$

Step 2= Conversion do binary

		Remainder	
2	14959	1	<
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	
	1		

So

$(3A6F)_{16} = (1110100110111)_2$

DLD (Major Assignment)

Date: 20-Aug-20

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

Solution:-

Step 1: Conversion into Decimal

$$1100001111100101_2 = 1\times2^{15}+1\times2^{14}+0\times2^{13}+1\times2^{9}+1\times2^{7}+1\times2^{6}+1\times2^{5}+1\times2^{2}+1\times2^{0} = 32768+16384+512+256+128+64+32+4+1 = 50149_{10}$$

$$1100001111100101_2 = 50149_{10}$$

Step 2: Decimal to Hex

16	50149	5
16	3134	14 = E
16	195	3
	12 = C	

$$50149_{10} = C3E5_{(16)}$$ Ans.

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

Solution:-

$$6173_8 = 6\times8^3+1\times8^2+7\times8^1+3\times8^0 = 3072+64+56+3 = 3195_{10}$$

$$6173_8 = 3195_{10}$$ Ans.

Date:

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

Solutions:

		Remainder
8	169	1
8	21	5 ↑
	2	

$169_{10} = \boxed{251_8}$ Answer.

i) $2A7D_{16} = (25175)_8$

Step (i) conversion to decimal.

$2A7D_{16} = 2\times16^3 + 10\times16^2 + 7\times16^1 + 13\times16^0 = 8192 + 2560 + 112 + 13 = \boxed{10877_{10}}$

Step (ii) conversion of decimal to octal

		Remainder
8	10877	5
8	1359	7
8	169	1
8	21	5 ↑
	2	

$10877_{10} = \boxed{25175_8}$ Answer

Date:

j) $11111111_2 = (?)_{10}$

Solution:

$11111111_2 = 1\times2^7+1\times2^6+1\times2^5+1\times2^4+1\times2^3+1\times2^2+1\times2+1\times2^0$

$= 128+64+32+16+8+4+2+1$

$= \boxed{255_{10}}$ Answer.

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

Solution:-

$-12_{10} = 0000000000001100$

l) $198_{10} = (?)_{BCD}$

Solution:-

In BCD code

1 = 0001

9 = 1001

8 = 1000 So,

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

m) $100001110000_{BCD} = (?)_{10}$

Solution:-

$100001110000 = (870)_{BCD}$

Date:

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

Solution:

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

o) $10101111_{Gray} = (?)_2$

Solution:

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

p) $01000001 = (?)_{ASCII}$

Solution:

ASCII code = 065

Letter = A

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

Solution:-

The number of 1's in question is odd so we drop another one to complete the parity bit.

$111000 = (1111000)_{\text{even parity}}$.

Q2: Calculate each of the following;

(a) $01111111_2 - 00000111_2$ using 2's complement.

12290

Date:

Solution:-

$$\begin{array}{r} 01111111 \\ -\ 00000111 \\ \hline 01111000_2 \end{array}$$ Answer.

b) $01101010_2 \times 11110001_2$

Solution:-

$$\begin{array}{r} 01101010 \\ \times\ 11110001 \\ \hline 1100011110010102 \end{array}$$ Answer.

c) $10001000_2 \div 0010010_2$

Solution:-

$$\frac{10001000}{0010010} = 100_2$$ Answer

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

Solution:-

$$\begin{array}{r} 6D_{16} \\ -\ 3F_{16} \\ \hline AC_{16} \end{array}$$

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

$$\begin{array}{rr} 0001 & 0110 \\ +\ 0001 & 0101 \\ \hline 0010 & 1011 \\ & -0110 \\ \hline 0011 & 0000 \end{array}$$

∴ we add 0110 to invalid code.

12290

Date:

converting 00110000 to binary.

00110000 = 31_{10} Answer.

(0011 → 3, 0000 → 1)

ON ——— NO

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

Solution:.

$x^7 + x^6 + x^4 + x + 1$

$x^3 + x$

Binary form (added zeros) = 11010011000 ÷ 1010

Result = 11101001   Remainder = 010

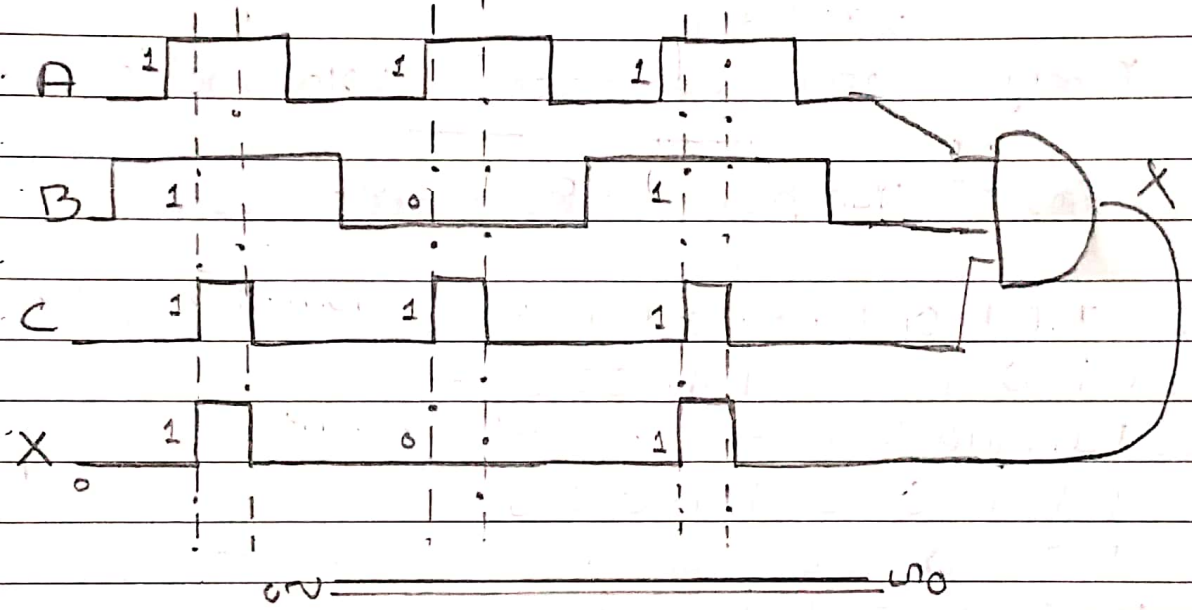
```
   1 1 1 0 1 0 0 1
  ________________
 1 1 0 1 0 0 1 1 0 0 0
 1 0 1 0
 ________
 1 1 1 0 0 1 1 0 0 0
 1 0 1 0
 ________
 1 0 0 0 1 1 0 0 0
 1 0 1 0
 ________
 0 1 0 1 1 0 0 0
 0 0 0 0
 ________
 1 0 1 1 0 0 0
 1 0 1 0
 ________
 0 0 1 0 0 0 0
 0 0 0 0
 ________
 0 1 0 0 0 0
 0 0 0 0
 ________
```

1 0 0 0
1 0 1 0
0 1 0

Transmitted value is = **1101001101 0** Ans.

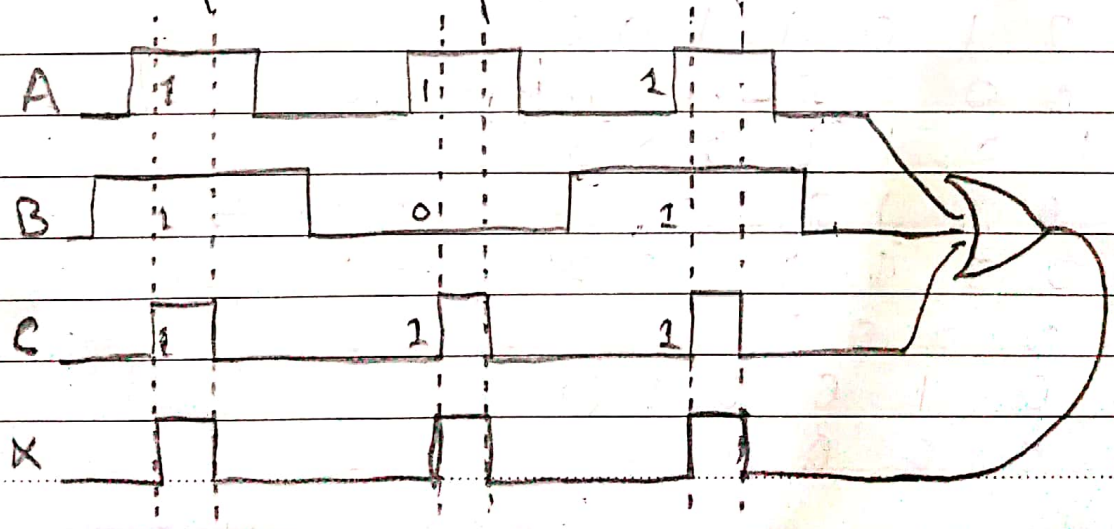
ON ——— UNO

Q5 The input waveform in fig 1 is applied to 3-input AND Gate. Show output waveform



ON ——— UNO

Q6 Q5 for 3-input OR Gate.



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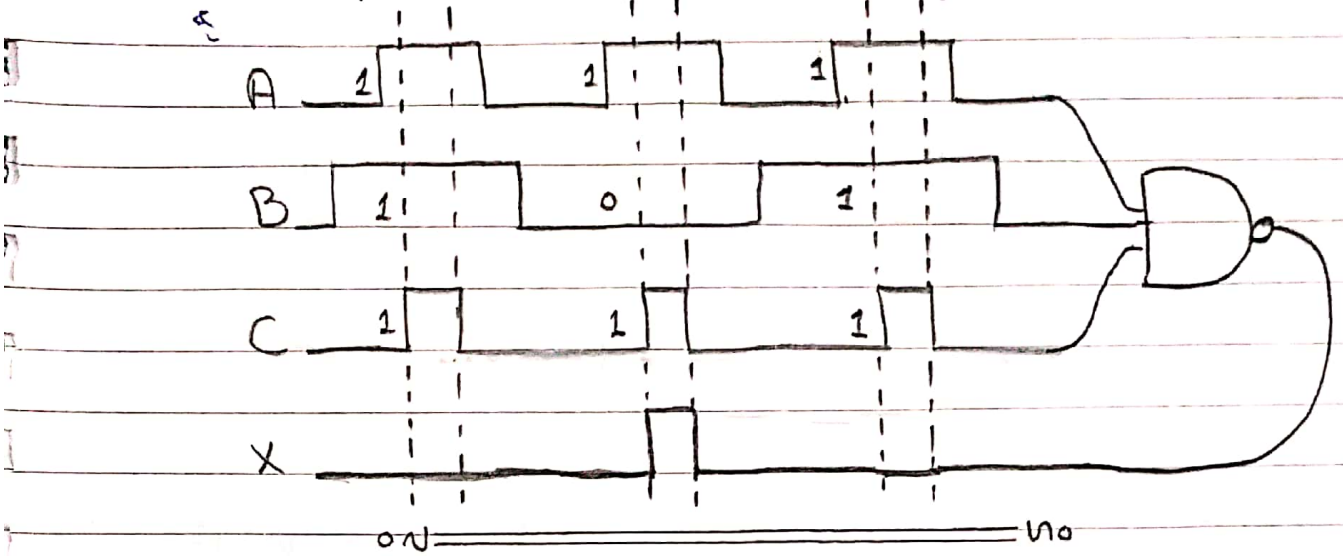
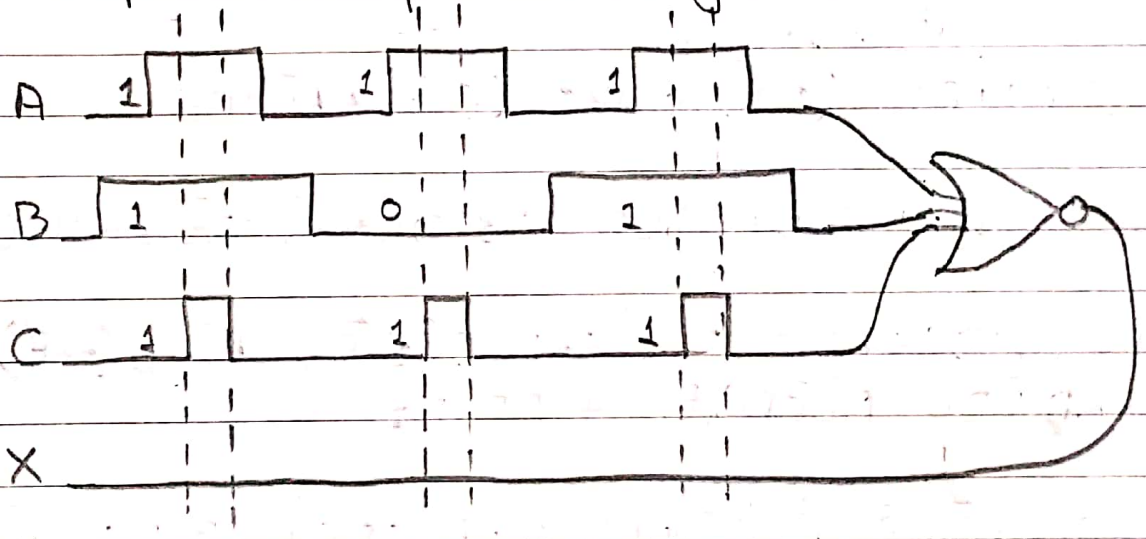
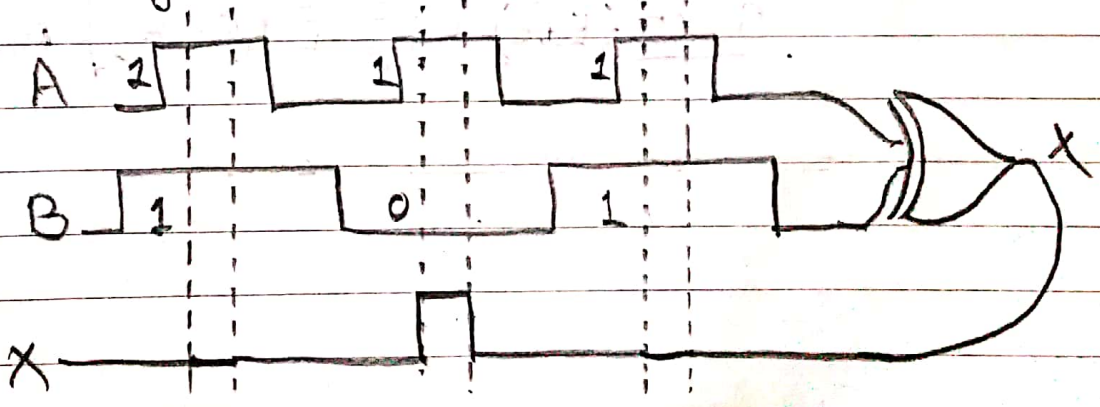
Q7:- Repeat Q5 for NAND gate.



Q8: Repeat Q5 for NOR gate:

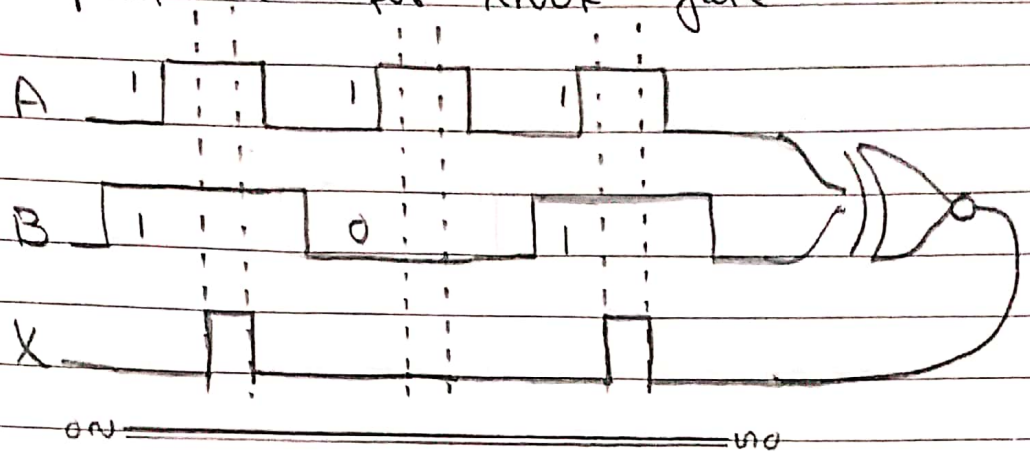


Q9: The input waveform in fig 2 is applied to XOR gate. Show waveform.



Date:

Q10: Repeal Q9 for XNOR gate



Q11: Using boolean algebra techniques simplify:-

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

Answer:-

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

$$= A\bar{B}(C+\bar{C}) + A\bar{B}C(D+\bar{D}) + A\bar{B}CD(E+\bar{E}) + A\bar{B}CDE$$

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

$$= A\bar{B}C(D+\bar{D}) + A\bar{B}\bar{C}(D+\bar{D}) + A\bar{B}CD(E+\bar{E}) + A\bar{B}C\bar{D}(E+\bar{E}) + A\bar{B}(DE + A\bar{B}CD)\bar{E} + A\bar{B}CDE$$

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

$$\boxed{ABCD(E+\bar{E}) + A\bar{B}C\bar{D}(E+\bar{E})}$$ Answer.

Date:

Q12: Convert the following into standard SOP form: $(C+D)(\bar{A}+D)$

Solution:

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

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

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

$$\boxed{= \bar{A}CD+\bar{A}C\bar{D}+ACD+\bar{A}\bar{C}D}$$

Q13: Write the standard POS expression using standard SOP Expression obtained in q12.

Solution:

We obtained the following SOP Exp=

$$\bar{A}CD+\bar{A}C\bar{D}+ACD+\bar{A}\bar{C}D$$
$$\downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow$$
$$011 \quad 010 \quad 111 \quad 001$$

The following SOP Exp has 4 combinations which means the rest of the combinations belong to POS i.e

$$\begin{array}{c} 000,\ 100,\ 101,\ 110 \\ \downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow \quad \downarrow\downarrow\downarrow \\ A+C+D \times \bar{A}+C+D \times \bar{A}+C+\bar{D} \times AC\bar{D} \end{array}$$

12290

Date:

Q14 Draw truth table for POS & SOP exp. obtained in Q12, Q13.

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

Q15 Use Karnaugh map to simplify the following expression to minimum SOP

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

AB \ C	0	1
0 0		(1)
0 1	(1)	
1 1		(1)
1 0	(1)	

Minimum SOP form:

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

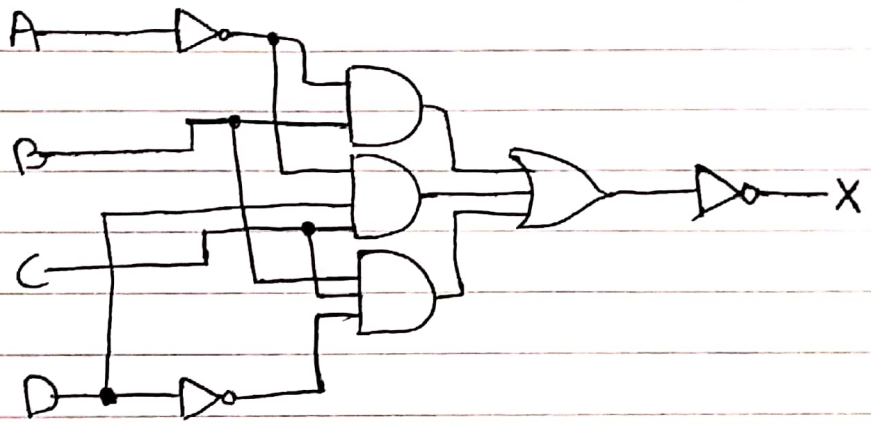
Date

Q16 Obtain the minimum POS exp from the karnaugh map used in q/15

Answer:

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

Q17 Write the output expression for following circuit.



Answer:-

$$\bar{A}B + \bar{A}CB + BD\bar{D}$$

So,

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