

Q7 Name: Yash Raj

Roll no: 24K-0737

Question #1:

1.  $(\overline{A} \cdot \overline{B}) \cdot (\overline{B} \cdot \overline{C})$   
Sol:-

$$\begin{aligned} &= (\overline{A} + \overline{B}) \cdot (\overline{B} \cdot \overline{C}) \\ &= \overline{A}\overline{B}\overline{C} + \overline{B}\overline{B}\overline{C} \\ &= \overline{A}\overline{B}\overline{C} \quad \text{Ans} \end{aligned}$$

2.  $(B + \overline{C})A + (C + \overline{D})B + BD$

Sol:-

$$\begin{aligned} &= AB + A\overline{C} + BC + \overline{D}B + BD \\ &= AB + A\overline{C} + BC + B(\overline{D} + D) \\ &= AB + A\overline{C} + BC + B \\ &= AB + A\overline{C} + B(C + 1) \\ &= AB + B + A\overline{C} \\ &= B(A + 1) + A\overline{C} \\ &= B + A\overline{C} \quad \text{Ans} \end{aligned}$$

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(iii)  $(x + \bar{y})z + (\bar{x}y)\bar{z}$

Sol:  $xz + \bar{y}z + \bar{x}y\bar{z}$  Ans.

(iv)  $\overline{(B \cdot C)}(\bar{A} \cdot B) + [(B \cdot C) \oplus B(\bar{B} \cdot C)]$

$\overline{(B \cdot C)}(A + \bar{B}) + [BC \oplus B(\bar{B} \cdot C)]$

$a \oplus b = ab' + a'b$

$BC(A + \bar{B}) + [BC(B(\bar{B} \cdot C)) + (\bar{B} \cdot C)B(\bar{B})]$

$ABC + [BC(B + BC) + (\bar{B} + \bar{C})B]$

$ABC + [BC(B(1+C)) + B\bar{B} + B\bar{C}]$

$ABC + BC + B\bar{C}$

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

$ABC + B$

$B(A+1) = B$  Ans.



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Q#21-

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

Soln

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

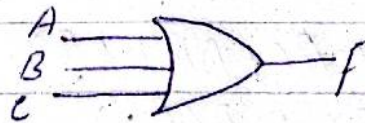
$$= BC + AB + AC + A + B + C + A\bar{B}C$$

$$= A + B + C + AB + BC + AC(1+\bar{B})$$

$$= A + B + C + AB + BC + AC$$

$$= A(1+B) + B(1+C) + C(1+A)$$

$$= A + B + C$$



A	B	C	$F = A+B+C$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

*[Signature]*

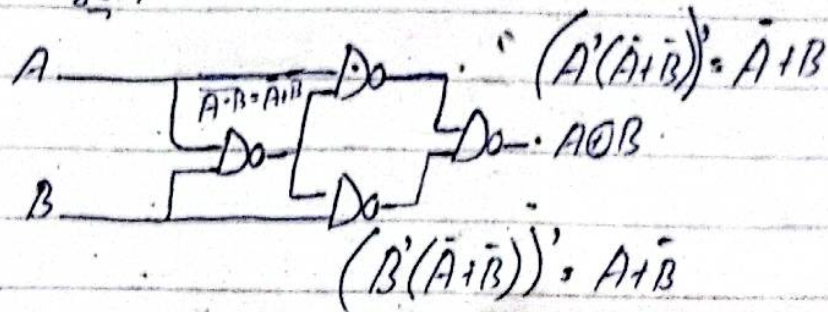
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Q43: Draw circuit using NAND & NOR gates only:

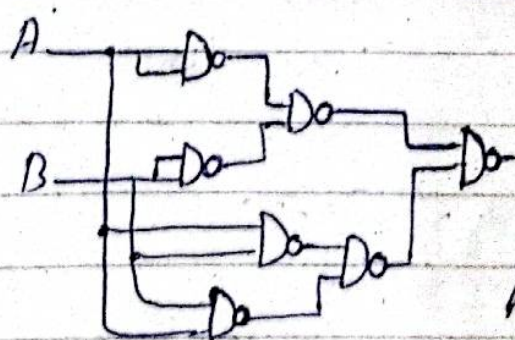
(i)  $A'B + AB'$

Sol:



(ii)  $A'B' + AB$

Sol:





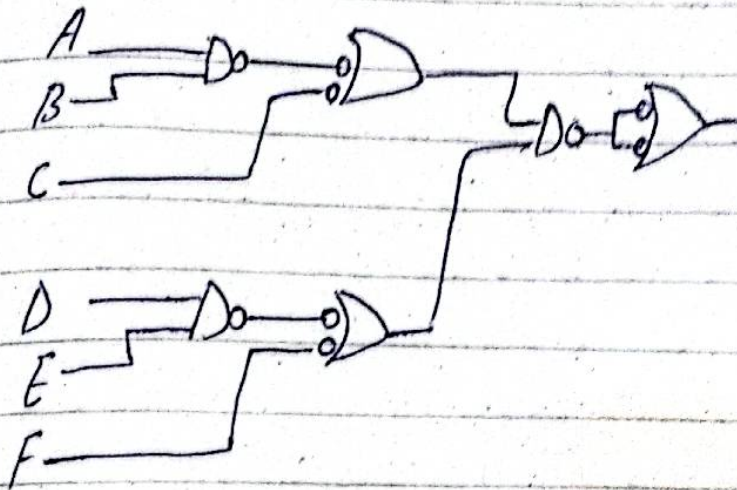
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Q4:-

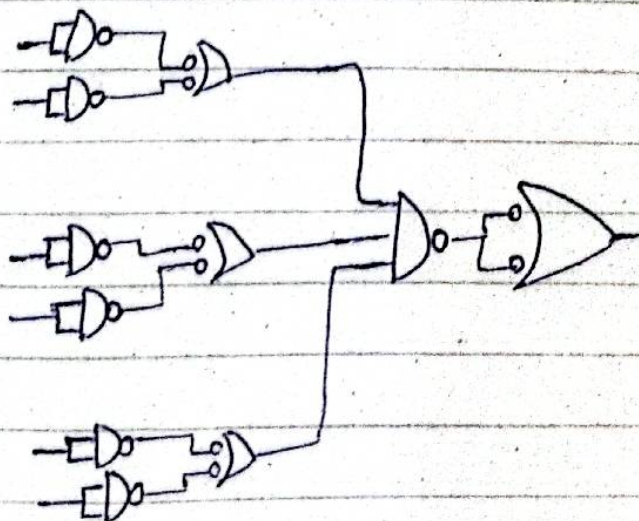
(i)  $(AB + C')(DE + F')$

Q4:-



Ans

(ii)  $(A+B)(C+D)(E+F)$



Ans

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Q451-

	00	01	11	10
00	1	1	x	1
01	x	0	0	0
11	1	0	0	0
10	1	1	x	x

$$SOP: \bar{B} + \bar{C}\bar{D}$$

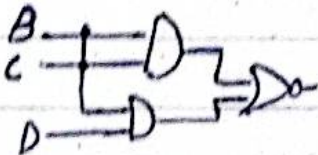
$$POS: (\bar{B} + \bar{C})(\bar{B} + \bar{D})$$

$$\bar{SOP}: B(C + D)$$

$$\bar{POS}: BC + BD$$

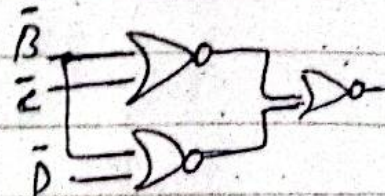
(i) AND-NOR:

POS  $\rightarrow$  USE:



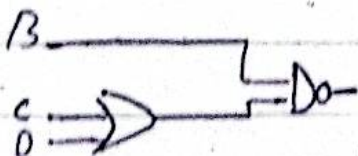
(ii) NOR-NOR

POS  $\rightarrow$  USE:



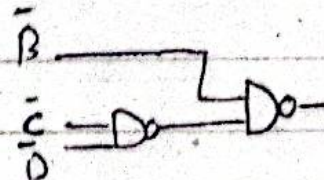
(iii) OR-NAND:

$\bar{SOP} \rightarrow$  USE:



(iv) NAND-NAND:

SOP  $\rightarrow$  USE:



Prz



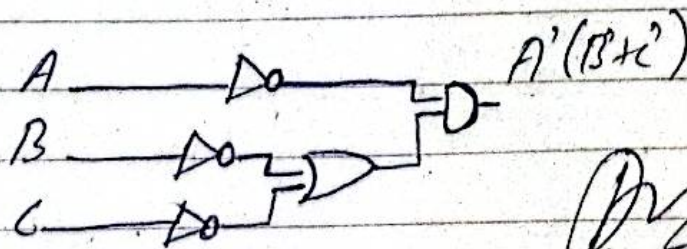
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Q#6: Combinational Circuit with 3 inputs & one output = 1

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

$$f = A'(B+C)$$



Prz



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Q47. Using a K-map convert the SOP Expression

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

$$(1100) (0100) (0001) (0011)$$

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

$$(1001) (0010)$$

SOP

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

(i) Minimum POS expression:-

$$0100$$

$$0001$$

$$0011$$

$$1100$$

$$1001$$

$$0010$$

$$B'CD$$

$$BCD'$$

$$ABC'$$

$$= (A + B + C')(B' + C + D)(B + C + D')$$



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(ii) Standard SOP Expression:-

0000	0111	1011
1000	1111	1010
0101	0110	-
1101	1110	-

$$\Rightarrow A'B'C'D + AB'C'D + A'BC'D + ABC'D + A'BCD + ABCD + A'BCD' + ABCD' + AB'CD + AB'CD'$$

Ans

(iii) Minimized SOP Expression:-

<del>0000</del>	<del>1111</del>	<del>0111</del>	<del>0101</del>
<del>1000</del>	<del>1010</del>	<del>0110</del>	<del>0111</del>
$B'C'D'$	<del>1011</del>	<del>1111</del>	<del>1101</del>
	<del>1010</del>	<del>1110</del>	<del>1111</del>
	$AC$	$BC$	$BD$

$$\Rightarrow B'C'D' + AC + BC + BD$$

Ans

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Q#8. Use Karnaugh map to find minimum pos for each expression.

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

$$(A+B+C)(\bar{A}+\bar{B}+\bar{C})(A+\bar{B}+C)$$
$$(0\ 0\ 0)(1\ 1\ 1)(0\ 1\ 0)$$

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

$$\begin{array}{r} 000 \\ 010 \\ \hline AC \end{array}$$

$$\begin{array}{r} 111 \\ \hline \bar{A}\bar{B}\bar{C} \end{array}$$

∴ minimized pos :-

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



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$$1) (X + \bar{Y})(\bar{X} + Z)(X + \bar{Y} + \bar{Z})(\bar{X} + \bar{Y} + Z)$$

SOP

$$(X + \bar{Y} + \bar{Z} \cdot Z)(\bar{X} + Y \cdot \bar{Y} + Z)(X + \bar{Y} + \bar{Z})(\bar{X} + \bar{Y} + Z)$$

$$(X + \bar{Y} + Z)(X + \bar{Y} + \bar{Z})(\bar{X} + Y + Z)(\bar{X} + \bar{Y} + Z)(\cancel{X + \bar{Y} + \bar{Z}})(\cancel{\bar{X} + \bar{Y} + Z})$$

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

$$(010)(011)(100)(110)$$

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

$$\begin{array}{ccc} 110 & 010 & 010 \\ 100 & 110 & 011 \\ \hline A'C & B'C & AB' \end{array}$$

ii) minimized POS :-

$$(A' + C)(B' + C)(A + B)$$

or

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



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Q#9.

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⇒ Convert the given pos expression into sop using a Karnaugh-map:-

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

Sol:

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

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

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

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

$(0 \ 1 \ 0)(0 \ 1 \ 1)(0 \ 0 \ 1)(1 \ 1 \ 0)$

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

000

001

$A'B'C'$

111

$101$

$AC$

100

$101$

$AB'$

⇒ minimized sop:-  $A'B'C' + AC + AB'$

*Ans*



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

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

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

$$\begin{matrix} 1 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ (\bar{A}+B+C+D)(\bar{A}+B+\bar{C}+\bar{D})(\bar{A}+\bar{B}+\bar{C}+D)(\bar{A}+\bar{B}+\bar{C}+\bar{D})(A+B+\bar{C}+D) \\ (\bar{A}+B+\bar{C}+D)(A+\bar{B}+C+\bar{D}) \\ (1 & 0 & 1 & 0)(0 & 1 & 0 & 1) \end{matrix}$$

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

$$\begin{matrix} 1101 & 1100 & 0100 & 0000 & 0000 & 0001 \\ 1001 & 1101 & 1100 & 0100 & 0001 & 0011 \\ \hline AC'D & \cancel{ABC} & B\bar{C}D' & \cancel{A'C'D} & A'B\bar{C}' & \cancel{A'B}D \end{matrix}$$

$$0011$$

$$0111$$

$$0111$$

$$0110$$

$$A'CD$$

$$A'BC$$

$$\Rightarrow \text{Minimized SOP: } AC'D + \cancel{ABC} + B\bar{C}D' + \cancel{A'CD} + A'B\bar{C}' + \cancel{A'B}D + A'CD + A'BC$$

## Q DLD Assignment #2:

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Q#10: Simplify the following boolean function  $f$  together with don't care conditions  $d$ ; then express in minimum SOP & POS.

(i)  $F(A, B, C, D) = \Sigma(0, 6, 8, 13, 14); d(2, 4, 10)$

Sol:-

⇒ Using K-map:-

	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

AB \ CD	00	01	11	10
00	1	0	0	x
01	x	0	0	1
11	0	1	0	1
10	1	0	0	x



⇒ for SOP:-

$$\begin{array}{r} 0000 \\ 0100 \\ \hline A'C'D' \end{array}$$

$$\begin{array}{r} 1101 \\ \hline ABC'D \end{array}$$

$$\begin{array}{r} 1000 \\ \hline ABC'D' \end{array}$$

$$\begin{array}{r} 0010 \\ 0110 \\ 1110 \\ 1101 \\ \hline CD' \end{array}$$

⇒ minimized SOP:-

$$A'C'D' + ABC'D + ABC'D' + CD'$$

⇒ for POS:-

$$\begin{array}{r} 0100 \\ 1100 \\ \hline A'BC \end{array}$$

$$\begin{array}{r} 1001 \\ 1011 \\ \hline A'BD \end{array}$$

$$\begin{array}{r} 0001 \\ 0011 \\ 0101 \\ 0111 \\ \hline A'D' \end{array}$$

$$\begin{array}{r} 0011 \\ 0111 \\ 1111 \\ 1011 \\ \hline C'D' \end{array}$$

⇒ minimized POS:-

$$(A+B+C)(A+B+D)(A+D')(C'+D')$$

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(ii)  $F(A, B, C, D) = \sum (1, 3, 5, 7, 9, 15)$ ;  $d(A, B, C, D) = \sum (4, 6, 12)$

$\Rightarrow$  Using K-map:-

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

AB \ CD	00	01	11	10
00	0	1	1	0
01	x	1	1	x
11	x	x	1	0
10	0	1	0	0

$\Rightarrow$  for SOP:-

0100	0001	0001	1101
0101	0011	0101	1111
0111	0101	1101	ABD
0110	0111	1001	
<u>A'B</u>	<u>A'D</u>	<u>C'D</u>	

$\Rightarrow$  minimized SOP:-  $A'B + A'D + C'D + ABD$



=) for Pos:

0000  
0100  
1100  
1000  
CD

0010  
0110  
1110  
1010  
C'D

1011  
A'B'C'D'

=) minimized Pos:

$$(A+B+C+D')(C+D)(C'+D) \text{ Ans.}$$