QUESTION BANK

UNIT - 1

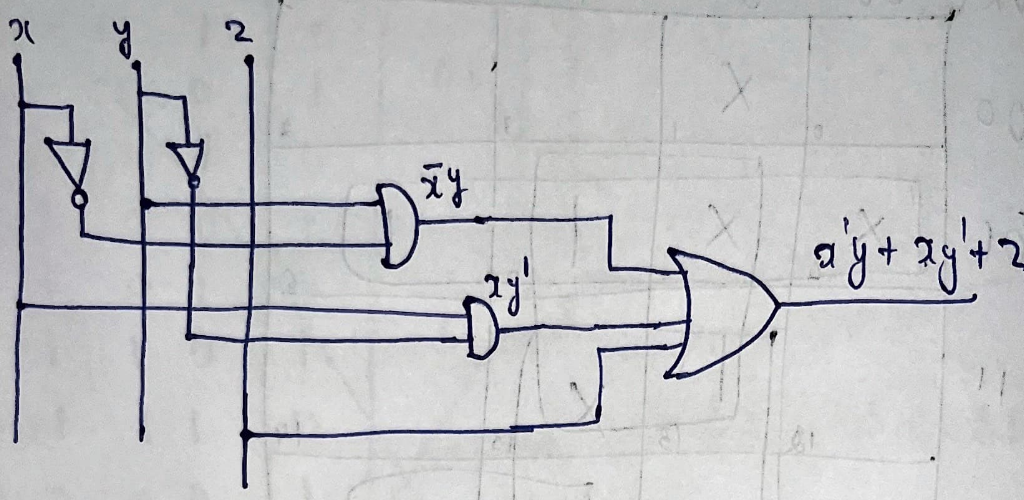
1	Implement the following function using logic gates. a. $x'y + xy' + z$ b. $(a + b' + c)(a' + b' + c)$
2	Write the following Boolean function into minterm Canonical Form. $f(a, b, c, d) = (a + b' + c)(a' + d)$
3	Find Minimal Sum for the following expression. $F(w, x, y, z) = \Sigma m(0,1,2,5,8,15) + \Sigma d(6,7,10)$
4	Using K-Map, find Minimal Sum expression for the following switching function. $f(w, x, y, z) = \sum m(6,7,9,10,13) + dc(1,4,5,11,15)$
5	Convert the following functions into proper canonical form. i) $f(w, x, y, z) = \bar{w}x + y\bar{z}$ ii) $f(a, b, c, d) = (a + \bar{b} + c)(\bar{a} + d)$
6	Find the Minimal Sum of the given Boolean Expression using K-Map: $f(a, b, c, d) = \sum m(0,1,4,5,8,9,11) + d(2,10)$
7	Define i) Minterm ii) Maxterm iii) Canonical SOP iv) Canonical POS
8	Using K-Map, find Minimal Sum expression for the following switching function $f(w,x,y,z) = \sum m(1, 5, 6, 7, 9, 11, 12, 13) + dc(0, 3, 4)$
9	Design a minimal three-input, one-output network that has a logic-1 output when majority of its inputs are logic-1 and has a logic-0 output when majority of its input are logic-0
10	Convert the following numbers to the given base. i. $255.75_{(8)} = (?)_{16}$ ii. $7251.5_{(10)} = (?)_2$ iii. $110100111100.0101_{(2)} = (?)_{10}$
11	Convert the given expression into its canonical form $f(w, x, y, z) = \bar{w}x(y + y)\overline{(z + \bar{z})}$
12	Design the combinational logic circuit which takes two, 2-bit numbers as its inputs and generates an output to indicate when the sum of the two numbers is even.
13	Simplify the following switching equations using Boolean theorem and realize the minimal expression using basic gates. i. $\bar{X}\,\bar{Y}\,\bar{Z} + X\bar{Y}Z + \bar{X}\,Y\bar{Z} + XYZ$ ii. $(A + \bar{B} + C)(\bar{A} + \bar{B} + C)$
14	With a neat logic diagram, truth table and expression sketch AND, OR, NOT, NAND, EXOR and EXNOR gates used in digital circuits.
15	Using K-map and simplify the following function (i) $f(a, b, c) = \sum m(0,1,2,3,7)$ (ii) $f(a, b, c) = \sum m(0,2,3,6,7)$ (iii) $f(a, b, c, d) = \sum m(0,1,3,7,8,9,11,15)$ (iv) $f(a, b, c, d) = \sum m(0,1,3,4,5,6,9,11,12,13,14)$
16	Prove the following identity and also verify using truth table. $(a + b)\,(\bar{a}\bar{c} + c)\overline{(\bar{b} + ac)} = \bar{a}\,b$
17	Perform the code conversion for the following and show each steps clearly. i. $12.6532_{(10)} = (?)_{16}$ ii. $7566_{(8)} = (?)_{16}$ iii. $CF.52_{(16)} = (?)_{10}$

	iv. $1376.185_{(10)} = (?)_2$
18	Prove the following identities (i) $AB + A\bar{B} + \bar{A}\,\bar{B} = A + \bar{B}$ (ii) $\overline{\bar{A}\bar{C} + \bar{A}\,B + \bar{A}\,C + AB} = A\bar{B}$
19	Convert the following equations into their requested Canonical Form i. $R = L + \bar{M}(\bar{N}M + \bar{M}L)$ into SOP form ii. $P = (\bar{w} + x)(y + \bar{z})$ into POS form
20	Find the Minimal Sum of the incomplete Boolean Function using K-Map V = f(a,b,c,d) = ∑m(2,3,4,5,13,15) + ∑d(8,9,10,11)
21	Convert the following equations into their requested Canonical Form $P = A + \bar{B}C$ into SOP form
22	Using Q-M Method find the Minimal Sum for the Boolean Function Y = f(a, b, c, d) = ∑m(0,4,5,6,7,8,9,10,11,13,14,15)
23	Find the Minimal Sum of the following Boolean Function using K-Map a) Y = f(a,b,c,d) = ∑m(1,2,3,4,8,9,10,12,13,14,15) b) Y = f(a,b,c,d) = ∑m(1,3,5,6,7,13,14) + ∑d(8,10,12)
24	Find the Minimal sums of incomplete Boolean function using Karnaugh Maps. $f(a,b,c,d) = \prod M(1,2,3,,4,9,10) + dc(0,14,15)$
25	Find the Minimal Sum of the given Boolean Expression using K-Map: $Y = \bar{A}\bar{B}C\bar{D} + ABC\bar{D} + A\bar{B}C\bar{D} + A\bar{B}CD + A\bar{B}\bar{C}\bar{D} + AB\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}\bar{D}$
26	Perform the conversion $(98.23)_{10} = (\ ?\ )_2 = (\ ?\ )_{16}$
27	Design a combinational logic circuit that will generate the square of all the combinations of a three bit binary number represented by $A_2\ A_1\ A_0$.
28	Convert the following equations into their requested canonical form i)X=$\bar{A}$ B+BC. (SOP) ii)P=($\bar{W}$+X)(Y+$\bar{Z}$) . (POS)
29	Find the minimal sum for the following expression. F(w,x,y,z)=$\Sigma m(1,5,7,8,9,10,11,13,15)$
30	Design a logic circuit that controls the passage of the signal ‘A’ according to the following requirement i) Output ‘X’ will equal ‘A’ when control inputs B and C are the same ii) ‘X’ will remain ‘HIGH’ when B and C are different
31	Design a combinational logic circuit with inputs P,Q,R so that output S is high whenever P is zero or whenever Q=R=1
32	Using QM method and simplify the following function i) $f(a,b,c,d) = \sum m(0,1,2,3,8,9)$ ii) $f(a,b,c,d) = \sum m(0,1,2,3,6,7,8,9,14,15)$ iii) $f(a,b,c,d) = \sum m(0,1,3,7,8,9,11,15)$ iv) $f(a,b,c,d) = \sum m(0,1,3,4,5,6,9,11,12,13,14)$
33	Design a combinational circuit which accepts two, 2 bit binary numbers and generates three outputs. The first output indicates when the 2 numbers differ by 2 or more, the second output indicates when the 2 numbers are identical and the third output indicates when the first number exceeds second number.
34	Design the combinational logic circuit which takes two, 2 bit numbers as its inputs and generates an output to indicate when the sum of the two numbers is odd.
35	An exam consisted of 3 questions (Q1, Q2 and Q3), where the marks allotted for Q1, Q2 and Q3 were four, two and one respectively. The minimum qualifying mark for the exam was announced as three. Implement a logic circuit which indicates whether the student has qualified in the exam or not.
36	Realize the EX-OR and EX-NOR gate using basic gates.
37	State and prove De-Morgan’s theorem using the tabular method.

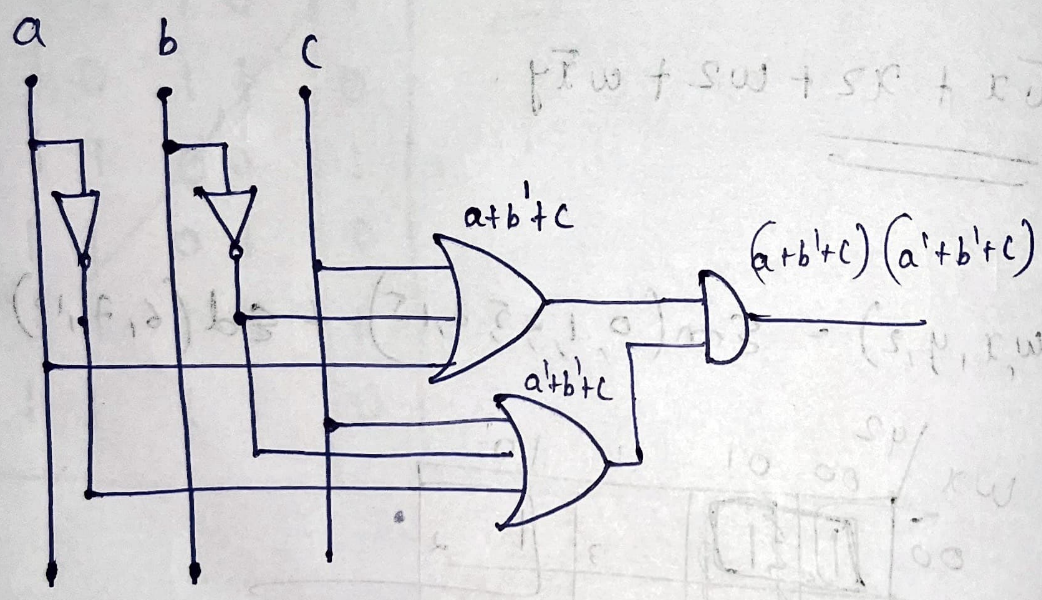
38	Simplify the following switching equations using Boolean theorem and realize the minimal expression using basic gates. *i.* $F = \bar{X}\,\bar{Y}\,\bar{Z} + X\bar{Y}Z + \bar{X}\,Y\bar{Z} + XYZ$ *ii.* $F = (A + \bar{B} + C)(\bar{A} + \bar{B} + C)$
39	List the difference between analog and digital signals.
40	Explain the logic circuit to multiply two 2 bit numbers.
41	Simplify the following using Boolean Algebra: (A + B’ + C’)(A +B’ + C)(A + B + C’)
42	Minimize the given logic function using the K-map method. F(A,B,C)=A’BC’+ABC’+ABC
43	Given the simplified expression of a Boolean function, write the truth table, and minterm list and obtain the given simplified function first by writing the equation in canonical form and then use k-map to simplify. Y = f (a, b, c) = c’
44	Use 2’s complement method to find: (a) 1101-1001 (b) 1001-1101
45	Perform the conversion for the following and show each step clearly. $(i) 1A2_{16} = (?)_{10}$ $(ii)\ 45.25_{10} = (?)_2$
46	A system receives three inputs and generates a one-bit output based on the even number of ones present in the input. If the inputs are completely zeros or if it has an odd number of ones, the output will be zero and if the input has an even number of ones then the output will be set to one. Write the truth table for such a system and represent the simplified function using the logic diagram.
47	Simplify the logic function f(a,b,c) =∑m(0,2,3,4,6,7) using QM technique
48	Use K-map to minimize the logic function f(a,b,c) =∑m(0,2,3,4,6,7).
49	Convert the hexadecimal number $A6.7_{16}$ to binary by using decimal representation of the number. Verify the result using direct conversion.
50	Given the simplified expression of Boolean function, write the truth table, minterm list and obtain the given simplified function using K-map method. Y = f (a, b, c) = c’
51	Design a combinational logic circuit to generate an output whenever a majority of four inputs is logic 1 and output function is not specified whenever the number of 0’s and 1’s is equal in the inputs. However, the output is logic zero for the remaining conditions.
52	Prove the commutative law using truth table method for both the law of addition and law of multiplication.
53	Design a combinational logic circuit to generate an output of logic 1 whenever the result of multiplication of two numbers of 2-bits each is non zero.

1. Implement using logic gates.

a) $x'y + xy' + z$



b) $(a + b' + c)(a' + b' + c)$



Q. $f(a,b,c,d) = (a+b'+c)(a'+b)$

$$= (a+b'+c+dd')(a'+b+cc')(dd')$$

$$= (a+b'+c+d)(a+b'+c+d')(a'+b+c+d)$$

$$(a'+b+c'+d)(a'+b+c+d')(a'+b+c'+d')$$

$$= (M_4 \; M_5 \; M_8 \; M_{10} \; M_9 \; M_{11})$$

$$= \prod M(4,5,8,10,9,11)$$

(3) $F(w,x,y,z) = \sum m(0,1,2,5,8,15) + \sum d(6,7,10)$.

$wx \backslash yz$	00	01	11	10
00	1 (0)	1 (1)	(3)	1 (2)
01	(4)	1 (5)	X (7)	X (6)
11	(12)	(13)	1 (15)	(14)
10	1 (8)	(9)	(11)	X (10)

$\bar{x}\bar{z} + \bar{w}\bar{x}\bar{y} + \bar{w}xz + xyz$

7) $F(w,x,y,z) = \Sigma m(6,7,9,10,13) + dc(1,4,5,11,15)$

$wx \backslash yz$	00	01	11	10
00		X		
01	X	X	1	1
11		1	X	
10		1	X	1

$= \bar{w}x + xz + wz + w\bar{x}y.$

5) (i) $f(w,x,y,z) = \bar{w}x + y\bar{z}$

$= \bar{w}x + y\bar{z}$

$= \bar{w}x(y+\bar{y})(z+\bar{z}) + y\bar{z}(w+\bar{w})(x+\bar{x})$

$= \bar{w}xyz + \bar{w}x\bar{y}z + \bar{w}xy\bar{z} + \bar{w}x\bar{y}\bar{z} + y\bar{z}wx + y\bar{z}w\bar{x} + y\bar{z}\bar{w}x + y\bar{z}\bar{w}\bar{x}$

$= \bar{w}xyz + \bar{w}x\bar{y}z + \bar{w}xy\bar{z} + \bar{w}x\bar{y}\bar{z} + wxy\bar{z} + w\bar{x}y\bar{z} + \cancel{\bar{w}xy\bar{z}} + \bar{w}\bar{x}y\bar{z}$

$= \bar{w}xyz + \bar{w}x\bar{y}z + \bar{w}xy\bar{z} + \bar{w}x\bar{y}\bar{z} + wxy\bar{z} + w\bar{x}y\bar{z} + \bar{w}\bar{x}y\bar{z}$

$= M_7 + M_5 + M_6 + M_4 + M_{14} + M_{10} + M_2$

$= \Sigma M(2, 4, 5, 6, 7, 10, 14)$

5 (ii) $f(a,b,c,d) = (a+\bar{b}+c)(\bar{a}+d)$

$= (a+\bar{b}+c+d\bar{d})(\bar{a}+d+b\bar{b}+c\bar{c})$

$= (a+\bar{b}+c+d)(a+\bar{b}+c+\bar{d})(\bar{a}+d+b+c)(\bar{a}+b+d+\bar{b}+c)$

$(\bar{a}+d+\bar{b}+\bar{c})(\bar{a}+d+\bar{b}+\bar{c})$

$= (a+\bar{b}+c+d)(a+\bar{b}+c+\bar{d})(\bar{a}+b+c+d)(\bar{a}+\bar{b}+c+d)$

$\cancel{(\bar{a}+\bar{b}+\bar{c}+d)}(\bar{a}+\bar{b}+\bar{c}+d)$

$= M_4, M_5, M_8, M_{12}, M_{10}, M_{14} = \Pi M(4,5,8,10,12,14)$

(6) $f(a,b,c,d) = \Sigma m(0,1,4,5,8,9,11) + d(2,10)$

ab \ cd	00	01	11	10
00	1 (0)	1 (1)	(3)	X (2)
01	1 (4)	1 (5)	(7)	(6)
11	(12)	(13)	(15)	(14)
10	1 (8)	1 (9)	1 (11)	X (10)

$= \bar{a}\bar{c} + a\bar{b}$

8) $f(w,x,y,z) = \Sigma m(1,5,6,7,9,11,12,13) + dc(0,3,4)$

wx \ yz	00	01	11	10
00	X (0)	1 (1)	X (3)	(2)
01	X (4)	1 (5)	1 (7)	1 (6)
11	1 (12)	1 (13)	(15)	(14)
10	(8)	1 (9)	1 (11)	(10)

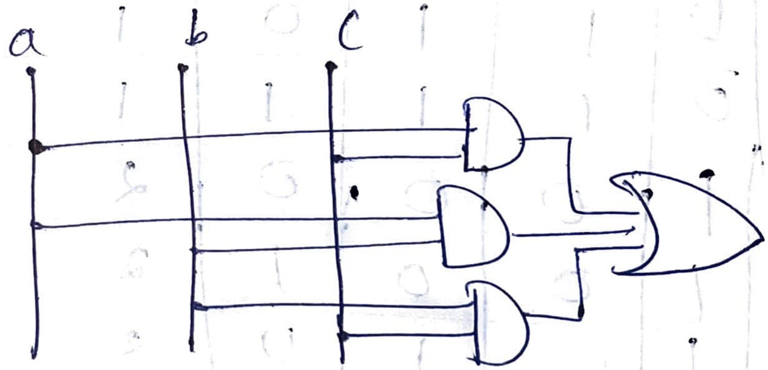
$= \bar{w}z + \bar{x}z + \bar{w}x + x\bar{y}$

9)

a	b	c	y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

a \ bc	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$= ac + ab + bc$

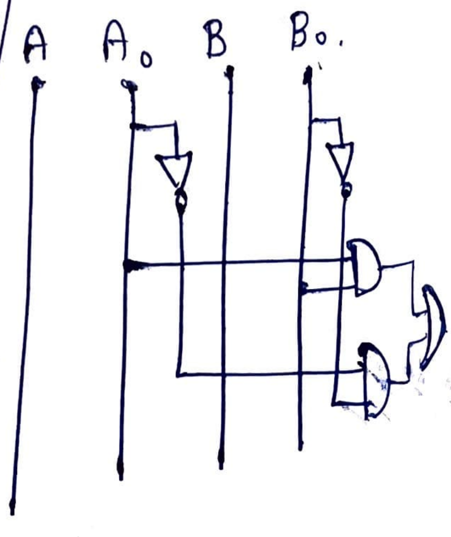


12)

A	A_0	B	B_0	A	B	Y (A+B)
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	2	1
0	0	1	1	0	3	0
0	1	0	0	1	0	0
0	1	0	1	1	1	1
0	1	1	0	1	2	0
0	1	1	1	1	3	1
1	0	0	0	2	0	1
1	0	0	1	2	1	0
1	0	1	0	2	2	1
1	0	1	1	2	3	0
1	1	0	0	3	0	0
1	1	0	1	3	1	1
1	1	1	0	3	2	0
1	1	1	1	3	3	1

AA_0 \ BB_0	00	01	11	10
00	1			1
01		1	1	
11		1	1	
10	1			1

$A_0 B_0 + \overline{A_0}\,\overline{B_0}$



7

Minterms

A minterm is a special product of literals in which each input variable appears exactly once

A function with n variables has 2^n minterms. Each minterm is true for exactly one combination of inputs

x	y	z		
0	0	0	$\rightarrow \bar{x}\bar{y}\bar{z}$	$= m_0$
0	0	1	$\rightarrow \bar{x}\bar{y}z$	$= m_1$
0	1	0	$\rightarrow \bar{x}y\bar{z}$	$= m_2$
0	1	1	$\rightarrow \bar{x}yz$	$= m_3$
1	0	0	$\rightarrow x\bar{y}\bar{z}$	$= m_4$
1	0	1	$\rightarrow x\bar{y}z$	$= m_5$
1	1	0	$\rightarrow xy\bar{z}$	$= m_6$
1	1	1	$\rightarrow xyz$	$= m_7$

Maxterms:

A maxterm is a special sum of literals, in which each input variable appears exactly once.

A function with n variable has 2^n maxterms. Each maxterm is false for exactly one combination of inputs.

x	y	z	
0	0	0	$\rightarrow x+y+z$
0	0	1	$\rightarrow x+y+\bar{z}$
0	1	0	$\rightarrow x+\bar{y}+z$
0	1	1	$\rightarrow x+\bar{y}+\bar{z}$
1	0	0	$\rightarrow \bar{x}+y+z$
1	0	1	$\rightarrow \bar{x}+y+\bar{z}$
1	1	0	$\rightarrow \bar{x}+\bar{y}+z$
1	1	1	$\rightarrow \bar{x}+\bar{y}+\bar{z}$

Canonical forms.

A canonical form of a switching equation is one that contains all of the available input variables.

Canonical sum of products :- It is a complete set of minterms that defines when the output is logical 1.

Canonical product of sums: It is complete set of maxterms that defines when the output is logical 0.

1

10) (i) $255.75_{(8)} \longrightarrow (?)_{16}$

$2\times8^2 + 5\times8 + 5 + 7\times8^{-1} + 5\times8^{-2}$ $\frac{7}{8}$

$128 + 40 + 5 + 0.875 + 0.078$ $\frac{5}{64}$

173.953

$16 \,|\, 173$

$16 \,|\, 10 - 13$

$(173)_d \longrightarrow AD$

$0.953 \times 16 = 15.248 = F$

$0.24 \times 16 = 3.968 = 3$

$\cancel{0.84 \times 16}$

$0.968 \times 16 = 15.488 = F$

$= 7.808 = 7$

$0.488 \times 16 = 12.928 = C$

$0.808 \times 16 = 14.848 = E$

0.928×16

$\therefore (255.75)_8 \downarrow$ AD.F3F7CE

9
10 A
11 B
12 C
13 D
14 E
15 F

(iii) $110100111100.0101_{(2)} = (?)_{10}$

$1\times2^{11} + 1\times2^{10} + 1\times2^8 + 1\times2^5 + 1\times2^4 + 1\times2^3 + 1\times2^2 + 8 + 1\times2^{-2} + 1\times2^{-4}$

$2048 + 1024 + 256 + 32 + 16 + 8 + 0.25 + 0.062$

$(= 3,384.312)_{10}$

13 ii] $(A+\bar{B}+C)(\bar{A}+\bar{B}+C$

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

$\underbrace{A\bar{A}}_{0}+A\bar{B}+AC+\bar{A}\bar{B}+\bar{B}\bar{B}+C\bar{B}+\bar{A}C+\bar{B}C+CC$

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

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

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

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

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

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

$\bar{B}+C$

13 i] $\bar{X}\bar{Y}\bar{Z}+X\bar{Y}Z+\bar{X}Y\bar{Z}+XYZ$

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

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

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

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

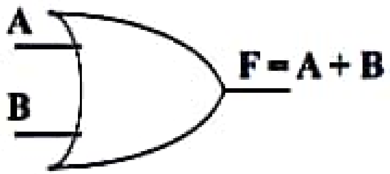
$\bar{X}\bar{Z}+XZ$

$X\odot Z$

14 .

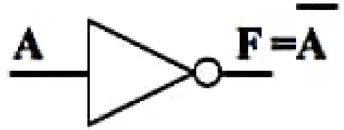
A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

OR



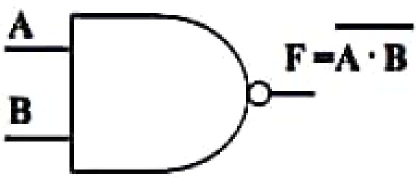
A	$\overline{A}$
0	1
1	0

NOT



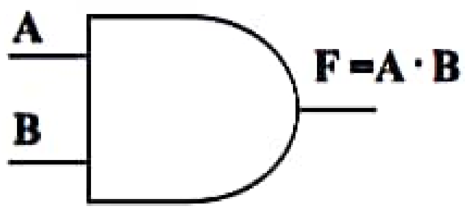
A	B	$\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

NAND



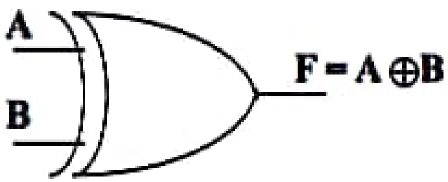
A	B	A · B
0	0	0
0	1	0
1	0	0
1	1	1

AND



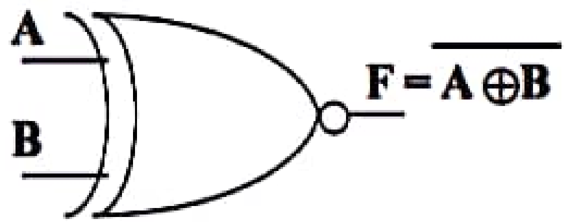
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

XOR



A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

XNOR



16 Prove the following identity and also verify using truthlable.

$$(a+b)(\bar{a}\bar{c}+c)(\overline{\bar{b}+ac}) = \bar{a}b$$

$[a+\bar{a}b = a+b]$

$= (a+b)(c+\bar{a})(b\overline{ac})$

$= (a+b)(c+\bar{a})(b.\bar{a}+\bar{c})$

$= (a+b)(c+\bar{a})(b\bar{a}+b\bar{c})$

$= (a\bar{a}+ac+bc+b\bar{a})(b\bar{a}+b\bar{c})$

$= (ac+bc+b\bar{a})(b\bar{a}+b\bar{c})$

$= \underbrace{ac.b\bar{a}}_{=0} + bc.b\bar{a} + b\bar{a}.b\bar{a} + \underbrace{ac.b\bar{c}}_{=0} + \underbrace{bc.b\bar{c}}_{=0} + b\bar{a}.b\bar{c}$

$= b\bar{a}c + b\bar{a} + b\bar{a}c$

$= b\bar{a}(c+1) + b\bar{a}c$

$= b\bar{a} + b\bar{a}c$

$= b\bar{a}(c+1)$

$= \underline{\underline{b\bar{a}}}$

a	b	c	a+b	$\bar{a}\bar{c}+c$	$\overline{\bar{b}+ac}$	output $(a+b)(\bar{a}\bar{c}+c)(\overline{\bar{b}+ac})$	$\bar{a}b$
0	0	0	0	1	0	0	0
0	0	1	0	1	0	0	0
0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	1
1	0	0	1	0	0	0	0
1	0	1	1	1	0	0	0
1	1	0	1	0	1	0	0
1	1	1	1	1	0	0	0

18 $AB + A\bar{B} + \bar{A}\bar{B}$

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

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

$A + \bar{A}\bar{B}$ $\quad [\bar{A}B + A = A + B]$

$A + \bar{B}$

20. Similar to 23 b)

21. Convert the following equations to their requested canonical form:

$P = A + \bar{B}C$ into (SOP)

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

$P = ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + A\bar{B}C + \bar{A}\bar{B}C$

$P = m_7 + m_6 + m_5 + m_4 + m_5 + m_1$

$P = \Sigma m(1, 4, 5, 6, 7)$

22. $Y = f(a,b,c,d) = \Sigma m(0,4,6,5,7,8,9,10,11,13,14,15)$

ab \ cd	00	01	11	10
00	1	0	0	0
01	1	1	1	1
11	0	1	1	1
10	1	1	1	0

$f(a,b,c,d) = \bar{a}\bar{c}\bar{d} + a\bar{b}\bar{c} + bc\bar{d} + \bar{a}b + ad$

Q3.

(i) $Y = f(a,b,c,d) = \Sigma m(1,2,3,4,8,9,10,12,13,14,15)$

ab \ cd	$\bar{c}\bar{d}$ 00	$\bar{c}d$ 01	cd 11	$c\bar{d}$ 10
$\bar{a}\bar{b}$ 00	0_{0}	1_{1}	1_{3}	1_{2}
$\bar{a}b$ 01	1_{4}	0_{5}	0_{7}	0_{6}
ab 11	1_{12}	1_{13}	1_{15}	1_{14}
$a\bar{b}$ 10	1_{8}	1_{9}	0_{11}	1_{10}

$$f(a,b,c,d) = ab + a\bar{c} + a\bar{d} + b\bar{c}\bar{d} + \bar{a}\bar{b}d + \bar{a}\bar{b}c$$

(ii) $Y = f(a,b,c,d) = \Sigma m(1,3,5,6,7,13,14) + \Sigma d(8,10,12)$

ab \ cd	00	01	11	10
00	0_{0}	1_{1}	1_{3}	0_{2}
01	0_{4}	1_{5}	1_{7}	1_{6}
11	X_{12}	1_{13}	0_{15}	1_{14}
10	X_{8}	0_{9}	0_{11}	X_{10}

$$f(a,b,c,d) = a\bar{d} + \bar{a}d + b\bar{c}d + bc\bar{d}$$

15

15) (i) $f(a,b,c) = \sum m(0,1,2,3,7)$

$2^3 = 2 \times 2 \times 2 = 8$

$a \backslash bc$	00	01	11	10
0	1 (0)	1 (1)	1 (3)	1 (2)
1	(4)	(5)	1 (7)	(6)

set 1 $= \bar{a}\bar{b}\bar{c} + \bar{a}\bar{b}c + \bar{a}bc + \bar{a}b\bar{c}$

$\bar{a}\bar{b} + \bar{a}b$

set 2 $\bar{a}bc + abc$

$= bc$

$\Rightarrow \bar{a} + bc$

(ii) $f(a,b,c) = \Sigma m(0,2,3,6,7)$

a \ bc	00	01	11	10
0	1 (0)	(1)	1 (3)	1 (2)
1	(4)	(5)	1 (7)	1 (6)

$b + \bar a \bar c$

Sol1: $\bar a bc + \bar a b\bar c + \cancel{\bar a}abc + ab\bar c$
$= b$

Sol2: $\bar a\bar b\bar c + \bar a b\bar c$
$= \bar a\bar c$

$= b + \bar a\bar c$

(iii) $f(a,b,c,d) = \Sigma m(0,1,3,7,8,9,11,15)$

ab \ cd	00	01	11	10
00	1 (0)	1 (1)	1 (3)	(2)
01	(4)	(5)	1 (7)	(6)
11	(12)	(13)	1 (15)	(14)
10	1 (8)	1 (9)	1 (11)	(10)

$cd + b'c'$

(iv) $f(a, b, c, d) = \Sigma m(0, 1, 3, 4, 5, 6, 9, 11, 12, 13, 14)$

ab \ cd	00	01	11	10
00	1_{0}	1_{1}	1_{3}	0_{2}
01	1_{4}	1_{5}	0_{7}	1_{6}
11	1_{12}	1_{13}	0_{15}	1_{14}
10	0_{8}	1_{9}	1_{11}	0_{10}

$\bar{a}\bar{c} + \bar{b}d + b\bar{d}$

17

$(1376.185)_{10} - (?)_2$

(iv) 1376 . 185

$$
\begin{array}{l|l}
2 & 1376 \\
\hline
 & 688 - 0 \\
 & 344 - 0 \\
 & 172 - 0 \\
 & 86 - 0 \\
 & 43 - 0 \\
 & 21 - 1 \\
 & 10 - 1 \\
 & 5 - 0 \\
 & 2 - 1 \\
 & 1 - 0
\end{array}
$$

10101100000

$\therefore (10101100000 \cdot 00101)_2$

$0.185 \times 2 = 0.37 = 0$

$0.37 \times 2 = 0.74 = 0$

$0.74 \times 2 = 1.48 = 1$

$0.48 \times 2 = 0.96 = 0$

$0.96 \times 2 = 1.92 = 1$

9 -
10 - A
11 -
12 -

17) (i) $(12.6532)_{10} = (?)_{16}$

$16 \,|\, 12$

$12 = C$

$0.6532 \times 16 = 10.4512 = A$

$0.4512 \times 16 = 7.2192 = 7$

$0.2192 \times 16 = 3.5072 = 3$

$0.5072 \times 16 = 8.1152 = 8$

$0.1152 \times 16 = 1.8432 = 1$

$0.8432 \times 16 = 13.4912 = D$

$0.4912 \times 16 = 7.8592 = 7$

$0.8592 \times 16 = 13.6192 = D$

~~CA~~ $(C.A7381D7D)_h$.

Date
Page

(iii) $7566_{(8)} \Rightarrow (?)_{16}$

$7 \times 8^3 + 5 \times 8^2 + 6 \times 8^1 + 6$

$3,584 + 320 + 48 + 6$

$= 3958$

16 | 3958
16 | 247 - 8
16 | 15 - 7

$(7566)_{10} = F76$

(iii) $CF \cdot 52_{(16)} \Rightarrow (?)_{10}$

$15 \times 10^0 + 5 \times 10^{-1} + 2 \times 10^{-2}$

$15 + 0.5 + 0.02$

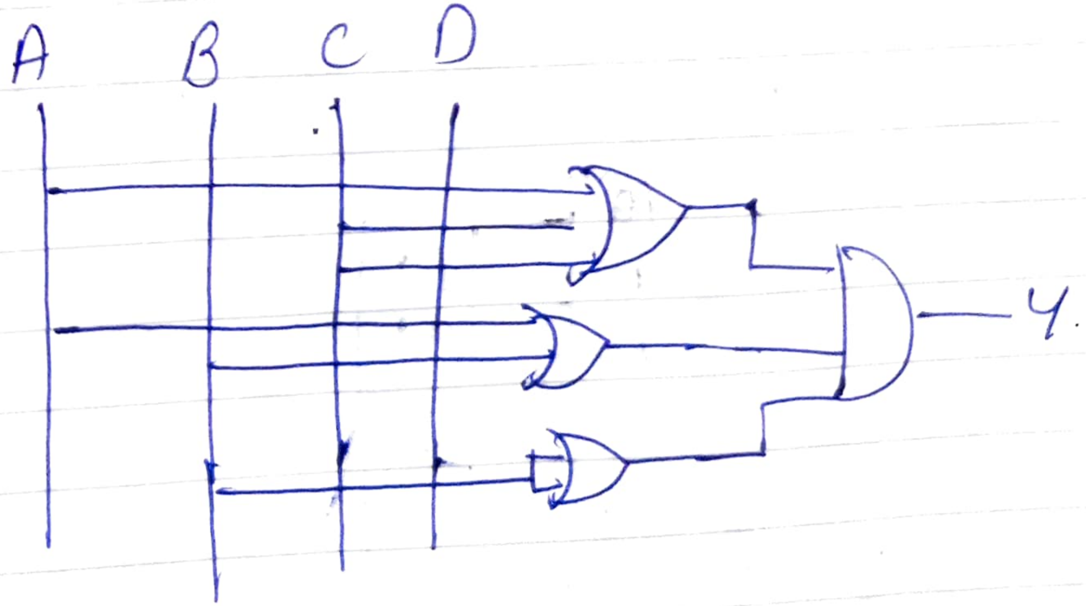
$= (15.52)_{10}$

A
B
C
D
E
F

24) $f(a,b,c,d) = \pi M(1,2,3,4,9,10) + dc(0,14,15)$

$A+B \backslash C+D$	$C+D$	$C+\bar{D}$	$\bar{C}+\bar{D}$	$\bar{C}+D$
$A+B$	X_0	0_1	0_3	0_2
$A+\bar{B}$	0_4	5	7	6
$\bar{A}+\bar{B}$	12	13	X_{15}	X_{14}
$\bar{A}+B$	8	0_9	11	0_{10}

$$Y = (A+C+D)(A+B)\cdot(B)$$

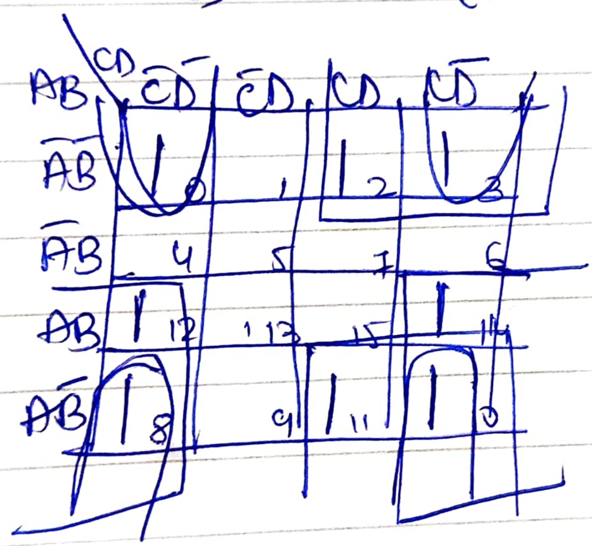


25) $Y = \bar{A}\bar{B}C\bar{D} + ABC\bar{D} + A\bar{B}C\bar{D} + A\bar{B}CD + A\bar{B}\bar{C}\bar{D} +$
$AB\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}\bar{D}$

$= \overset{8421}{0010} + \overset{8421}{1110} + \overset{8421}{1010} + \overset{8421}{1011} + \overset{8421}{1000} + \overset{8421}{1100} +$
$\overset{8421}{0011} + \overset{8421}{0000}$

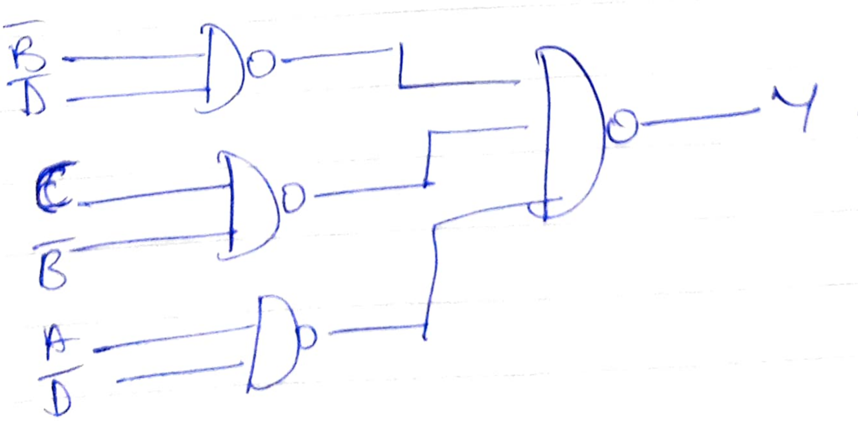
$= 2 + 14 + 10 + 11 + 8 + 12 + 3 + 0.$

$Y = F(ABCD) = \sum m(0, 2, 3, 8, 10, 12, 11, 14)$

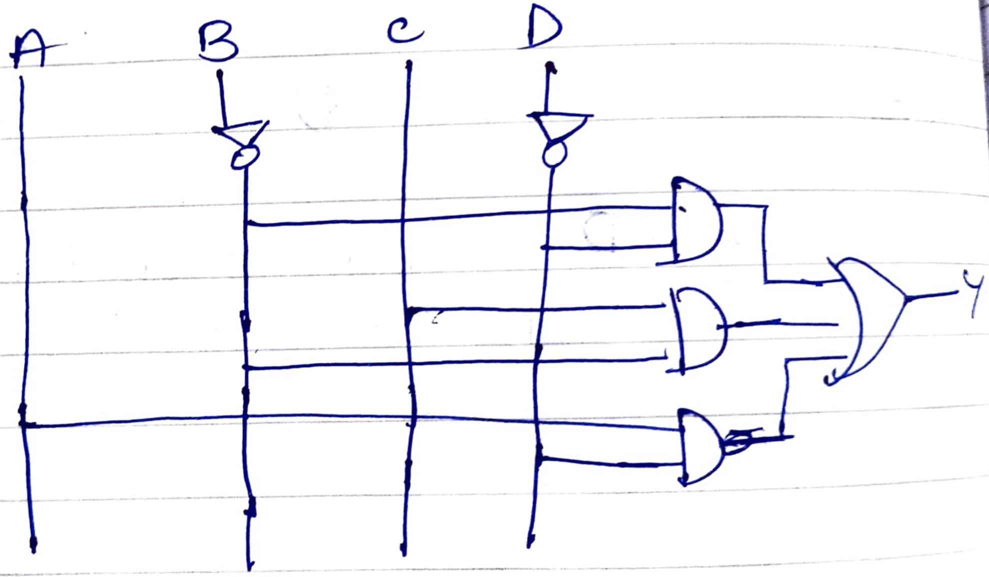


$Y = \bar{B}\bar{D} + C\bar{B} + A\bar{D}$

SOP $=$ $Y = \bar{B}\bar{D} + C\bar{B} + A\bar{D}$



२८) circuit.



27)

A_2	A_1	A_0		Y_5 (32)	Y_4 (16)	Y_3 (8)	Y_2 (4)	Y_1 (2)	Y_0 (1)
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	1
0	1	0	2	0	0	0	1	0	0
0	1	1	3	0	0	1	0	0	1
1	0	0	4	0	1	0	0	0	0
1	0	1	5	0	1	1	0	0	1
1	1	0	6	1	0	0	1	0	0
1	1	1	7	1	1	0	0	0	1

$$Y_0 = \bar{A}_2\bar{A}_1A_0 + \bar{A}_2A_1A_0 + A_2\bar{A}_1A_0 + A_2A_1A_0$$

$$\begin{array}{cccc} 001 & 011 & 101 & 111 \\ 1 & 3 & 5 & 7 \end{array}$$

$$Y_0 = f(A_2, A_1, A_0) = \sum m(1,3,5,7).$$

$A_2A_1 \backslash A_0$	$\bar{A}_0$	A_0
$\bar{A}_2\bar{A}_1$	0	1 (1)
$\bar{A}_2A_1$	2	1 (3)
A_2A_1	6	1 (7)
$A_2\bar{A}_1$	4	1 (5)

$$Y_0 = A_0.$$

Similary do for Y_1, Y_2, Y_3, Y_4, Y_5 (refer the truth table).

28) i) $X = \bar{A}B + BC$

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

OR

$$\begin{array}{cccccccc} & 4\,2\,1 & & 4\,2\,1 & & 4\,2\,1 & & 4\,2\,1 \\ X = & 011 & + & 010 & + & 111 & + & 011 \end{array}$$

$= 3 + 2 + 7 + 3$

$X = f(A,B,C) = \Sigma m(2,3,7)$

ii) $P = (\bar{W}+X)(Y+\bar{Z})$

$= \cancel{(\bar{W}+X+Y)\cdot(\bar{W}+X+\bar{Y})\cdot(W}$

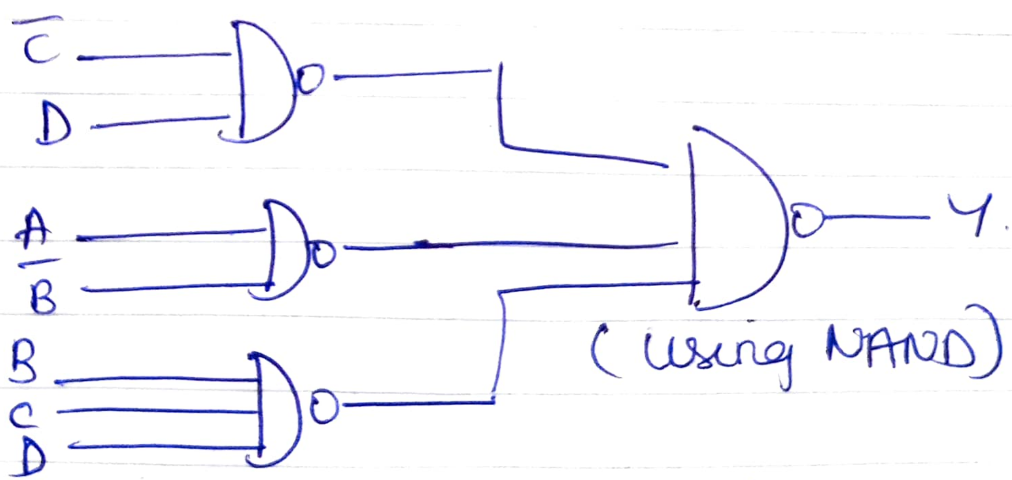
$P = (\bar{W}+X+Y+Z)\cdot(\bar{W}+X+\bar{Y}+\bar{Z})\cdot(\bar{W}+X+\bar{Y}+Z)\cdot$
$(\bar{W}+X+Y+\bar{Z})\cdot(W+X+Y+\bar{Z})\cdot(\bar{W}+\bar{X}+Y+\bar{Z})\cdot$
$(W+\bar{X}+\bar{Y}+Z)\cdot(\bar{W}+X+Y+Z)$.

29) $F(w,x,y,z) = \Sigma m(1,5,7,8,9,10,11,13,15)$.

~~A B C D~~

$AB \backslash CD$	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	1	2	3
$\bar{A}B$	4	1 (5)	1 (7)	6
AB	12	1 (13)	1 (15)	14
$A\bar{B}$	1 (8)	1 (9)	1 (11)	1 (10)

$Y = \bar{C}D + A\bar{B} + BCD$. (SOP)



(using NAND).

* you can draw using basic gates also

30) Design the logic circuit that controls passage of signal ~~of~~ A according to following requirements

i) Output x will equals A when control input B and C are same

ii) x will remain high when B and C are different.

A	B	C	X	
	B & C are same			
0	0	0	0	→ output equals to A
0	0	1	1	→ output is 1
	B & C are different			
0	1	0	1	
0	1	1	0	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

$X = \bar A\bar B C + \bar A B\bar C + A\bar B\bar C + A\bar B C + AB\bar C + ABC$

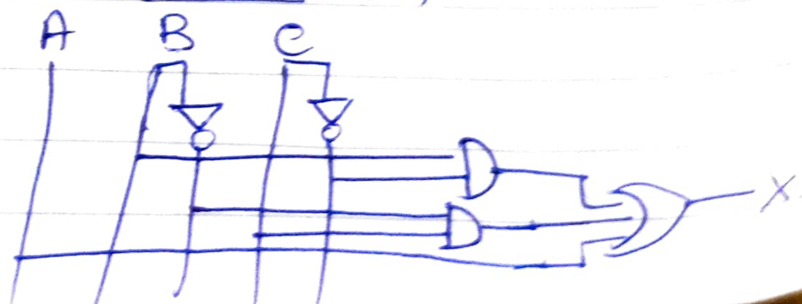
$X = 001 + 010 \quad 100 \quad 101 \quad 110 \quad 111$

$\quad 1 \quad 2 \quad 4 \quad 5 \quad 6 \quad 7$

$X = f(A,B,C) = \Sigma m(1,2,4,5,6,7)$

AB \ C	$\bar C$	C
$\bar A\bar B$	0 (0)	1 (1)
$\bar A B$	1 (2)	(3)
AB	1 (6)	1 (7)
$A\bar B$	1 (4)	1 (5)

$\Rightarrow X = B\bar C + \bar B C + A$



31)

P	Q	R	S		
0	0	0	1	m_0	~~ABC~~ $\bar{P}\bar{Q}\bar{R}$
0	0	1	1	m_1	$\bar{P}\bar{Q}R$
0	1	0	1	m_2	$\bar{P}Q\bar{R}$
0	1	1	1	m_3	$\bar{P}QR$
1	0	0	0	m_4	
1	0	1	0	m_5	
1	1	0	0	m_6	
1	1	1	1	m_7	PQR

$P=0$, $S=1$

$Q=R=1$

$$y = \underset{000}{\bar{P}\bar{Q}\bar{R}} + \underset{001}{\bar{P}\bar{Q}R} + \cancel{\bar{P}\bar{Q}R} + \underset{010}{\bar{P}Q\bar{R}} + \underset{011}{\bar{P}QR} + \underset{111}{PQR}$$

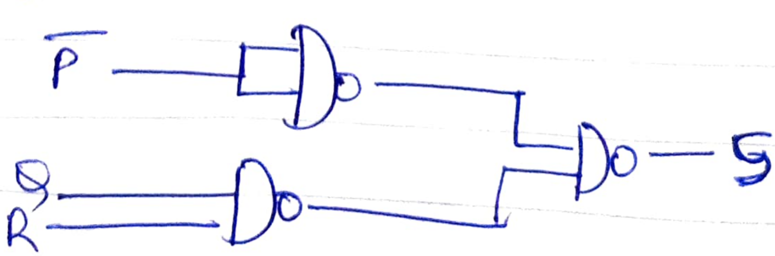
0 1 2 3 7

$$y = F(P,Q,R) = \Sigma m(0,1,2,3,7).$$

PQ \ R	$\bar{R}$	R
$\bar{P}\bar{Q}$	1 (0)	1 (1)
$\bar{P}Q$	1 (2)	1 (3)
PQ	(6)	1 (7)
$P\bar{Q}$	(4)	(5)

$\bar{P}\bar{Q}\bar{R}$
$\bar{P}\bar{Q}R$
$\bar{P}Q\bar{R}$
$\bar{P}QR$

$$S = \bar{P} + QR.$$



classmate
Date
Page

Q33) Design a combinational circuit which accepts two - 2 bit binary numbers and generates 3 outputs. The first output indicates when the 2 numbers differ by two or more, the second output indicates wether 2 numbers are identical and the third output indicates when the first no exceeds 2nd no. → Draw separate K-map for each O/P. circuit also separate

	A	B	C	D		Y_1	Y_2	Y_3
0	0	0	0	0	0	0	1	0
0	0	0	0	1	1	0	0	0
0	0	0	1	0	2	1	0	0
0	0	0	1	1	3	1	0	0
1	0	1	0	0	0	0	0	1
1	0	1	0	1	1	0	1	0
1	0	1	1	0	2	0	0	0
1	0	1	1	1	3	1	0	0
2	1	0	0	0	0	1	0	1
2	1	0	0	1	1	0	0	1
2	1	0	1	0	2	0	1	0
2	1	0	1	1	3	0	0	0
3	1	1	0	0	0	1	0	1
3	1	1	0	1	1	1	0	1
3	1	1	1	0	2	0	0	1
3	1	1	1	1	3	0	1	0

if equal (Y_2)

2 - 0 = 2

3 - 0 = 3

1 - 1 = 0

2 - 1 = 1

3 (3 - 1 = 2)

differ by 2 or more

for all 3 output you must compare this

equation.

$$y_1 = \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}D$$

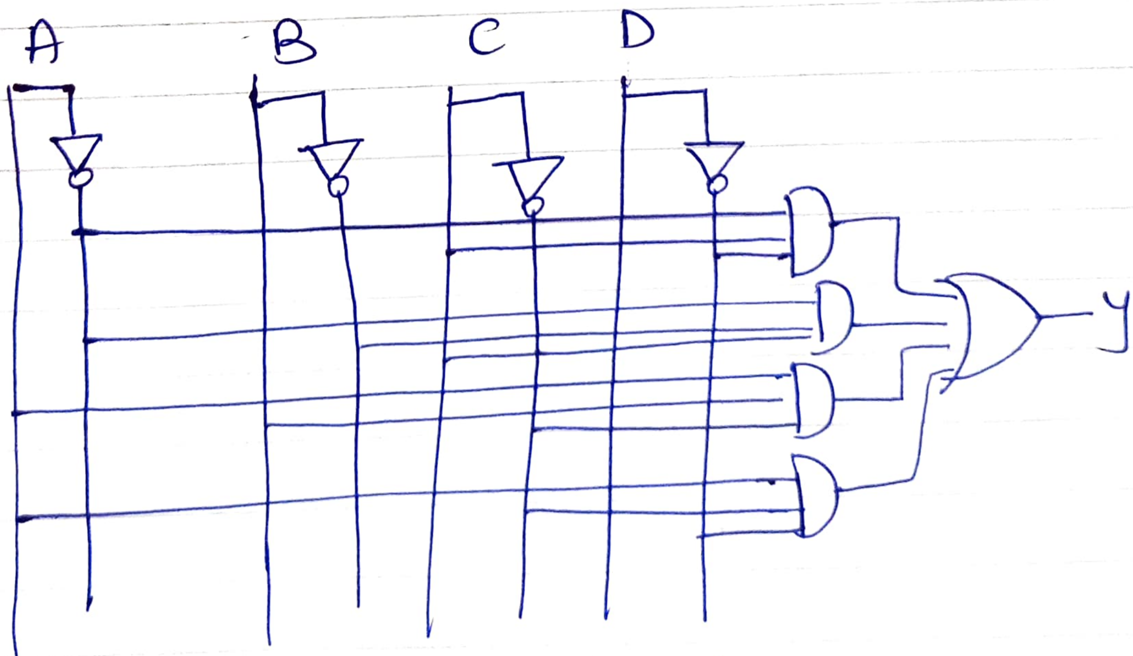
$$= \overset{8421}{0010} \quad \overset{8421}{0011} \quad \overset{8421}{0111} \quad \overset{8421}{1000} \quad \overset{8421}{1100} \quad \overset{8421}{1101}$$

$$\quad 2 \quad\quad 3 \quad\quad 7 \quad\quad 8 \quad\quad 12 \quad\quad 13$$

$$y_1 = f(A,B,C,D) = \Sigma m(2,3,7,8,12,13)$$

AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	1	1 2	1 3
$\bar{A}B$	4	5	1 7	6
AB	1 12	1 13	15	14
$A\bar{B}$	1 8	9	11	10

$$y_1 = \bar{A}CD + \bar{A}\bar{B}C + AB\bar{C} + A\bar{C}\bar{D}.$$



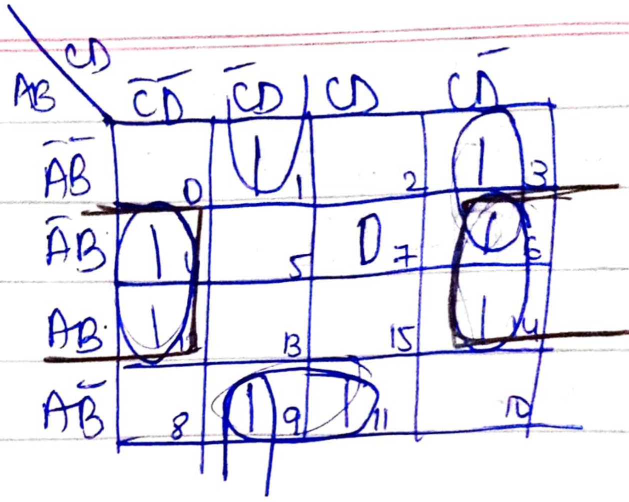
* Similarly do for y_2 & y_3, by refering the truth table.

3)

	A	B	C	D		Y		
0	0	0	0	0	0	0	m_0	
0	0	0	0	1	1	1	m_1	$\bar{A}\bar{B}\bar{C}D$
0	0	0	1	0	2	0	m_2	
0	0	0	1	1	3	1	m_3	$\bar{A}\bar{B}CD$
1	0	1	0	0	0	1	m_4	$\bar{A}B\bar{C}\bar{D}$
1	0	1	0	1	1	0	m_5	
1	0	1	1	0	2	1	m_6	$\bar{A}BC\bar{D}$
1	0	1	1	1	3	0	m_7	
2	1	0	0	0	0	0	m_8	
2	1	0	0	1	1	1	m_9	$A\bar{B}\bar{C}D$
2	1	0	1	0	2	0	m_{10}	
2	1	0	1	1	3	1	m_{11}	$A\bar{B}CD$
3	1	1	0	0	0	1	m_{12}	$AB\bar{C}\bar{D}$
3	1	1	0	1	1	0	m_{13}	
3	1	1	1	0	2	1	m_{14}	$ABC\bar{D}$
3	1	1	1	1	3	0	m_{15}	

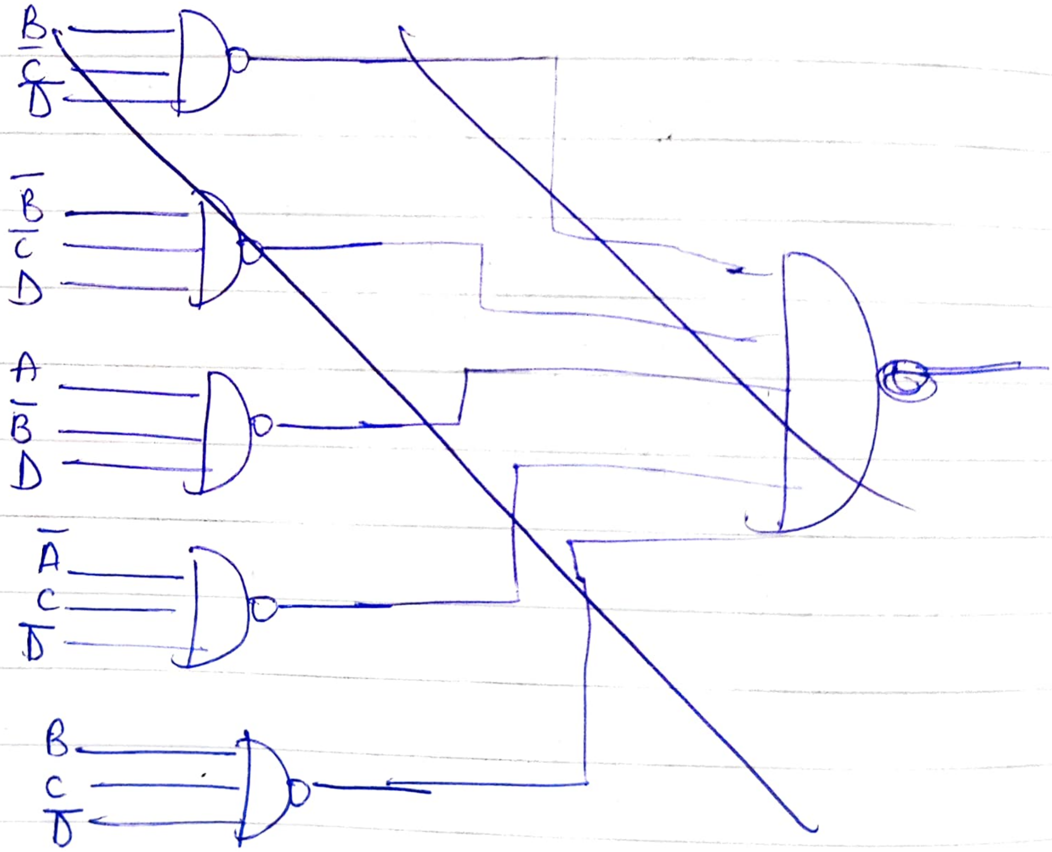
$$Y = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}BC\bar{D} + A\bar{B}\bar{C}D + A\bar{B}CD + AB\bar{C}\bar{D} + ABC\bar{D}$$

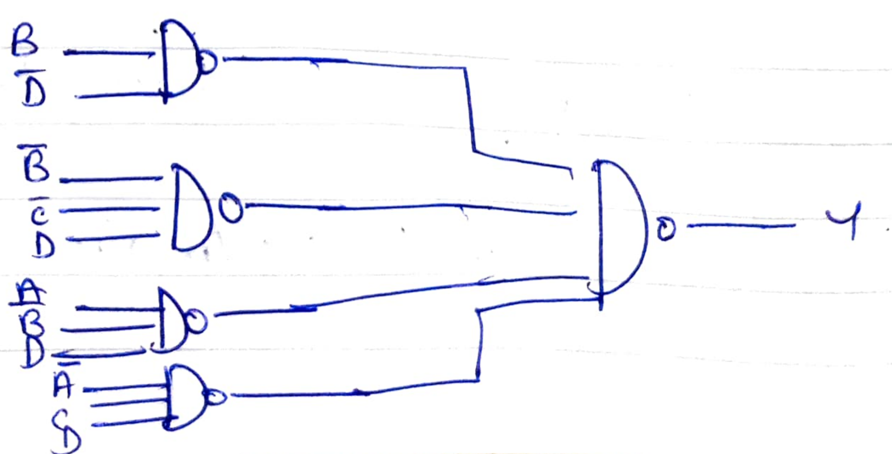
$$Y = F(A,B,C,D) = \sum m(1,3,4,6,9,11,12,14)$$



$Y = \cancel{B\bar C\bar D + \bar B \bar C D + A\bar B D + \bar A C \bar D + BC\bar D}$.

$B\bar D + \bar B \bar C D + A\bar B D + \bar A C D$.





26

26) $(98.23)_{10} = (?)_2 = (?)_{16}$

$$
\begin{array}{r|l}
2 & 98 \\
\hline
 & 49 - 0 \\
 & 24 - 1 \\
 & 12 - 0 \\
 & 6 - 0 \\
 & 3 - 0 \\
 & 1 - 1
\end{array}
$$

$98 = 1100010$

$0.23 \times 2 = 0.46 = 0$

$0.46 \times 2 \quad 0.92 = 0$

$0.92 \times 2 = 1.84 = 1$

$0.84 \times 2 = 1.68 = 1$

$0.68 \times 2 = 1.36 = 1$

$0.36 \times 2 = 0.72 = 0$

$0.72 \times 2 = 1.44 = 1$

$\therefore \Rightarrow 1100010.0011101$

$\underline{O}$.

$P = (\bar{w} + x)(y + \bar{z})$

$P = (\bar{w} + x + yy' + zz')(y + \bar{z} + x\bar{x} + w\bar{w})$

$\Rightarrow (\bar{w} + x + y + z)(\cancel{\bar{w} + x} + y + \bar{z})(\bar{w} + x + y + z)(\bar{w} + x + y' + \bar{z})$

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

$= M_8, M_{10}, M_{11}, M_1, M_9, M_5, M_{13}$.

Date :

(iv.) $1376.185_{(10)} = (?)_2$

$$
\begin{array}{r|l}
2 & 1376 \\
2 & 688 - 0 \\
2 & 344 - 0 \\
2 & 172 - 0 \\
2 & 86 - 0 \\
2 & 43 - 0 \\
2 & 21 - 1 \\
2 & 10 - 1 \\
2 & 5 - 0 \\
2 & 2 - 1 \\
 & 1 - 0
\end{array}
$$

$0.185 \times 2 = 0.37 - 0$

$0.37 \times 2 = 0.74 - 0$

$0.74 \times 2 = 1.48 \rightarrow 1$

$0.48 \times 2 = 0.96 \rightarrow 0$

$\therefore (10101100000.0010)_2$

19.) b

(i.) $R = L + \bar{M}(\bar{N}M + \bar{M}L)$ into SOP form

$= L + \bar{M}\bar{N}M + \bar{M}\bar{M}L$

$\bar{M}M = 0$

$\bar{M}\bar{M} = \bar{M}$

$= L + \bar{M}L\,\cancel{(N + \bar{N})}$

$= L(1 + \bar{M})$ $\cancel{1}$

$= L(N + \bar{N})(M + \bar{M})$

$= LMN + LM\bar{N} + L\bar{M}N + L\bar{M}\bar{N}$

35)

(A) Q_1	(B) Q_2	(C) Q_3	Y	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	1	$\bar{A}BC$
1	0	0	1	$A\bar{B}\bar{C}$
1	0	1	1	$A\bar{B}C$
1	1	0	1	$AB\bar{C}$
1	1	1	1	ABC

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

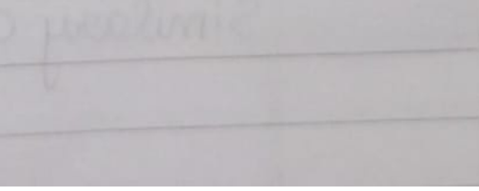
$$\underset{3}{011} \quad \underset{4}{100} \quad \underset{5}{101} \quad \underset{6}{110} \quad \underset{7}{111}$$

$$Y = f(A,B,C) = \Sigma m(3,4,5,6,7)$$

AB \ C	$\bar{C}$	C
$\bar{A}\bar{B}$	0	1
$\bar{A}B$	2	1 (3)
AB	1 (6)	1 (7)
$A\bar{B}$	1 (4)	1 (5)

$Y = A + BC$

circuit ⇒



36)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

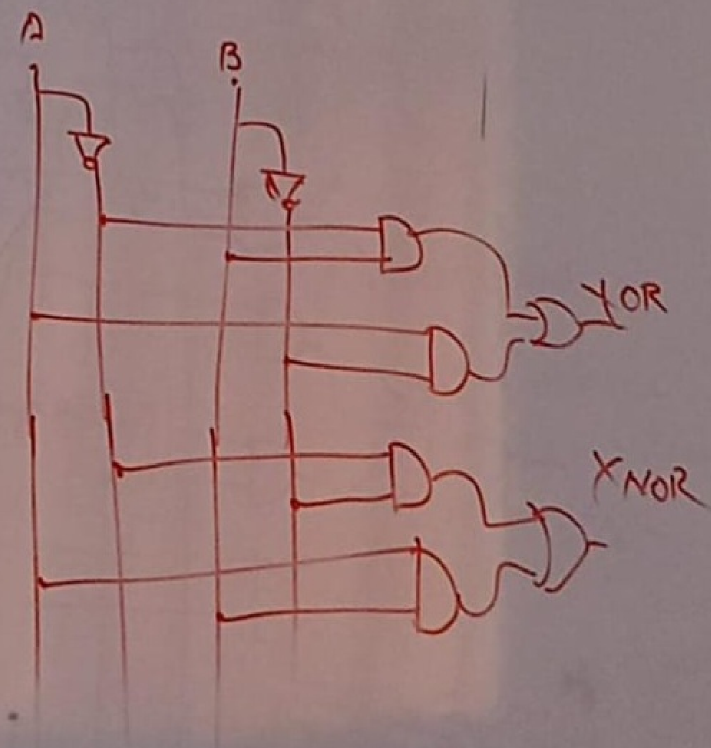
$Y = \bar{A}B + A\bar{B}$

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

$Y = \bar{A}\bar{B} + AB$

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

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



DeMorgan's Theorems

37)

(i) $\overline{A+B} = \overline{A}\,\overline{B}$

(ii) $\overline{AB} = \overline{A} + \overline{B}$

A	B	$\overline{A}$	$\overline{B}$	$A+B$	$\overline{A+B}$	$\overline{A}\,\overline{B}$	AB	$\overline{AB}$	$\overline{A}+\overline{B}$
0	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	0	0	1	1
1	0	0	1	1	0	0	0	1	1
1	1	0	0	1	0	0	1	0	0

38) i)

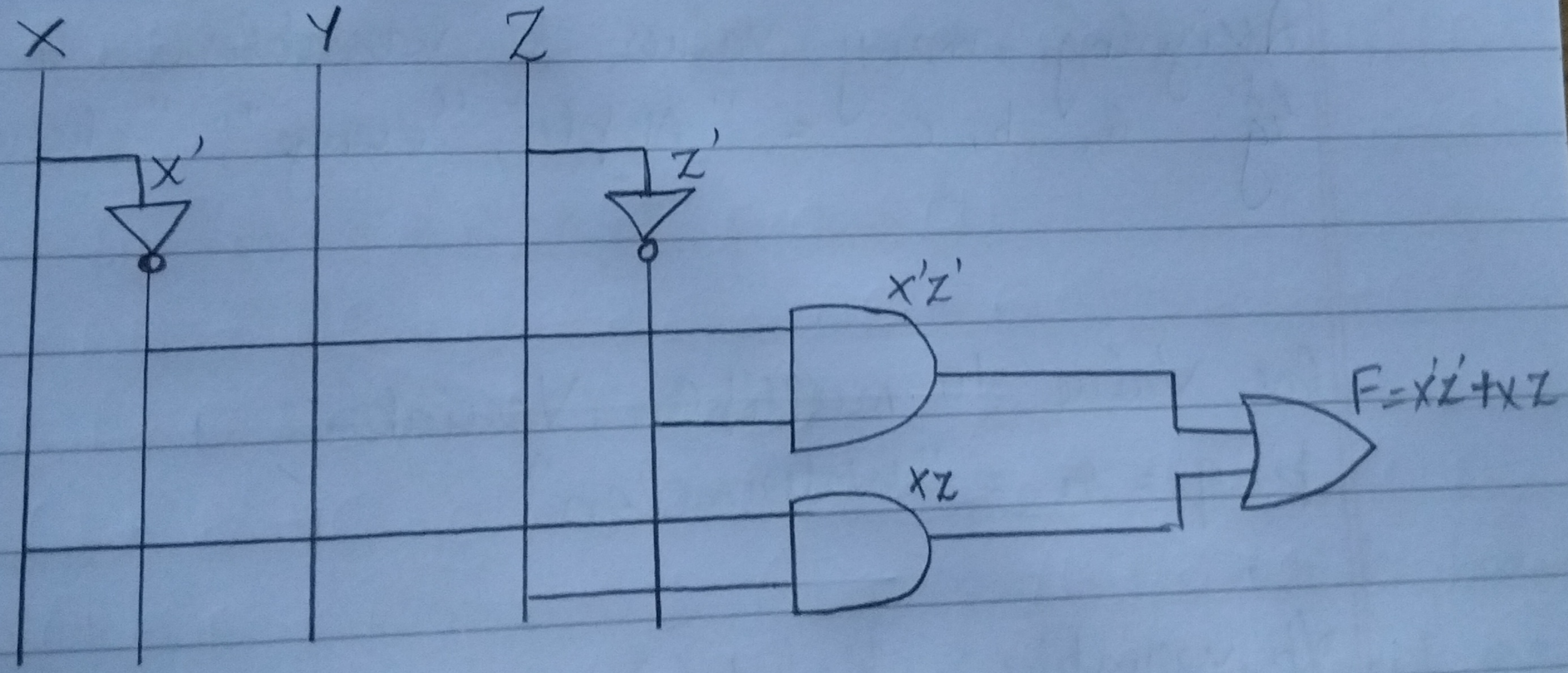
38) i) $F = \bar{x}\,\bar{y}\,\bar{z} + x\bar{y}z + \bar{x}y\bar{z} + xyz$

$\longrightarrow$ $F = x'y'z' + xy'z + x'yz' + xyz$

$= x'z'(y' + y) + xz(y' + y)$

$= x'z' \cdot 1 + xz \cdot 1$ $\quad (\because y + y' = 1)$ (complement)

$F = x'z' + xz$



38) ii)

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

$\longrightarrow$ $F = (A+B'+C)(A'+B'+C)$

By distributive law,

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

$= AA' + AB' + AC + A'B' + B'B' + B'C + A'C + B'C + CC$

$= 0 + AB' + AC + A'B' + B' + B'C + A'C + B'C + C$

$[\because AA' = 0,\ B'B' = B',\ C \cdot C = C]$

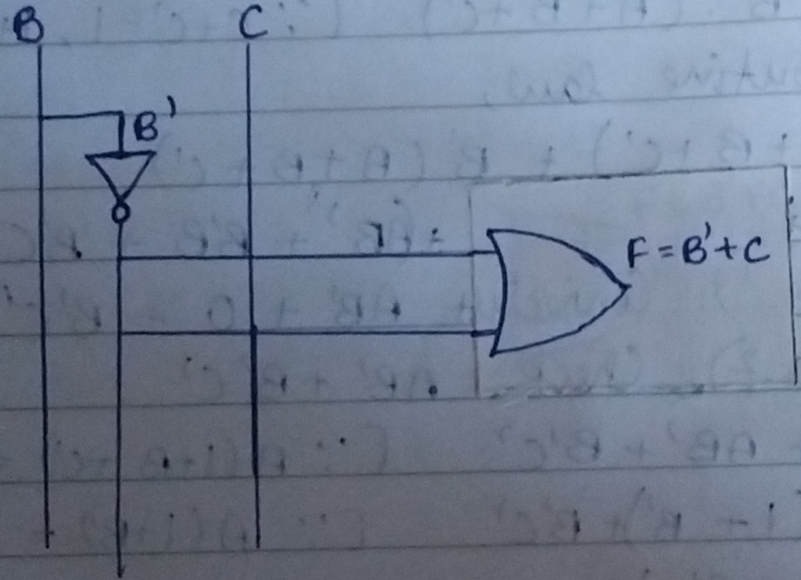
$= AB' + AC + A'B' + B' + B'C + A'C + B'C + C$

$= B'(\underbrace{A+A'}+1+\underbrace{C+C}) + AC + A'C + C$

$= B'(\underbrace{1+1}+C) + AC + A'C + C$

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

$\underline{F = B'+C}$ $[\because A+A' = 1\ \&\ 1+1 = 1]$



39)

Differences of Analog and Digital Signals

Analog Signals	**Digital Signals**
Continuous both time and amplitude	Discrete in time and quantized in amplitude
Infinite range of values	Finite range of values
More exact values, but more difficult to work with	Not as exact as analog, but easier to work with
Storing such a signal requires large amount of memory	Storing such a signal requires less amount of memory
Processing requires large processing power or more time	Processing requires low processing power or less time
Transmitting requires a large bandwidth	Transmitting requires a less bandwidth than analog

41)

41) $F = (A+B'+C')(A+B'+C)(A+B+C')$

$\rightarrow$ By using distributive law,

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

$= (AA + AB' + AC + AB' + B'B' + B'C + AC' + B'C' + CC').(A+B+C')$

$= (A + AB' + AC + AB' + B' + B'C + AC' + B'C' + 0).(A+B+C')$

$[\because AA = A,\ B'.B' = B',\ C.C' = 0]$

$= (A + AB' + AC + B' + B'C + AC' + B'C').(A+B+C')$

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

$= A(1+B'+\underbrace{C+C'}) + B'(1+C+C').(A+B+C')$

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

$= A + B'.(A+B+C')$ $[\because C+C'=1,\ 1+1=1,\ 1+B'=1]$

By distributive law,

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

$= (A.A + AB + AC') + (AB' + B'B + B'C')$

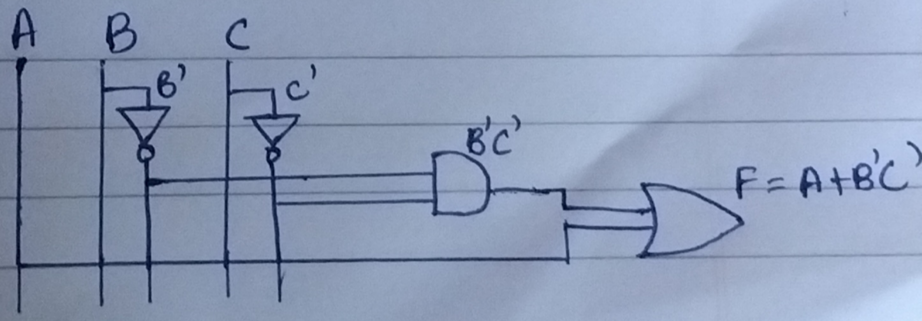
$= A + AB + AC' + AB' + 0 + B'C'$

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

$= A + AB' + B'C'$ $[\because A(1+B+C') = 1]$

$= A(1+B') + B'C'$ $[\because A(1+B') = 1]$

$F = \underline{A + B'C'}$



42)

42) $F(A,B,C) = A'BC' + ABC' + ABC$

$\longrightarrow \quad = 010 + 110 + 111 \Rightarrow \Sigma m(2,6,7)$

$\therefore F(A,B,C) = \Sigma m(2,6,7)$

A \ BC	00	01	11	10
0	0 (000)	0 (001)	0 (011)	1 (010)
1	0 (100)	0 (101)	1 (111)	1 (110)

$F = AB + BC'$

$\therefore F(A,B,C) = AB + BC'$

43) $Y = f(a,b,c) = c'$

43)

	a	b	c	$Y = c'$
m_0	0	0	0	1
m_1	0	0	1	0
m_2	0	1	0	1
m_3	0	1	1	0
m_4	1	0	0	1
m_5	1	0	1	0
m_6	1	1	0	1
m_7	1	1	1	0

$$\underbrace{\begin{aligned} m_0 &= a'b'c' \\ m_2 &= a'bc' \\ m_4 &= ab'c' \\ m_6 &= abc' \end{aligned}}_{\text{minterm list}}$$

$Y = \Sigma m(0,2,4,6) = a'b'c' + a'bc' + ab'c' + abc'$

↳ Canonical form

43)

abc \ c	0	1
00	1 $_{000}$	0 $_{001}$
01	1 $_{010}$	0 $_{011}$
11	1 $_{110}$	0 $_{111}$
10	1 $_{100}$	0 $_{101}$

$Y = c'$

44. (a) $1101 - 1001$

$-3 - (-7)$

$7 + (-3) = 4$

$3 \Rightarrow 0011$

1's complement of $3 = 1100$

2's complement of $3 = 1100$

$$\begin{array}{r} 1100 \\ +\quad 1 \\ \hline 1101 \end{array}$$

$$7 + (-3) \Rightarrow \begin{array}{r} 0111 \\ 1101 \\ \hline 10100 \end{array} \Rightarrow \underline{\underline{4}}$$

$\therefore 1101 - 1001 = \underline{\underline{0100}}$

(b) $1001 - 1101$

$-7 - (-3)$

$3 - 7 = -4$

$7 \Rightarrow 0111$

1's complement of $7 = 1000$

2's complement of $7 = 1000$

$$\begin{array}{r} 1000 \\ +\quad 1 \\ \hline 1001 \end{array}$$

$$3 - 7 \Rightarrow \begin{array}{r} 0011 \\ 1001 \\ \hline 1100 \end{array} \Rightarrow -4$$

$1001 - 1101 = \underline{\underline{1100}}$

45. (i) $(1A2)_{16} = (?)_{10}$

$= (1\times16^2) + (10\times16^1) + (2\times16^0)$

$= 256 + 160 + 2$

$= \underline{\underline{(418)}}_{10}$

$\Longrightarrow \underline{\underline{(1A2)_{16} = (418)_{10}}}$

0 – 9
A – 10
B – 4
C – 12
D – 13
E – 14
F – 15

(ii) $(45.25)_{10} = (?)_2$

$$\begin{array}{r|ll} 2 & 45 & \\ 2 & 22 & -1 \\ 2 & 11 & -0 \\ 2 & 5 & -1 \\ 2 & 2 & -1 \\ 2 & 1 & -0 \\ & 0 & -1 \end{array}$$

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

$0.25 \times 2 = 0.5 \Longrightarrow 0$

$0.5 \times 2 = 1.0 \Longrightarrow 1$

$(0.25)_{10} = (01)_2$

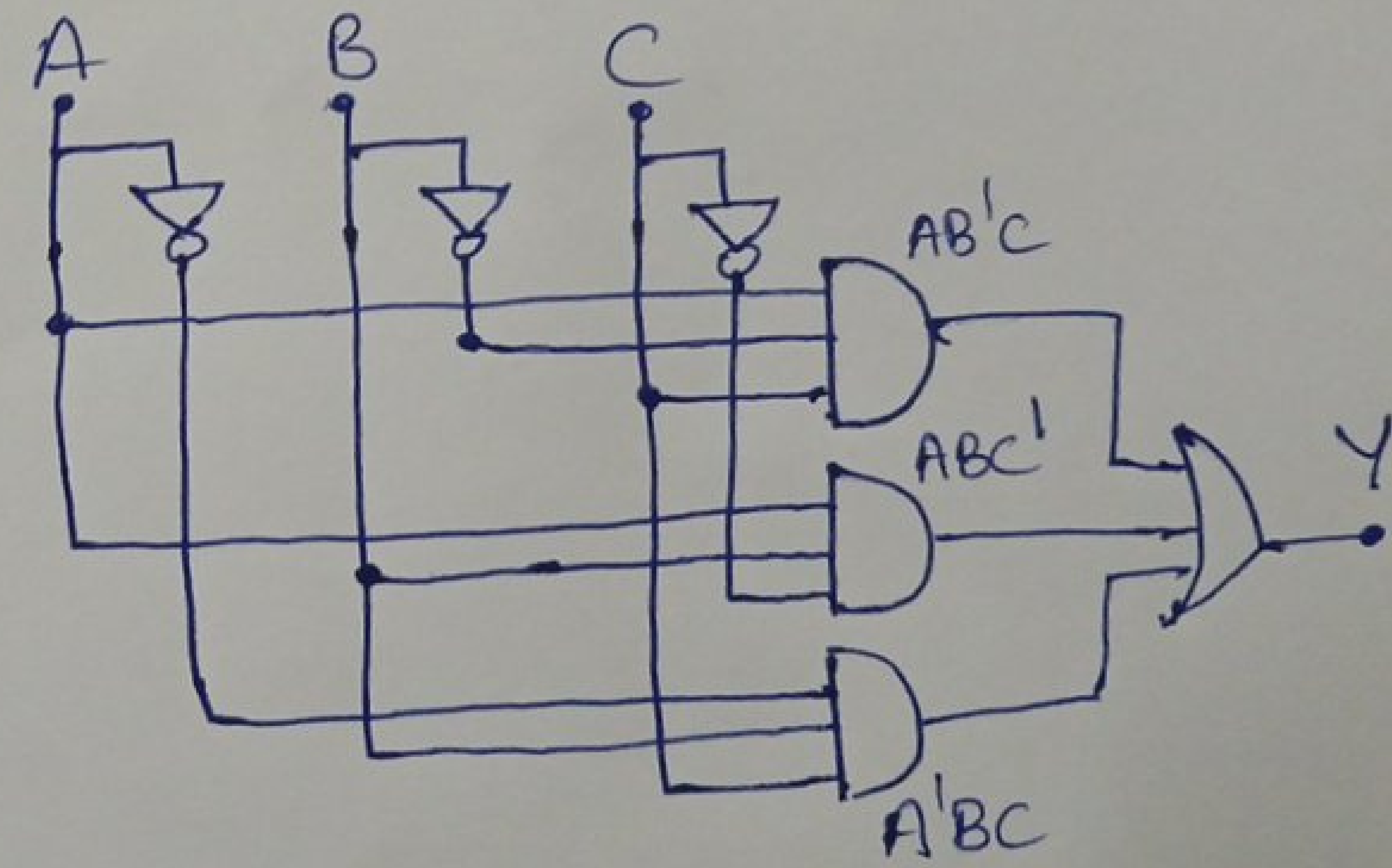
$\Longrightarrow \underline{(45.25)_{10} = (101101.01)_2}$

46.

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a \ bc	00	01	11	10
0	0 (000)	0 (001)	1 (011)	0 (010)
1	0 (100)	1 (101)	0 (111)	1 (110)

$$Y = AB'C + ABC' + A'BC$$



48. $f(a, b, c) = \sum m(0, 2, 3, 4, 6, 7) = Y$

a \ bc	00	01	11	10
0	1 000	001	1 011	1 010
1	1 100	101	1 111	1 110

$$Y = b'c' + b$$

49. $(A6.7)_{16} \longrightarrow (?)$

$(A6.7)_{16} \longrightarrow (10100110.0111)_2$

5. Commutative law

(0, 3, 5, 6, 9, 10, 12, 15)
or
(1, 2, 4, 7, 8, 11, 13, 14)

Add^n $\Rightarrow$ $A+B = B+A$

Multiplication $\Rightarrow$ $AB = BA$

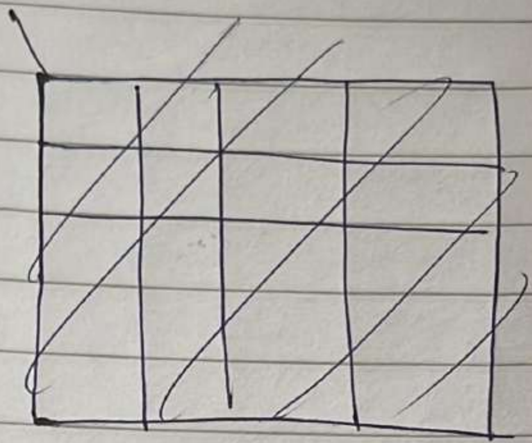
A	B	A+B	B+A	A*B	B*A
0	0	0	0	0	0
0	1	1	1	0	0
1	0	1	1	0	0
1	1	1	1	1	1

Using truth table, it is hence verified that commutative property holds true for both add^n and multiplication.

$\therefore$ $A+B = B+A$ & $A*B = B*A$

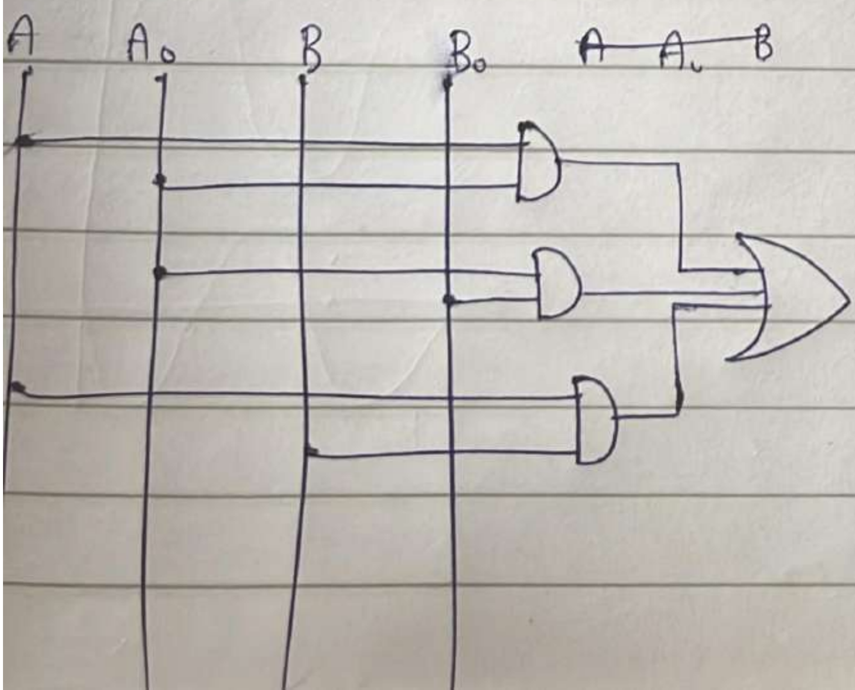
5

A	A_0	B	B_0	Y
0	0	0	0	X
0	0	0	1	0
0	0	1	0	0
0	0	1	1	X
0	1	0	0	0
0	1	0	1	X
0	1	1	0	X
0	1	1	1	1
1	0	0	0	0
1	0	0	1	X
1	0	1	0	X
1	0	1	1	1
1	1	0	0	X
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1



AA_0 \ BB_0	00	01	11	10
00	0		X	
01		X	1	X
11	X	1	1	1
10		X	1	X

$= AA_0 + A_0B_0 + AB$



53)

	A	B	C	D		Y	
0	0	0	0	0	0	0	
0	0	0	0	1	1	0	
0	0	0	1	0	2	0	
0	0	0	1	1	3	0	
1	0	1	0	0	0	0	
1	0	1	0	1	1	1	$\bar{A}B\bar{C}D$
1	0	1	1	0	2	1	$\bar{A}BC\bar{D}$
1	0	1	1	1	3	1	$\bar{A}BCD$
2	1	0	0	0	0	0	
2	1	0	0	1	1	1	$A\bar{B}\bar{C}D$
2	1	0	1	0	2	1	$A\bar{B}C\bar{D}$
2	1	0	1	1	3	1	$A\bar{B}CD$
3	1	1	0	0	0	0	
3	1	1	0	1	1	1	$AB\bar{C}D$
3	1	1	1	0	2	1	$ABC\bar{D}$
3	1	1	1	1	3	1	$ABCD$

$$Y = \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}BCD + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} +$$

$$\begin{array}{ccccc} \overset{8421}{0101} & \overset{421}{0110} & \overset{421}{0111} & \overset{8421}{1001} & \overset{8421}{1010} \end{array}$$

$$A\bar{B}CD + AB\bar{C}D + ABC\bar{D} + ABCD$$

$$\begin{array}{cccc} \overset{8421}{1011} & \overset{8421}{1101} & \overset{8421}{1110} & \overset{8421}{1111} \end{array}$$

5 6 7 9 10 11 13 14 15

$$Y = f(A,B,C,D) = \sum m(5,6,7,9,10,11,13,14,15)$$

AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	1	3	2
$\bar{A}B$	4	1 5	1 7	1 6
AB	12	1 13	1 15	1 14
$A\bar{B}$	8	1 9	1 11	1 10

$$Y = A\bar{C}D + \bar{A}BD + BC + AC$$