TYPE A : VERY SHORT ANSWER QUESTIONS

NOTE: " ' " is used instead of " - " .

1.	Name the person who developed Boolean algebra.	
Ans.		
2.	What is the other name of Boolean algebra? In which year was the Boolean algebra developed?	
Ans.	Other name of Boolean algebra is 'Switching Algebra'. Boolean algebra was developed in 1854.	
3.	What is the binary decision? What do you mean by a binary valued variable?	
Ans.	 Variables which can store truth values TRUE or FALSE are called logical variables or binary valued variable 	
4.	What do you mean by tautology and fallacy?	:5.
4. Ans.		
Alls.	FALSE or 0 it is called Fallacy.	ways
5.		
	What is a logic gate? Name the three basic logic gates.	
Ans.		
	Three basic logic gates are as following	
	1. Inverter (NOT Gate)	
	2. OR Gate	
6	3. AND Gate	
6.	Which gates implement logical addition, logical multiplication and complementation?	
Ans.		
	✓ AND gate implements logical multiplication	
-	✓ Inverter(NOT gate) implements complementation	
7.	What is the other name of NOT gate?	
Ans.		
8.	What is a truth table? What is the other name of truth table?	
Ans.		ie
	possible results of the given combinations of values.	
9.	Write the dual of : 1 + 1 = 1	
Ans	The dual of 1 + 1 = 1 is 0. 0 =0	
: 10.	Give the dual of the following in Boolean algebra :	
10.	(i) X . X' = 0 for each X (ii) X + 0 = X for each X	
Ans.		
Alls.	(i) $X + X = 1$ (ii) $X \cdot 1 = X$	
11.	Which of the following Boolean equation is/are incorrect? Write the correct forms of the incorrect ones :	
	(a) $A + A' = 1$ (b) $A + 0 = A$ (c) $A \cdot 1 = A$	
	(d) $AA'=1$ (e) $A+AB=A$ (f) $A(A+B)'=A$	
	(a) $A = 1$ (b) $(A = B) = A$ (c) $A = B = A$ (c) $A $	
	(i) (X + Y) = X + B (i)	
	(a) Correct (b) Correct (c) Correct	
Ans.		
AII3.	(e) Correct (f) Correct	
	(g) Incorrect. Correct form is $(A + B)' = A'B'$	
	(h) Incorrect. Correct form is (AB), = A' + B'	
	(i) Correct (j) Correct (k) Correct	
	(i) contect (i) contect (i) contect (ii) contect (ii) contect (ii) contect (ii) contect (ii) contect (iii) contec	
12.	What is the significance of Principle of Duality?	
Ans.		ean
AII3.	relation, another Boolean relation can be derived by :	can
	1. Changing each OR sign (+) to an AND sign(.).	
	2. Changing each AND sign (.) to an OR sign(+).	
	3. Replacing each 0 by 1 and each 1 by 0	

13. Ans.	How many input combination can be there in the truth table of a logic system having (N) input binary variables? There can be 2 ^N input combination in the truth table of a logic system having (N) input binary variables.
14.	Write dual of the following Boolean Expression : (a) (x + y') (b) xy + xy' + x'y (c) a + a'b + b' (d) (x + y' + z)(x + y)
A.m.c	
Ans.	
45	(c) a . (a' + b) . b' (d) xy'z + xy
15.	Find the complement of the following functions applying De'Morgan's theorem
_	(a) $F(x,y,z) = x'yz' + x'y'z$ (b) $F(x,y,z) = x(y'z + yz)$
Ans.	(a) $x'yz' + x'y'z$ (b) $x(y'z + yz)$
	= (x'yz' + x'y'z)' = x' + (y'z + yz)'
	= (x'yz')'(x'y'z)' = x' + (y'' + z')(y' + z')
	= (x'' + y' + z'')(x'' + y'' + z') = x' + (y + z')(y' + z')
	= (x + y' + z)(x + y + z')
16.	What is the logical product of several variables called? What is the logical sum of several variables called?
Ans.	Logical product of several variables is called Minterm and logical sum of several variables is called Maxterm.
17.	What is the procedure "Break the line, change the sign"?
Ans.	The procedure "Break the line, change the sign" is called demorganization which is performed by following steps :
	1. Complement the entire function
	2. Change all ANDs (.) to ORs (+) and all the ORs (+) to ANDs (.)
	Complement each of the individual variables.
18.	What is a logical product having all the variables of a function called?
Ans.	Logical product having all the variables of a function is called Minterm.
19.	What is a logical sum having all the variables of a function called?
Ans.	Logical sum having all the variables of a function is called Maxterm.
20.	What do you understand by a Minterm and Maxterm?
Ans.	Minterm: - Minterm is a product of all the literals within the logic system. Each literal may be with or without the bar
	(i.e. complemented).
	Maxterm:- Maxterm is a product of all the literals within the logic system. Each literal may be with or without the bar
	(i.e. complemented).
21.	Write the minterm and Maxterm for a function $F(x,y,z)$ when $x = 0$, $y = 1$, $z = 0$.
Ans.	Minterm : x'yz'
	Maxterm: x + y' + z
22.	Write the minterm and Maxterm for a function $F(x,y,z)$ when $x = 1$, $y = 0$, $z = 0$.
Ans.	Minterm : xy'z'
	Maxterm: x' + y + z
23.	Write short hand notation for the following minterms : XYZ, X'YZ', X'YZ
Ans.	Short hand notation for the minterms XYZ, X'YZ', X'YZ is $F = \Sigma(2, 3, 7)$
24.	Write short hand notation for the following maxterms :
	X + Y + Z, X + Y' + Z, X' + Y + Z', X + Y' + Z'
Ans.	Short hand notation for the maxterms $X + Y + Z$, $X + Y' + Z$, $X' + Y + Z'$, $X + Y' + Z'$ is $F = \pi(0, 2, 3, 5)$
25.	What is the Boolean expression, containing only the sum of minterms, called?
Ans.	The Boolean expression, containing only the sum of minterms, is called Canonical Sum- of –Product Form of an
	expression.
26.	What is the Boolean expression, containing only the product of Maxterms, called?
Ans.	The Boolean expression, containing only the product of Maxterms, is called Canonical Product- of –Sum Form of an
	expression.
27.	What is the other name of Karnaugh map? Who invented Karnaugh maps?
Ans.	The other name of Karnaugh map is Veitch diagrams. Maurice Karnaugh was invented Karnaugh maps.
28.	Why are NAND and NOR gates called Universal gates?
Zð. Ans	Circuits using NAND and NOR are popular as they are easier to design and therefore cheaper. Functions of other gates
:	can easily be implemented using NAND and NOR gates. For this reason they are called universal gates.
29.	Which gates are called Universal gates and why?
Ans.	NAND and NOR gates are called Universal gates because NAND and NOR gates are less expensive and easier to design.
	Also other functions (NOT, AND, OR) can easily be implemented using NAND/NOR gates.

30.	State the purpose of reducing the switching functions to	the minimal form?
Ans.	The switching functions are practically implemented in the	e form of gates. A minimized Boolean expression means less
	number of gates which means simplified circuitary. Thus,	the purpose of reducing the switching functions to the
	minimal form is getting circuitary.	
31.	Draw a logic circuit diagram using NAND or NOR only to	mplement the Boolean function
	F(a,b) = a'b' + ab	
Ans.		
	b/	
32.	How is gray code different from normal binary code?	
Ans.		ray code each successive number differs only in one place.
33.	How many variables are reduced by a pair, quad and oct	
Ans.	Two, four and eight variables are reduced by a pair, quad	
34.	What is inverted AND gate called? What is inverted OR g	ate called?
Ans.	Inverted AND gate is called NAND gate and Inverted OR ga	
35.	When does an XOR gate produce a high output? When d	
		ination has odd number of 1's and an XNOR gate produces
Ans.	a high output when the input combination has even numb	per of 1's.
36.	Write duals of the following expressions :	
	(i)1 + x = 1 $(ii) (a + b).(a' + b')$ $(iii) ab + bc = 1$ (iv)) (a'c + c'a)(b'd + d'b)
Ans.	(i) $0 \cdot x = 0$ (ii) $ab + a'b'$	
	(iii) $(a + b)(b + c) = 0$ (iv) $((a' + c)(c' + a)) + ((b' + d)(d))$	′ + b))
37.	Find the complements of the expressions :	
	(i)X + YZ + XZ (ii) AB(C'D + B'C)	
Ans.		AB(C'D + B'C)
	= (X + YZ + XZ)'	= (AB)'(C'D + B'C)'
	= (X)'(YZ)'(XZ)'	= (AB)'((C'D)' + (B'C)')
	= X'(Y' + Z')(X' + Z')	=(AB)'(CD' + BC')
		=(A' + B')+(C + D')(B + C')

TYPE B : SHORT ANSWER QUESTIONS

				141. 6	
1.	What do you understan	d by 'trut	h table' ai	nd 'truth fu	unction'? How are these related?
Ans.	✓ The statements whi	ch can be	determine	ed to be Tr	ue or False are called logical statements or truth functions.
	✓ The result TRUE or F	ALSE are	called trut	h values.	
	✓ Both 'truth table' ar	ld 'truth fu	unction' ai	re related i	n a way that truth function yields truth values.
2.	What do you understan	d by 'logi	cal functio	on'? What i	is its alternative name? Give examples for logical functions.
	Logic statements or trut	h functior	is are com	bined with	the help of Logical Operators like AND, OR and NOT to form a
Ans.	Logical function. Its alte	rnative na	me is Corr	pound sta	tement.
	Examples for logical fun	ctions are	as Follow	ing :	
	 He prefers tea n 	ot coffee.			
	 He plays guitar a 	and she pl	ays sitar.		
	 I watch TV on St 	undays or	I go for sw	/imming.	
3.	What is meant by tauto	logy and f	allacy? Pr	ove that 1	+ Y is a tautology and 0 . Y is a fallacy.
Ans.	If result of any logical sta	atement o	r expressi	on is alway	ys TRUE or 1, it is called Tautology and if the result is always
	FALSE or 0 it is called Fa	llacy.			
	We will prove 1 + Y is a t	autology	with the h	elp of trut	h table which is given below :
		1	Y	R	
		1	0	1	
		1	1	1	
	From truth table it is pro	ove that 1	+ Y is a ta	utology.	1
					ble which is given below :
	·	•	•		5

8. Ans. 9. Ans.	(a) N (a)M = N 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 1 1 1 1 1 1	I = N (P + N (P + R) P 0 1 1 0 1 1 0 1 1 0 1 0 1 0 0 1 0 0 1 0 0 1 0 1 1 1 1	-	P + R 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	BC + CA' AB 0 0 0 0 0 0 0 1 1	ations : P + R) 0 1	1 1 1 0 1 0 1 0 1 0 0 1 0 0 0 0 0 0 0 0	0 0 0	P 0 1 1 0 0 1 1 1 + BC + 0 1 0 1 0 0 1 1 0 0 1 1 1	R 0 1 0 1 0 1 0 1 0 1 0 1	P' 1 1 1 0 0 1 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1	NP' 0 0 0 1 1 1 0 0 0	N + P + NP' 0 1 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 1 5 0 0 0 0 0 0 1 1 1 1	I = N (P + N (P + R) P 0 1 1 0 1 1 0 1 1 0 1 0 1 0 1 0 0 1 0 0 0 0 0 1 0 1 0 1	1 able for tl - R) R 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	1 he follow P + R 0 1 1 1 1 1 hat AB + A' 1 1 1 1 0 0 0 0 0 0 0 0 0	0 ving equa N (F BC + CA' AB 0 0 0 0 0 0 0 1	ations : P + R) 0 0 0 0 0 0 1 1 1 = AB + 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 2 2 2 2 3 2 3 2 3 2 3 3 2 3 3 3 3 3	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 1 1 1 1 1 1 0 1 0 1 0 1 0 1 0	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 0 0 0 AB+0 0 1 0 1 0 0 1 0 0 1	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 1 1 5 0 0 0 0 0 0 1 1 1	I = N (P + N (P + R) P 0 1 1 0 1 1 0 1 1 0 1 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0	1 able for tl - R)	1 he follow P + R 0 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0	0 ving equa N (F N (F BC + CA' AB 0 0 0 0 0 0 0 0 0 0 0 0 0	ations : P + R) 0 0 0 0 0 0 1 1 1 1 = AB + (BC 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 2 2 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4 3 4	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC + 0 1 0 1 0 0 1 0 0 0	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 1 1 1 1 1 1 1 1 5 0 0 0 0 0 0 1	I = N (P + N (P + R) P 0 1 1 0 1 0 1 1 0 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0	1 able for tl - R)	1 he follow P + R 0 1 1 1 1 1 1 hat AB + A' 1 1 1 1 0 0 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	0 ving equa N (F N (F 0 0 0 0 0 0 0 0 0 0 0 0 0	ations : P + R) 0 0 0 0 0 0 1 1 1 = AB + C 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	1 1 2 2 2 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC + 0 1 0 1 0 1	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+0 0 1 0 1 0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 1 1 5 0 0 0 0 0 0 0	I = N (P + N (P + R) P 0 1 1 0 1 1 1 1 1 1 0 1 1 0 0 1 uth table B 0 1 1	1 able for tl - R) R 0 1 0 1 0 1 0 1 0 1 , prove tl 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 0 1	1 he follow P + R 0 1 1 1 1 1 1 hat AB + A' 1 1 1 1 1 1	BC + CA' AB 0 0 0 0 0	ations : P + R) 0 0 0 0 0 0 0 1 1 1 1 = AB + C 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 2 2 2 2 3 2 3 2 3 2 3 2 3 2 3 3 2 3	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 1 1 1 1 + BC + 0 1 0 1 0	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+0 0 1 1 0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 1 1 5 0 0 0 0 0	1 = N (P + N (P + R) 0 0 1 1 0 0 1 1 1 with table B 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 able for tl R 0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 0 1 0 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 1 0	1 he follow P + R 0 1 1 1 1 1 1 hat AB + A' 1 1 1 1	0 ving equa 8 N (F 8 N (F 9 9 9 9 9 8 8 7 8 8 7 8 7 8 8 7 8 7 8 8 7 8 8 7 8 8 7 8 7 8 8 7 8 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8	ations : P + R) 0 0 0 0 0 0 0 1 1 1 1 = AB + (0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 1 CA'. CA' 0 1 0	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC + 0 1 0	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+0 0 1 0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans. 9.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 Using tru A 0 0	1 = N (P + N (P + R) 0 0 1 1 0 0 1 1 1 with table B 0 0 0	1 able for tl - R)	1 he follow P + R 0 1 1 1 1 1 1 1 hat AB + A' 1 1	0 ving equa 8 N (F 9 0 8 0 0	ations : 2 + R) 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 = AB + 0 0 0 0	1 1 CA'. CA' 0 1	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC + 0 1	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+0 0 1	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans. 9.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 Using tru A 0	I = N (P + N (P + R) P 0 1 1 0 1 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 able for tl - R) - R - 0 - 1 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0	1 he follow P + R 0 1 1 1 1 1 1 1 1 hat AB + A' 1	0 ving equa 8 N (F BC + CA' AB 0	ations : P + R) 0 0 0 0 0 1 1 1 = AB + C BC 0	1 1 CA'. CA' 0	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC + 0	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+(0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans. 9.	(a) N (a)M = N 0 0 0 1 1 1 1 1 Using tru A	1 = N (P + N (P + R) 0 0 1 1 0 0 1 1 1 uth table B	1 able for tl R 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 5, prove tl C	1 he follow P + R 0 1 1 1 1 1 1 1 hat AB + A'	0 ving equa 8 N (F 8 N (F 9 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	ations : 2 + R) 0 0 0 0 0 0 1 1 = AB + 0 BC	1 1 CA'.	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 0 1 1 1 + BC +	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0 0 AB+0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans. 9.	(a) N (a)M = N 0 0 0 0 1 1 1 1 1 Using tru	I = N (P + N (P + R) 0 0 1 0 1 0 1	1 able for tl - R) 0 1 0 1 0 1 0 1 0 1 0 1 , prove tł	1 he follow P + R 0 1 1 1 1 1 1 1 1 1 1 1 1 1	0 ving equa 8 N (F	ations : 2 + R) 0 0 0 0 0 0 1 1 = AB + 0	1 1 CA'.	0 0 (b) M = I N 0 0 0 0 1 1 1 1 1	P 0 1 1 0 1 1 1 1 1 1	R 0 1 0 1 0 1 0 1 0 1 1	1 1 0 0 1 1 1 0 0	0 0 0 1 1 0 0	0 0 1 1 1 1 1 1 1
Ans.	(a) N (a)M = N 0 0 0 0 1 1 1 1	1 = N (P + N (P + R) P 0 0 1 1 0 0 1 1 1 1	1 able for tl - R)	1 he follow 0 1 1 1 1 0 1 1 1 1 1	0 ving equa	ations : P + R) 0 0 0 0 0 1 1 1 1	1	0 0 (b) M = I N 0 0 0 0 1 1 1	P 0 1 0 0 1 0 0 1	R 0 1 0 1 0 1 0 1 0 1 0	1 1 0 0 1 1 0	0 0 0 1 1 0	0 0 1 1 1 1 1 1 1
	(a) N (a)M = N 0 0 0 1 1 1	1 = N (P + N (P + R) P 0 0 1 1 0 0 1 1 0 1	1 able for tl - R)	1 he follow 0 1 1 1 0 1 1 0 1 1	0 ving equa	ations : 2 + R) 0 0 0 0 0 1 1	1	0 0 (b) M = I N 0 0 0 0 1 1 1	P 0 1 0 0 1 0 0 1	R 0 1 0 1 0 1 0 1 0 1 0	1 1 0 0 1 1 0	0 0 0 1 1 0	0 0 1 1 1 1 1 1 1
	(a) N (a)M = N 0 0 0 0 1 1	I = N (P + N (P + R) P 0 0 1 1 0 0 0	1 able for tl - R) - R 0 1 0 1 0 1 0 1	1 he follow 0 1 1 1 1 0 1 1	0 ving equa	ations : P + R) 0 0 0 0 0 1	1	0 0 (b) M = I N 0 0 0 0 1 1	P 0 1 1 0 0	R 0 1 0 1 0 1 0 1 0 1	1 1 0 0 1 1	0 0 0 1 1	0 0 1 1 1 1 1
	(a) N (a)M = N 0 0 0 0 1	1 = N (P + R) P 0 0 1 1 0	1 able for tl - R) - R 0 1 0 1 0 1 0	1 he follow P + R 0 1 1 1 1 0	0 Ving equa	ations : P + R) 0 0 0 0 0 0 0	1	0 0 (b) M = I N 0 0 0 0 0 1	P 0 1 1 0	R 0 1 0 1 0 0	1 1 0 0 1	0 0 0 0 1	0 0 1 1 1 1
	(a) N (a)M = N 0 0 0	1 = N (P + N (P + R) P 0 0 1 1	1 able for tl - R) - R 0 1 0 1 0 1	1 he follow 0 1 1 1	0 ving equa	ations : P + R) 0 0 0 0 0	1	0 0 (b) M = I N 0 0 0 0	P 0 1 1	R 0 1 0 1	1 1 0 0	0 0 0 0	0 0 1 1
	(a) N (a)M = N 0 0	1 = N (P + N (P + R) P 0 0 1	1 able for tl - R) - R 0 1 1 0	1 he follow P + R 0 1 1	0 ving equa	ations : P + R) 0 0 0	1	0 0 (b) M = I N 0 0	P 0 0 1	R 0 1 0	1 1 0	0 0 0	0 0 1
	(a) N (a)M = <u>N</u> 0	1 = N (P + N (P + R) P 0	1 able for th - R) R 0	1 he follow P + R 0	ving equa	ations : P + R) 0	1	0 0 (b) M = I N 0	P 0	R 0	1	0	0
	(a) N (a)M = N	1 = N (P + N (P + R) P	1 able for tl - R) R	1 he follow P+R	0 ving equa	ations : P + R)	1	0 0 (b) M = I N	Ρ	R			
	(a) N (a)M =	1 = N (P + N (P + R)	1 able for tl - R)	1 he follow	0 ving equa	ations :	1	0 0 (b) M = I			P'	NP'	N + P + NP'
	(a) №	1 = N (P +	1 able for tl - R)	1	0		1	0	N + P +	NP'			
8.			1 able for tl	1	0		1	0					
			1	1	0		1	0					
							1	0					
	1						0	1					
			0	1	0		0	1					
			0	0	1		1	0					
Ans.			X	Y	Y'		, - X + Y'	(X + Y'))'				
7.			for the Bo					.u.					
	Both the		т s (X + Y)' а	-		cal hen	•			0	0		
			1	0	1		0	0		1 0	0		
			0	1	1		0	1		0	0		
			0	0	0		1	1		1	1		
Ans.			X	Y	X +	Y ((X + Y)'	X'		Y'	X'Y'	·	
6.			lgebra, ve				•	' = X'Y' fo	or each	X,Yin	{0,1}.		
	Both the	e columns	s X and X	-				-					
				1	0	0		1					
				0	1	0		0					
				0	0	0		0					
Ans.				X	Y	X	Y)	(+ XY					
5.			lgebra, ve		-			= X for e	ach X ,	Y in {0 ,	, 1}.		
	-		values an						trutti				e possible
Ans.				•		•		-				-	with all the e possible
4.			able? Wh		•			<i>.</i>					
	From tru	uth table	it is prove	e that 0 .	Y is a fall	асу.							
				0	1	0							
				0	0	0							
				0	Y	R							

Ans.	Followin	g are the	hacic no	stulator	of Boology	1 algebr	۰ .				
		-	•			-		then X equal to	0		
		OR Relatic			•		not equal to I	then A equal to			
		(i) 0 + 0 = (0 – 1	(iv) 1 + 1 = 1				
		AND Relat	• • •		. ,		(10) 1 1 1 - 1				
		(i)0 . 0 = 0) . 1 = 0	(iii) 1 .		(iv) 1 . 1 = 0				
		Compleme	. ,		(111) 1.	0 - 0	(10) 1 · 1 – 0				
	-	(i)0' = 1		3 1'= 0							
11.		.,			What is i	te ueago	in Boolean alg	abra?			
Ans.		-				-	-	another Boolea	n relation c	an he derive	hv ·
All3.	-	1. Changir	-		-						Lu by .
		2. Changir	-								
		 Replaci 	-		-		<i>)</i> .				
		-	-	-		-	lement the Bo	olean expressio	n		
12.					-			of the Boolean		•	
12.	State th			+Z').(Y +	-		i give the dual	of the boolean	expression	•	
Ans.	The prin	•			•	ith a Bo	olean relation	another Boolea	n relation c	an he derive	ed by ·
/	-	1 .Changir	-		-						cu by .
		2. Changir	-				-				
		3. Replacii	-		-		,.				
		l of (X + Y)	-	-		-					
13.							do they differ	from the distri	butive laws	of ordinary	algebra?
		tive laws c			-		ao ano, amo			or or annur y	algebrai
Ans.	(i)		Z) = XY +	-							
		X + YZ									
			-		l for all va	lues of)	(. Y and Z in or	dinary algebra v	whereas X +	YZ = (X + Y)((X + Z) holds
		ly for two					,	,		(/	_,
14.						bra with	the help of tr	uth table.			
Ans.		tence law			-		•				
	(a) X +	X = X		• •			(b) X . 2	X = X			
	To prov	o this law	wowil	l make a t	following	truth tal	hle · To prov	o this law way	will make a f		
		ve this law	, , , , , , , , , , , , , , , , , , , ,				ole. To prov	ve this law, we	will make a i	ollowing tru	uth table :
	. [,	Х	R		ole. To pro-	X X	X	ollowing tru R	uth table :
			, we wi		R 0					1	uth table :
		Х	, we wii	Х				Х	Х	R	uth table :
		X 0		X 0	0			X 0	X 0	R 0	uth table :
	0 + 0 =	X 0 1 0 and 1 +	1 = 1	X 0 1	0 1		0.0=	X 0 1 0 and 1 . 1 = 1	X 0 1	R 0 1	uth table :
15.	0 + 0 = From tr	X 0 1 0 and 1 + ruth table	1 = 1 it is prov	X 0 1 ve that X	0 1 + X = X	algebra	0 . 0 = 0 From t	X 0 1 0 and 1 . 1 = 1 ruth table it is p	X 0 1 prove that X	R 0 1	uth table :
15. Ans.	0 + 0 = From tr Prove th	X 0 1 0 and 1 + ruth table ne comple	1 = 1 it is prov mentari	X 0 1 ve that X ty law of	0 1 + X = X Boolean	•	0 . 0 = (From t with the help (X 0 1 0 and 1 . 1 = 1	X 0 1 prove that X	R 0 1	uth table :
	0 + 0 = From tr Prove th Complet	X 0 1 0 and 1 + ruth table ne comple mentarity	1 = 1 it is prov mentari	X 0 1 ve that X ty law of	0 1 + X = X Boolean	•	0 . 0 = (From t with the help (X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table	X 0 1 prove that X	R 0 1	uth table :
	0 + 0 = From tr Prove th Complet (a) X +	X 0 1 0 and 1 + ruth table mentarity X' = 1	1 = 1 it is prov mentari law stat	X 0 1 ve that X ty law of te that (a	0 1 + X = X Boolean) X + X' =	1 (b) >	0 . 0 = 0 From to with the help o (. X'= 0 (b) X . 2	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table X'= 0	X 0 1 prove that X	R 0 1 . X = X	
	0 + 0 = From tr Prove th Complet (a) X +	X 0 1 0 and 1 + ruth table ne comple mentarity	1 = 1 it is prov mentari law stat	X 0 1 ve that X ty law of te that (a	0 1 + X = X Boolean) X + X' =	1 (b) >	0 . 0 = 0 From to with the help o (. X'= 0 (b) X . 2	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table	X 0 1 prove that X	R 0 1 . X = X	
	0 + 0 = From tr Prove th Complet (a) X +	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X	1 = 1 it is prov mentari law stat	X 0 1 ve that X ty law of te that (a l make a t X'	0 1 + X = X Boolean) X + X' = following R	1 (b) >	0 . 0 = 0 From to with the help o (. X'= 0 (b) X . 2	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table K'= 0 ve this law, we y	X 0 1 prove that X will make a f X'	R 0 1 .X = X ollowing true	
	0 + 0 = From tr Prove th Complet (a) X +	X 0 1 0 and 1 + ruth table ne comple mentarity X' = 1 ve this law X 0	1 = 1 it is prov mentari law stat	X 0 1 ty law of te that (a l make a t X' 1	0 1 + X = X Boolean) X + X' = Following R 1	1 (b) >	0 . 0 = 0 From to with the help o (. X'= 0 (b) X . 2	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table X'= 0 ve this law, we X	X 0 1 vrove that X · will make a f X' 1	R 0 1 . X = X following true R 0	
	0 + 0 = From tr Prove th Compler (a) X + To prov	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1	1 = 1 it is prov mentari law stat	X 0 1 ve that X ty law of te that (a l make a t X'	0 1 + X = X Boolean) X + X' = following R	1 (b) >	0 . 0 = 0 From ti with the help o (. X'= 0 (b) X . X ble : To prov	X 0 1 D and 1 . 1 = 1 ruth table it is p of a truth table X'= 0 ve this law, we X 0 1	X 0 1 prove that X will make a f X'	R 0 1 . X = X following true R	
	0 + 0 = From tr Prove th Complex (a) X + To prov	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1 1 and 1 +	1 = 1 it is prov mentari law stat	X 0 1 ve that X ty law of te that (a l make a t X' 1 0	0 1 + X = X Boolean) X + X' = following R 1 1	1 (b) >	0.0=0 From to with the help of (.X'= 0 (b) X.2 ble : To prov 0.1=0	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table K'= 0 ve this law, we verthis law, we v	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans.	0 + 0 = From tr Prove th Complet (a) X + To prov 0 + 1 = From tr	X 0 1 0 and 1 + ruth table ne comple mentarity X' = 1 ve this law X 0 1 1 1 1 1 1 1 1 veth table	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov	X 0 1 ty that X ty law of te that (a I make a that X' 1 0 ve that X	0 1 + X = X Boolean) X + X' = following R 1 1 1 + X' = 1	1 (b) >	0.0=0 From to with the help of (.X'= 0 (b) X.2 ble : To prov 0.1=0 From to	X 0 1 D and 1 . 1 = 1 ruth table it is p of a truth table X'= 0 ve this law, we X 0 1	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Complet (a) X + To prov 0 + 1 = From tr Give the	X 0 1 0 and 1 + ruth table ne comple mentarity X' = 1 ve this law X 0 1 1 and 1 + ruth table truth table	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov le proof	X 0 1 ve that X ty law of te that (a l make a f X' 1 0 ve that X for distr	0 1 + X = X Boolean) X + X' = following R 1 1 + X' = 1 ibutive la	1 (b)) truth tal	0 . 0 = 0 From ti with the help of (. X'= 0 (b) X . 2 ble : To prov 0 . 1 = 0 From ti blean algebra.	X010 and 1 . 1 = 1ruth table it is pof a truth tableof a truth tableX'= 0ye this law, weX010 and 1 . 0 = 0ruth table it is p	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans.	0 + 0 = From tr Prove th Complet (a) X + To prov 0 + 1 = From tr Give the Distribut	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1 and 1 + ruth table e truth table tive law st	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov le proof ate that	X 0 1 ve that X ty law of te that (a l make a f X' 1 0 ve that X for distr	0 1 + X = X Boolean) X + X' = following R 1 1 + X' = 1 ibutive la	1 (b)) truth tal	0.0=0 From to with the help of (.X'= 0 (b) X.2 ble : To prov 0.1=0 From to	X010 and 1 . 1 = 1ruth table it is pof a truth tableof a truth tableX'= 0ye this law, weX010 and 1 . 0 = 0ruth table it is p	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Complet (a) X + To prov 0 + 1 = From tr Give the Distribut (a) X(Y +	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1 and 1 + ruth table e truth table tive law st -Z) = XY + 2	1 = 1 it is prov mentari law stat r, we wil 0 = 1 it is prov le proof ate that XZ	X 0 1 ve that X ty law of te that (a N' 1 0 ve that X for distr (a) X(Y + 2)	0 1 + X = X Boolean) X + X' = following R 1 1 1 + X' = 1 ibutive la Z) = XY + X	1 (b) > truth tal	$0 \cdot 0 = 0$ From to with the help of (. X'= 0 (b) X · 2 ble : To prov $0 \cdot 1 = 0$ From to blean algebra. X + YZ = (X + Y)	X010 and 1 . 1 = 1ruth table it is pof a truth tableof a truth tableX'= 0ye this law, weX010 and 1 . 0 = 0ruth table it is p	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Complet (a) X + To prov 0 + 1 = From tr Give the Distribut (a) X(Y + To prove	X 0 1 0 and 1 + ruth table ne comple mentarity X' = 1 ve this law 0 1 1 and 1 + ruth table truth table truth table truth table truth table	1 = 1 it is prov mentari law stat r, we wil 0 = 1 it is prov le proof ate that XZ	X 0 1 ty law of te that (a l make a for ve that X for distr (a) X(Y +2	0 1 + X = X Boolean) X + X' = following 1 1 + X' = 1 ibutive la 2) = XY + X	1 (b) > truth tal w of Boo (Z (b) > ruth tab	0 . 0 = 0 From ti with the help of (. X'= 0 (b) X . 2 ble : To prov 0 . 1 = 0 From ti blean algebra. X + YZ = (X + Y) le :	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table X'= 0 Ve this law, we X 0 1 0 and 1 . 0 = 0 ruth table it is p (X + Z)	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Complem (a) X + To prove 0 + 1 = From tr Give the Distribut (a) X(Y + To prove X	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1 and 1 + ruth table truth table tive law st Z) = XY + X e this law, Y	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov le proof ate that XZ we will Z	X 0 1 ve that X ty law of te that (a X' 1 0 ve that X for distr (a) X(Y + 2) make a for Y + Z	0 1 + X = X Boolean) X + X' = following R 1 1 + X' = 1 ibutive la Z) = XY + X ollowing tr XY	1 (b) > truth tal w of Boo (Z (b) > ruth tab XZ	0 . 0 = 0 From to with the help of (. X'= 0 (b) X . 2 ble : To prov 0 . 1 = 0 From to blean algebra. X + YZ = (X + Y) le : X(Y + Z)	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table of a truth table x'= 0 ve this law, we verthis law, w	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Comples (a) X + To prov 0 + 1 = From tr Give the Distribut (a) X(Y + To prove X 0	X 0 1 0 and 1 + ruth table ne complementarity X' = 1 ve this law X 0 1 and 1 + ruth table e truth table 0 1 0 1 0	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov le proof ate that XZ we will Z 0	X 0 1 ve that X ty law of te that (a I make a for X' 1 0 ve that X for distr (a) X(Y +2) make a for Y + Z 0	0 1 $+ X = X$ Boolean $X + X' =$ Following R 1 1 $+ X' = 1$ ibutive la $Z = XY + X$ blowing to XY 0	1 (b) > truth tal w of Boo (Z (b)) ruth tab XZ 0	0.0=0 From to with the help of (. X'= 0 (b) X.2 ble : To prov 0.1=0 From to blean algebra. X + YZ = (X + Y) le : X(Y + Z) 0	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table of a truth table x'= 0 ve this law, we verthis law of the l	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	
Ans. 16.	0 + 0 = From tr Prove th Complem (a) X + To prove 0 + 1 = From tr Give the Distribut (a) X(Y + To prove X	X 0 1 0 and 1 + ruth table mentarity X' = 1 ve this law X 0 1 and 1 + ruth table truth table tive law st Z) = XY + X e this law, Y	1 = 1 it is prov mentari law stat v, we wil 0 = 1 it is prov le proof ate that XZ we will Z	X 0 1 ve that X ty law of te that (a X' 1 0 ve that X for distr (a) X(Y + 2) make a for Y + Z	0 1 + X = X Boolean) X + X' = following R 1 1 + X' = 1 ibutive la Z) = XY + X ollowing tr XY	1 (b) > truth tal w of Boo (Z (b) > ruth tab XZ	0 . 0 = 0 From to with the help of (. X'= 0 (b) X . 2 ble : To prov 0 . 1 = 0 From to blean algebra. X + YZ = (X + Y) le : X(Y + Z)	X 0 1 0 and 1 . 1 = 1 ruth table it is p of a truth table x'= 0 ve this law, we verthis law, we v	X 0 1 prove that X will make a f X' 1 0	R 0 1 . X = X following true R 0 0 0	

			1	1			1					
	1	0	0	0	0	0	0	0				
	1	0	1	1	0	1	1	1				
	1	1	0	1	1	0	1	1				
	1	1	1	1	1	1	1	1				
			•	ethat X(Y +Z) = XY	+ XZ						
	(b) X + Y	Z = (X + Y	′)(X + Z)	[[٦	
	X	Y	Z	YZ	X + YZ	XZ	X + Y	X + Z	(X	(X + Y)(X + Z)	-	
	0	0	0	0	0	0	0	0		0	-	
	0	0	1	0	0	0	0	1		0		
	0	1	0	0	0	0	1	0		0	-	
	0	1	1	1	1	0	1	1		1		
	1	0	0	0	1	0	1	1		1	_	
	1	0	1	0	1	1	1	1		1	_	
	1	1	0	0	1	0	1	1		1	_	
	1	1	1	1	1	1	1	1		1		
	From tru	th table i	it is prove	e that X +	- YZ = (X +	Y)(X + Z)						
17.	-	•		-	law of Bo		-					
Ans.			ates that	(i) X + X	Y=X and	X (ii) k	X(X + Y) = X					
	(i) $X + XY = X$ (ii) $X(X + Y) = X$											
	$LHS = X + XY = X(1 + Y) \qquad \qquad LHS = X(X + Y) = X \cdot X + XY$											
	$= X \cdot 1$ [: 1 + Y = 1] $= X + XY$											
		= X =	ERHS. H	lence pro	oved.					(1 + Y)		
	= X . 1 = X = RHS. Hence proved.											
10	Drava al				7) - X - V	7			= X	= KHS. Henc	e proved.	
18.	Prove algebraically that $(X + Y)(X + Z) = X + YZ$. L.H.S. = $(X + Y)(X + Z) = XX + XZ + XY + YZ$											
Ans.	-	x + Y)(x + (+ XZ + X	-	+ XZ + X î	+ YZ		/VV – V Indo	mpotonco la)			
			(Z + YZ =)	/(1 _ V) _	$7(Y \pm V)$			mpotence lav	vv)			
		(.1 + Z(X ·		(1 ' ') '	2(/ ' ')	(1 + V = 1 pro	perty of 0 an	nd 1)			
		(+ XZ + Y	-			(•	operty of 0 an	-			
		<(1 + Z) +					(X : <u>1</u> – X pi		na 1)			
		(.1 + YZ	. –				(1 + Z = 1 pr	operty of 0 a	nd 1)			
		(.1 + YZ						operty of 0 ar				
			Hence pro	oved.					,			
19.			lly that X		(+ Y.							
Ans.	L.H.S. = >	-	-									
	= >	(.1 + X'Y				(X . 1 =	X property of	of 0 and 1)				
	= >	(1 + Y) +	X'Y			-		perty of 0 an	nd 1)			
	= >	(+XY+)	X'Y				-					
	= >	<pre>< + Y(X + 2</pre>	X')									
		(+ Y.1				•		nplementarit	• •	1		
	= >	(+ Y				(Y)	. 1 = Y prope	rty of 0 and 1	1)			
			Hence pr									
20.			-		-		•	rgan's theore	em.			
Ans.	-		rems stat	te that	(i) (X + Y)'	= X'.Y'	(ii) (X.Y)'= 2	κ' + Υ'				
	(i) (X + Y	-		. .								
			-				•	•				
	Now to prove DeMorgan's first theorem, we will use complementarity laws. Let us assume that $P = x + Y$ where, P, X, Y are logical variables. Then, according to complementation law $P + P' = 1$ and $P \cdot P' = 0$											
				ooloon	ariables h	en this c	complement	arity law mus	st hold	l for variables	P. In other word	
	That mea	ans, if P, 2	X, Y are B	oolean								
		(X + Y)' = 2	X'.Y'then									
		(X + Y)'= X (X + Y) +	X'.Y'then + (XY)'mu	st be eq			•	as X + X'= 1)				
	P i.e., if	(X + Y)' = X (X + Y) + (X + Y).	X'.Y'then	st be eq st be equ			•	as X + X'= 1) as X . X'= 0)				

(X + Y) + (XY)' = 1(X + Y) + (XY)' = ((X + Y) + X').((X + Y) + Y')(ref. X + YZ = (X + Y)(X + Z))= (X + X' + Y).(X + Y + Y')(ref. X + X'=1)= (1 + Y).(X + 1)= 1.1 (ref. 1 + X = 1)= 1 So first part is proved. Now let us prove the second part i.e., (X + Y) . (XY)' = 0(X + Y) . (XY)' = (XY)' . (X + Y)(ref. X(YZ) = (XY)Z) = (XY)'X + (XY)'Y(ref. X(Y + Z) = XY + XZ) = X(XY)' + X'YY'= 0.Y + X'.0(ref. X . X'=0) = 0 + 0 = 0So, second part is also proved, Thus: $X + Y = X' \cdot Y'$ (ii) (X.Y)' = X' + Y'Again to prove this theorem, we will make use of complementary law i.e., X + X' = 1and X . X' = 0If XY's complement is X + Y then it must be true that (a) XY + (X' + Y') = 1 and (b) XY(X' + Y') = 0To prove the first part L.H.S = XY + (X'+Y')= (X'+Y') + XY(ref. X + Y = Y + X)= (X'+Y' + X).(X'+Y' + Y)(ref. (X + Y)(X + Z) = X + YZ)= (X + X' + Y').(X' + Y + Y')= (1 + Y').(X' + 1)(ref. X + X'=1)= 1.1 (ref. 1 + X = 1)= 1 = R.H.SNow the second part i.e., $XY.(\overline{X} + \overline{Y}) = 0$ L.H.S = (XY)'.(X'+Y')= XYX' + XYY'(ref. X(Y + Z) = XY + XZ) = XX'Y + XYY'(ref. X . X'=0) = 0.Y + X.0= 0 + 0 = 0 = R.H.S.XY.(X' + Y') = 0and XY + (X' + Y') = 1(XY)' = X' + Y'. Hence proved. Use the duality theorem to derive another boolean relation from : 21. A + A'B = A + BA.(A' + B) = A.BAns. 22. What would be the complement of the following: (a) A'(BC' + B'C) (b) xy + y'z + z'z? Ans. (a) A'(BC' + B'C) = (A'(BC' + B'C))'(b) xy + y'z + z'z = (xy + y'z + z'z)'= ((A')'(BC' + B'C)')= (xy)'(y'z)'(z'z)'= ((A')'((BC')' + (B'C)')= (x' + y')(y'' + z')(z'' + z')= (x' + y)(y + z')(z + z')= ((A)((B' C) + (BC')))= A + (B' + C)(B + C')Prove (giving reasons) that [(x + y)' + (x + y)']' = x + y23. [(x + y)' + (x + y)']' = ((x + y)')'.((x + y)')' (Using De Morgan's first theorem i.e., (A + B)' = A'.B') Ans. = (x + y).(x + y)(∵X′ = X) (X.X = 1)= x + y 24. Find the complement of the following Boolean function : $F_1 = AB' + C'D'$ (AB' + C'D')' = (AB')'.(C'D')'Ans. (De Morgan's first theorem) = (A' + B'').(C'' + D'')(DeMorgan's second theorem i.e., (A.B)' = A' + B')

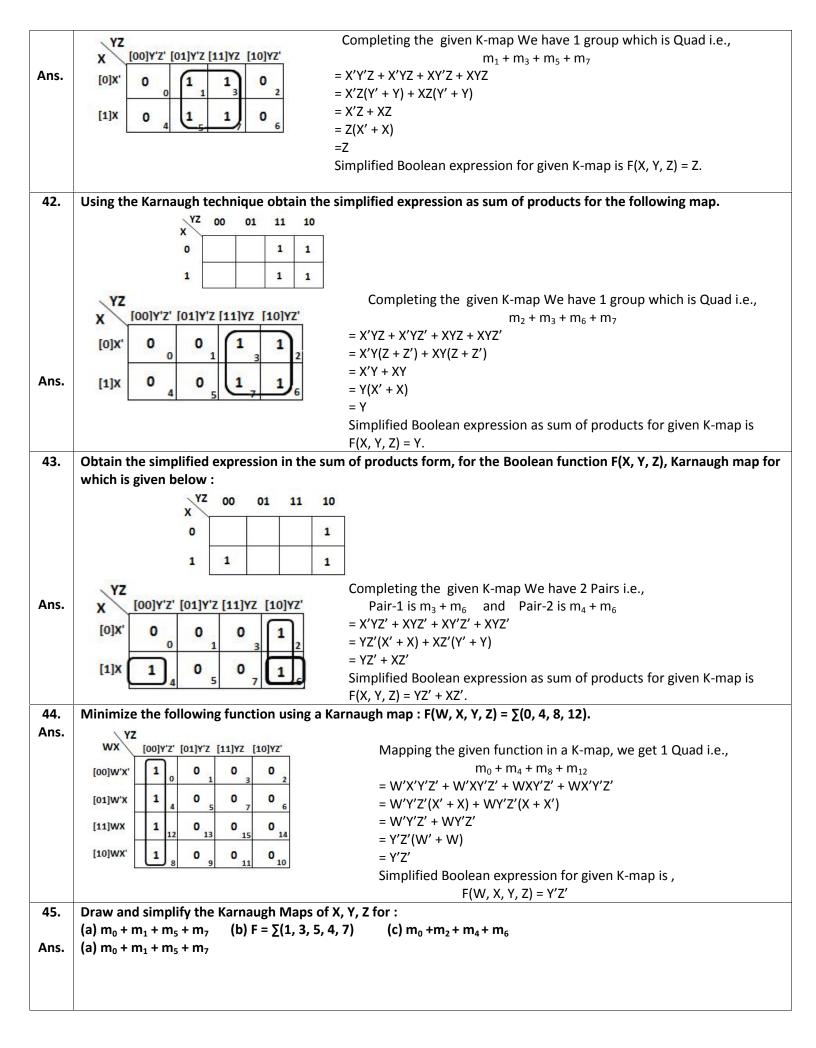
			= (A'	+ B').((C + D)								((X')'=	= X)
5.	Prove	the f	ollowi		,									,
				C') = A			(ii) A +	A'B' = A	+ B'					
				+ y + z		z (iv) A'B'C	+ A'BC +	- AB'C =	A'C +	B'C			
ıs.		-		2') = A		•	-							
	A		В	C		- () B	2.8.2.7	B'C	B'C'	B +	B'C + B'C'	A(B + B'C + B'	'C')
	0		0	0		1	1	0	1		1		0	
	0		0	1		1	0	1	0		1		0	
	0		1	0		0	1	0	0		1		0	
	0		1	1		0	0	0	0		1		0	
	1		0	0		1	1	0	1		1		1	
	1		0	1		1	0	1	0		1		1	
	1		1	0		0	1	0	0		1		1	
	1		1	1		0	0	0	0		1		1	
	Both	the co	lumns	5 A(B +	B'C+	B'C')and	d A are	identica	, hence	prove	d.			
			= A +	-		,				•				
	A		В	С		Α'	B'	A'B'	A + A	'B'	A + B']		
	0		0	0		1	1	1	1		1	1		
	0		0	1		1	1	1	1		1	1		
	0		1	0		1	0	0	0		0			
	0		1	1		1	0	0	0		0			
	1		0	0		0	1	0	1		1			
	1		0	1		0	1	0	1		1			
	1		1	0		0	0	0	1		1			
	1		1	1		0	0	0	1		1			
	Both	the co	lumns	5 A + A	'B' and	d A + B'	are ide	ntical, he	ence pro	oved.				
	<u>(</u> iii) (x	(+ y +	z).(x'	+ y + z) = y +	z								_
	X		У	z		X'	x + y + z	x'+	y + z	(x + y	+ z).(x' + y +	z)	y + z	
	0		0	0		1	0		1		0		0	
	0		0	1		1	1		1		1		1	_
	0		1	0		1	1		1		1		1	4
	0		1	1		1	1		1		1		1	-
	1		0	0		0	1		0		0		0	-
	1		0	1		0	1		1		1		1	-
	1		1	0		0	1		1		1		1	-
	1		1	1		0	1		1		1		1	
				5 (x + y + AB'C		-	:) and y	+ z are i	dentical	, hence	e proved.			
	A	В	C	A'	B'	A'B'C	A'BO	C AB'C	C A'C	B'C	A'B'C +	A'B	C + AB'C	A'C + B'C
	0	0	0	1	1	0	0	0	0	0		0		0
	0	0	1	1	1	1	0	0	1	1		1		1
	0	1	0	1	0	0	0	0	0	0		0		0
	0	1	1	1	0	0	1	0	1	0		1		1
	1	0	0	0	1	0	0	0	0	0		0		0
	1	0	1	0	1	0	0	1	0	1		1		1
	1	1	0	0	0	0	0	0	0	0		0		0
	1	1	1	0	0	0	0	0	0	0		0		0
	Both	the co	lumns	s A'B'C	+ A'B	C + AB'C	and A	'C + B'C	are ider	ntical, ł	nence proved	ł.		
5.											hich of the f		wing are ca	nonical?
	(i) ab	+ bc		(ii) ab	c + a't	oc'+ ab'		(iii) (a ⊦	-					
				b'+ c)				(v) ab +						
	Boolo	an Fxi	oressio	on com	nposed	d entire	lv eithe	r of Mint	terms o	r maxte	erms is refer	red t	o as canoni	cal form of a l
IS.	BOOIE				•		/							

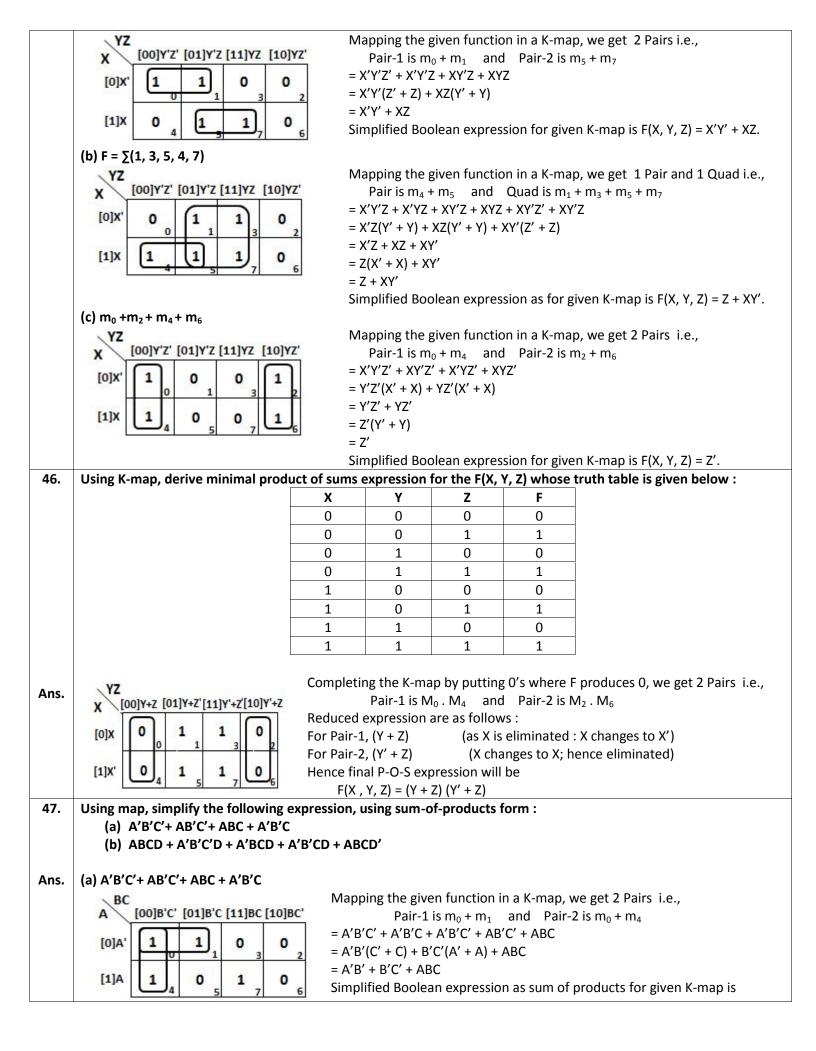
-							
	(i)Non canonical	(ii) canor			anonical	(iv) canonical	(v) Non canonical
27.	Give an example for e			-	_		
	(i) a boolean expre						
	(ii) a boolean expre		the non c	anonical	form.		
Ans.	For a function F(X, Y, Z						
	(i) Sum of minterms e	•					
		XYZ +	X'Y'Z + X	'Y'Z + XYZ	<u>Z'</u>		
	(ii) Non canonical form		•				
		XY + Y	′′Z + ZX′+	X'Y'			
28.	What are the fundam	ental pro	ducts for	each of	the input	words ABCD = 001	0. ABCD = 1101, ABCD = 1110?
	The fundamental proc	ducts for e	each of th	ne input v	vords ABC	D = 0010. ABCD = 1	1101, ABCD = 1110 are as following :
Ans.	A'B'CD' + ABC'D	+ ABCD'					
29.	A truth table has out	out 1's foi	r each of	these inp	outs :		
	(a)ABCD = 0011 (b) A	ABCD = 01	.01 (c) Al	BCD = 10	00, what a	are the fundament	al products?
Ans.	The fundamental proc	ducts are a	A'B'CD +	A'BC'D +	AB'C'D'		
30.	Construct a boolean f	unction o	of three v	ariables	p, q and r	that has an output	t 1 when exactly two of p, q, r are
	having values 0, and a						
Ans.		p	q	r	F		
		0	0	0	0		
		0	0	1	1		
		0	1	0	1		
		0	1	1	0		
		1	0	0	1		
		1		1	0		
			0				
		1	1	0	0		
		1	1	1	0		
	F = p'q'r + p'qr'		_				
31.	Write the Boolean ex	•	•			•	
_	X = 1, Y = 0, Z = 0; X		,Z=1;	X = 1, Y =	1, Z = 0; a	ind X = 1, Y = 1, Z =	1.
Ans.	X = 1, Y = 0, Z = 0	XY'Z'					
	X = 1, Y = 0, Z = 1	XY'Z					
	X = 1, Y = 1, Z = 0	XYZ'					
	X = 1, Y = 1, Z = 1	XYZ					
	The Boolean expression						
32.				-		that will have out	puts 0 only output when
	X = 1, Y = 1, Z = 1; X =		-	-	0, Z = 0.		
_	The outputs are to be		other cas				
Ans.		X	Y	Z	F		
		0	0	0	0		
		0	0	1	1		
		0	1	0	1		
		0	1	1	1		
		1	0	0	0		
		1	0	1	1		
		1	1	0	1		
		1	1	1	0		
	F = (X + Y + Z)(X' +	+ Y + Z)(X'	+ Y' +7')	I	-		
33.			-	nput vari	iables X V	and Z is 1 if and o	nly if number of 1(one) inputs is odd
53.							and express it in canonical sum-of-
	(eg Fic 1 if v - 1 V -	: 0 7 <u>-</u> 1	1)ra\\/ th	P Triitn T			
		= 0, Z = 0).	Draw th	e truth ta			
Δnc	products form.						
Ans.	products form. The output is 1, only i	f one of tl	ne inputs				when one of inputs is odd are
Ans.	products form. The output is 1, only i		ne inputs 0, Z = 0				

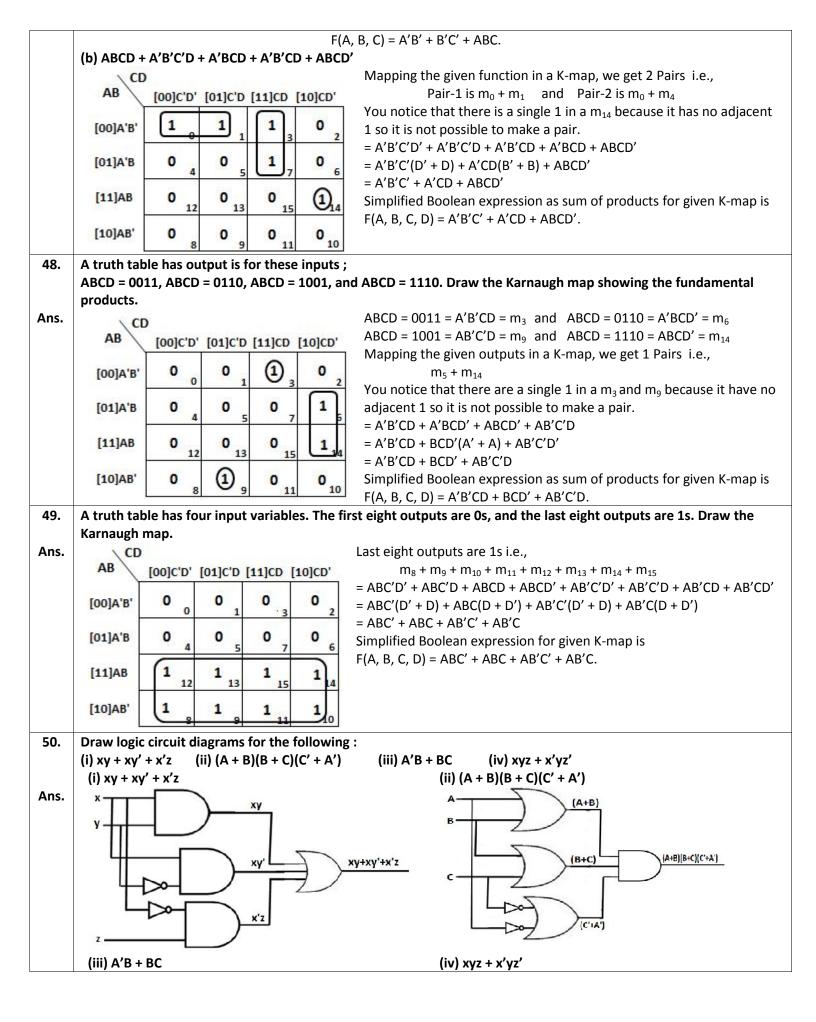
		herwise ol				
For these combination ou	X	Y	Z	F	Product Terms Minterms	
	0	0	0	0	X'Y'Z'	
	0	0	1	1	X'Y'Z	
	0	1	0	1	X'YZ'	
	0	1	1	0	X'YZ	
	1	0	0	1	XY'Z'	
	1	0	1	0	XY'Z	
	1	1	0	0	XYZ'	
	1	1	1	0	XYZ	
Adding all the minterms for		itput is 1, w	ve get			
X'Y'Z + X'YZ' + XY'						
 This is desired Canonical S					0001 4000 011	
Output 1s appear in the t		for these in	iput conditio	ons: ABCD =	0001, ABCD = 011	.0, and ABCD =
is the sum-of-products eq ABCD = 0001 = A'B'C'D	uation?					
ABCD = 0001 = A B C D ABCD = 0110 = A'BCD'						
ABCD = 0110 = A BCD' ABCD = 1110 = ABCD'						
The sum-of-products equa	ntion is as f	ollowing				
F = A'B'C'D + A'E		•				
Convert the following exp	ression to	canonical s	Sum-of=Pro	duct form :		
	(b) YZ + X'Y) AB' (B'+C')			
(a) X + X'Y + X'Y'						
= X(Y + Y')(Z + Z') + X'Y(Z +	Z') + X'Z'(Y	+ Y')				
= (XY + XY')(Z + Z') + X'YZ +	· X'YZ' + X'\					
= (XY + XY')(Z + Z') + X'YZ + = Z(XY + XY') + Z'(XY + XY')		′Z′ + X′Y′Z′	+ X'Y'Z'			
= Z(XY + XY') + Z'(XY + XY') $= XYZ + XY'Z + XYZ' + XYZ'$	+ X'YZ + X' + X'YZ + X'	'Z' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ'	+ X'Y'Z'			
= Z(XY + XY') + Z'(XY + XY') $= XYZ + XY'Z + XYZ' + XYZ'$ By removing duplicate ter	+ X'YZ + X' + X'YZ + X' ms we get	′Z′ + X′Y′Z′ YZ′ + X′YZ′ YZ′ + X′YZ′ canonical S	+ X'Y'Z' um-of=Prod	uct form :		
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XY'Z' By removing duplicate ter XYZ + XY'Z + XYZ	+ X'YZ + X' + X'YZ + X' ms we get	′Z′ + X′Y′Z′ YZ′ + X′YZ′ YZ′ + X′YZ′ canonical S	+ X'Y'Z' um-of=Prod	luct form :		
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XYZ' By removing duplicate ter XYZ + XY'Z + XYZ F = $\sum (1, 2, 3, 4, 5, 6, 7)$	+ X'YZ + X' + X'YZ + X' ms we get '' + XY'Z' + X	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' um-of=Prod	uct form :		
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XYZ' By removing duplicate ter XYZ + XY'Z + XYZ F = $\sum (1, 2, 3, 4, 5, 6, 7)$ F = m ₁ + m ₂ + m ₃ + m ₄ + m	+ X'YZ + X' + X'YZ + X' ms we get '' + XY'Z' + X	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' um-of=Prod	uct form :		
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XY'Z' By removing duplicate ter XYZ + XY'Z + XYZ F = $\Sigma(1, 2, 3, 4, 5, 6, 7)$ F = m ₁ + m ₂ + m ₃ + m ₄ + m (b) YZ + X'Y	+ X'YZ + X' + X'YZ + X' ms we get '' + XY'Z' + X	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' um-of=Prod	uct form :		
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XY'Z' By removing duplicate ter XYZ + XY'Z + XYZ F = $\sum(1, 2, 3, 4, 5, 6, 7)$ F = m ₁ + m ₂ + m ₃ + m ₄ + m (b) YZ + X'Y = YZ(X + X') + X'Y(Z + Z')	+ X'YZ + X' + X'YZ + X' ms we get '' + XY'Z' + X	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' um-of=Prod	uct form :		
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= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XY'Z' By removing duplicate ter XYZ + XY'Z + XYZ F = $\sum(1, 2, 3, 4, 5, 6, 7)$ F = m ₁ + m ₂ + m ₃ + m ₄ + m (b) YZ + X'Y = YZ(X + X') + X'Y(Z + Z')	+ X'YZ + X' + X'YZ + X' ms we get 2' + XY'Z' + 2' $5 + m_6 + m_7$ ms we get	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' Jum-of=Prod ' + X'Y'Z'			
= Z(XY + XY') + Z'(XY + XY') = XYZ + XY'Z + XYZ' + XY'Z' By removing duplicate ter XYZ + XY'Z + XYZ F = $\Sigma(1, 2, 3, 4, 5, 6, 7)$ F = m ₁ + m ₂ + m ₃ + m ₄ + m (b) YZ + X'Y = YZ(X + X') + X'Y(Z + Z') = XYZ + X'YZ + X'YZ + X'YZ' By removing duplicate ter	+ X'YZ + X' + X'YZ + X' ms we get 2' + XY'Z' + 2' $5 + m_6 + m_7$ ms we get	YZ' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ'	+ X'Y'Z' Jum-of=Prod ' + X'Y'Z'			
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= $Z(XY + XY') + Z'(XY + XY')$ = $XYZ + XY'Z + XYZ' + XYZ' + XY'Z'$ By removing duplicate ter XYZ + XY'Z + XYZ F = $\sum(1, 2, 3, 4, 5, 6, 7)$ F = $m_1 + m_2 + m_3 + m_4 + m_4$ (b) YZ + X'Y = $YZ(X + X') + X'Y(Z + Z')$ = $XYZ + X'YZ + X'YZ + X'YZ'$ By removing duplicate ter XYZ + X'YZ + F = $\sum(2, 3, 7)$ F = $m_2 + m_3 + m_7$ (c) AB'(B' + C') Try by yourself.	+ X'YZ + X' + X'YZ + X' ms we get Z' + XY'Z' + Z $T_5 + m_6 + m_7$ ms we get X'YZ'	72' + X'Y'Z' YZ' + X'YZ' YZ' + X'YZ' canonical S X'YZ + X'YZ' canonical S t <u>, the Boole</u> X 0 0	+ X'Y'Z' sum-of=Prod + X'Y'Z' sum-of=Prod sum-of=Prod <u>Y</u> 0	uct form : F(x, y, z), ar Z 0 1	F 1 0	for which is giv
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		Х		Y	Z	F		Maxterms		
		0		0	0	1	•	X + Y + Z		
		0		0	1	0)	X + Y + Z'		
		0		1	0	1	-	X + Y' + Z		
		0		1	1	0)	X + Y '+ Z'		
		1		0	0	1		X' + Y + Z		
		1		0	1	0)	X '+ Y + Z'		
		1		1	0	1		X' + Y '+ Z		
		1		1	1	1		X'+ Y' + Z'		
	Now by multiplying Max					ered pr	roduct c	of sums exp	ression	which is
		(X + Y + Z')								
37.	Given the truth table of	a function		Write S-O				n from the	followi	ng truth table :
		-	X	Y		Z	F			
		-	0	0		0	0			
		-	0	0		1	0			
		-	0	1		0	0			
		Ļ	0	1		1	1			
		F	1	0		0	1			
		F	1	0		1	0			
		-	1	1		0	0			
			1	1		1	1			
Ans.	Add a new column conta	ining Minte	erms and I	Maxterms	s. Now the	e table	is as fol	lows :		1
AIIS.		X	Y	Z	F		Minter		erms	
		0	0	0	0		X'Y'Z		Y + Z	
		0	0	1	0		X'Y'Z		(+ Z'	
		0	1	0	0		X'YZ'		/' + Z	
		0	1	1	1		X'YZ		' ' + Z'	
		1	0	0	1		XY'Z'		Y + Z	
		1	0	1	0		XY'Z		Y + Z'	
		1	1	0	0		XYZ'		Y '+ Z	
		1	1	1	1		XYZ		" + Z'	
	Now by adding all the mi			tput is 1,	we get de	sired si	um-of-p	products exp	oressio	n which is
		X'YZ + XY'Z		•						
	Now by multiplying Max		•			•		sums expr	ession	which is
20	•	Z)(X + Y + Z	<i>,</i> ,		1.)			
38.	Convert the following ex (a) (A + C)(C + D)	•	(B + C)(C')		(c) (X		т 2)(Х т	7)		
Ans.	(a) $(A + C)(C + D)$ (a) $(A + C)(C + D)$	(U) A			() (е I Д I .	· - ДЛ т	-1		
A113.	= (A + BB' + C + DD')(AA')	′ + BB′ + C +	- D)							
	= (A + B + C + D)(A + B' + D)(A + B' + C + D)(A + B' + D)(A + B' + C + D)(A + B' + D)(A + D)(A + B' + D)(A +		•)(A' + R' +	C + D)					
	By removing duplicate te	7.			,	orm:				
	(A + B + C + D)(A + B' + C)	-								
	$F = \pi(0, 5, 12)$	<i><i></i></i>	- /							
	$F = M_0 + M_5 + M_{12}$									
	(b) $A(B + C)(C' + D')$									
	Try by yourself.									
	(c) $(X + Y)(Y + Z)(X + Z)$									
	= (X + Y + ZZ')(XX' + Y + Z))(X + YY' + Z	<u>Z</u>)							
	= (X + Y + Z)(X + Y + Z')(X	+ Y + Z)(X' +	+ Y + Z)(X +	+ Y + Z)(X	+ Y' + Z)					
	By removing duplicate te	erms we get	t canonica	l Product	-of-Sum fo	orm:				
	(X + Y + Z)(X + Y + Z')(X' +	+ Y + Z)(X +	Y' + Z)							
	$F = \pi(0, 1, 2, 4)$									

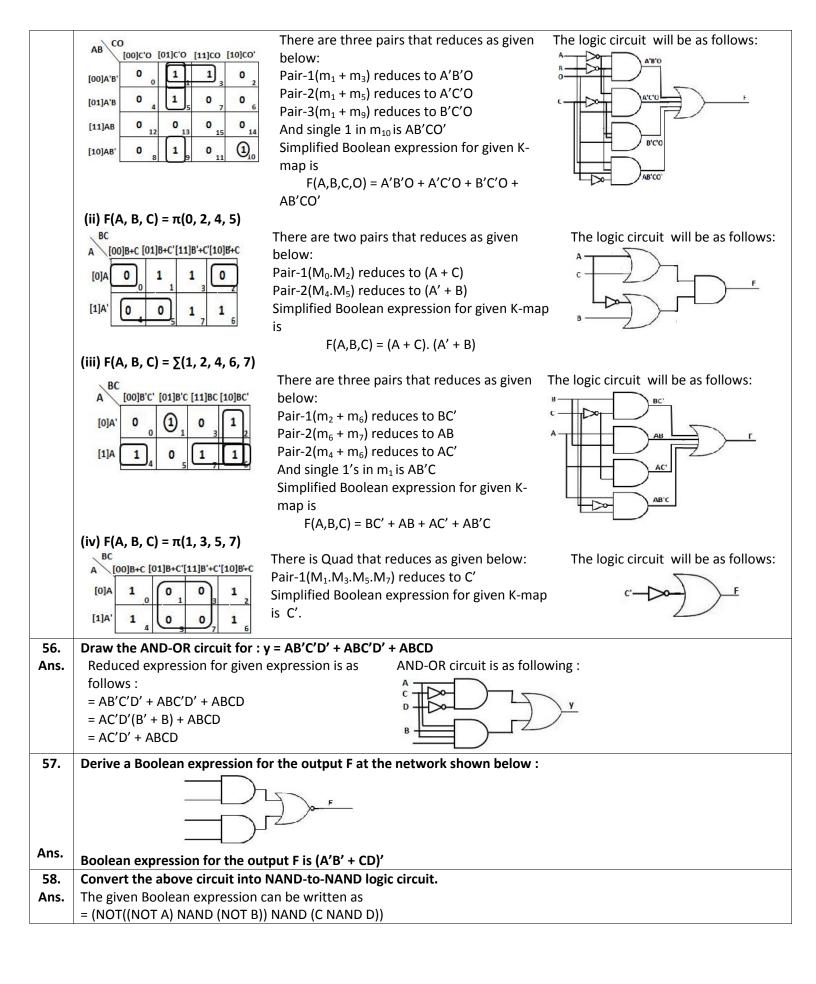
39.	Simplify the follo	owing Bool	•									
	(i) AB + AB'+ A'C	C + A'C'	(ii) XY + XY	Z' + XYZ' + XZ'	Y (iii)	XY(X'YZ'+ X	(Y'Z'+ XY'Z')					
Ans.	(i) AB + AB' + A'	C + A'C'										
	= A(B + B') + A	.'(C + C')		•	=1, C + C'	= 1)						
	= A + A'			(A + A'	= 1)							
	= 1											
	(ii) XY + XYZ' + X'	YZ' + XZY										
	= XY(Z') + XY((Z' + Z)		(Z + Z' =	=1)							
	= XY(Z') + XY											
	= XY(Z' + 1)			(Z' + 1	= 1)							
	= XY											
	(iii) XY(X'YZ' + X)	-										
	= XY[Z'(X'Y +											
	= XY[Z'(X'Y + = XY[Z'(X'Y +	• • •										
	= XYZ'(X'Y +)											
40.	Develop sum of		ad product o	f sums ovnrog	sions for	E. and E. fro	m the follow	ing truth table :				
. .		pi ouucis a		Inputs	510113 101		tputs					
			X	Y	Z	F 1	F ₂					
			0	0	0	0	0					
			0	0	1	0	1					
			0	1	0	0	1					
			0	1	1	1	0					
			1	0	0	1	0					
			1	0	1	0	0					
			1	1	0	0	1					
			1	1	1	1	1					
Ans.	Add a new colum	nn containii	-	-	-	-	-					
			Inputs		Outp		Minterms	Maxterms				
	_	Х	Υ	Z	F ₁	F ₂						
	_	0	0	0	0	0	X'Y'Z'	X + Y + Z				
					0	1	X'Y'Z	X + Y + Z'				
		0	U	1	U	1						
		0	0	1 0								
	_	0 0 0	1	0 1	1	1 0	X'YZ'	X + Y' + Z				
		0 0	1	0		1	X'YZ' X'YZ	X + Y' + Z X + Y '+ Z'				
		0 0 1	1 1	0 1	1 1 1	1 0	X'YZ' X'YZ XY'Z'	X + Y' + Z X + Y '+ Z' X' + Y + Z				
		0 0	1 1 0	0 1 0	1 1 1 0	1 0 0	X'YZ' X'YZ XY'Z' XY'Z					
		0 0 1 1	1 1 0 0	0 1 0 1	1 1 1	1 0 0 0	X'YZ' X'YZ XY'Z'	X + Y' + Z X + Y '+ Z' X' + Y + Z				
	Now by adding a	0 0 1 1 1 1 1	1 1 0 0 1 1	0 1 0 1 0 1 1 1	1 1 1 0 0 1	1 0 0 1 1	X'YZ' X'YZ XY'Z' XY'Z XYZ' XYZ		is			
	Now by adding a X'YZ' + X'YZ + XY	0 0 1 1 1 1 1 1	1 1 0 0 1 1	0 1 0 1 0 1 1 1	1 1 1 0 0 1	1 0 0 1 1	X'YZ' X'YZ XY'Z' XY'Z XYZ' XYZ	$\begin{array}{c} X + Y' + Z \\ X + Y + Z' \\ X' + Y + Z \\ X' + Y + Z' \\ X' + Y + Z' \\ X' + Y' + Z \\ X' + Y' + Z' \end{array}$	is			
	X'YZ' + X'YZ + XY	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 2' + XYZ	1 1 0 1 1 erms for whice	0 1 0 1 0 1 	1 1 0 0 1 in F1, we g	1 0 0 1 1 get desired s	X'YZ' X'YZ XY'Z' XY'Z XYZ' XYZ sum-of-produ	$\begin{array}{c} X + Y' + Z \\ X + Y + Z' \\ X' + Y + Z \\ X' + Y + Z' \\ X' + Y + Z' \\ X' + Y' + Z \\ X' + Y' + Z' \end{array}$				
	X'YZ' + X'YZ + XY	0 0 1 1 1 1 1 1 1 1 1 1 2' + XYZ II the minte	1 1 0 1 1 erms for whice	0 1 0 1 0 1 	1 1 0 0 1 in F1, we g	1 0 0 1 1 get desired s	X'YZ' X'YZ XY'Z' XY'Z XYZ' XYZ sum-of-produ	$ \begin{array}{r} X + Y' + Z \\ X + Y + Z' \\ X' + Y + Z \\ X' + Y + Z' \\ X' + Y + Z' \\ X' + Y' + Z' \\ X' + Y' + Z' \\ \text{cts expression which} \\ \end{array} $				
	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	110011erms for whicherms for which	0 1 0 1 0 1 ch output is 1 ch output is 1	1 1 0 0 1 in F1, we g	1 0 0 1 1 get desired s get desired s	X'YZ' X'YZ XY'Z' XY'Z XYZ XYZ sum-of-produ	$ \begin{array}{r} X + Y' + Z \\ X + Y + Z' \\ X' + Y + Z \\ X' + Y + Z' \\ X' + Y + Z' \\ X' + Y' + Z' \\ X' + Y' + Z' \\ \text{cts expression which} \\ \end{array} $				
	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY	0 0 1 1 1 1 If the minter 'Z' + XYZ If the minter 'Z' + XYZ ing Maxter	1 1 0 1 1 erms for which erms for the out	0 1 0 1 0 1 	1 1 0 0 1 in F1, we g	1 0 0 1 1 get desired s get desired s	X'YZ' X'YZ XY'Z' XY'Z XYZ XYZ sum-of-produ	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z'$ $X' + Y' + Z'$ cts expression which cts expression which	is			
	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 0 1 1 erms for whice erms for the out 2')(X' + Y '+ Z) ms for the out	0 1 0 1 0 1 ch output is 1 ch output is 1 ch output is 1 ch output os in F1, c) tput 0s in F2,	1 1 0 0 1 in F1, we g in F2, we g	1 0 0 1 1 get desired s get desired s get desired s	X'YZ' X'YZ XY'Z' XYZ XYZ sum-of-produ sum-of-produ	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z'$ $X' + Y' + Z'$ cts expression which cts expression which	is			
	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$ \begin{array}{c c} 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice ms for the ou Z')(X' + Y + Z $	0 1 0 1 0 1 0 1 ch output is 1 ch output is 1 ch output is 1 ch output os in F1, c) tput 0s in F2,)	1 1 0 0 1 in F1, we g we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$ \begin{array}{c c} 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice ms for the ou Z')(X' + Y + Z $	0 1 0 1 0 1 0 1 ch output is 1 ch output is 1 ch output is 1 ch output os in F1, c) tput 0s in F2,)	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z'$ $X' + Y + Z'$ $X' + Y' + Z'$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z Obtain a simplifi	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$ \begin{array}{c c} 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice ms for the ou Z')(X' + Y + Z $	0 1 0 1 0 1 0 1 	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z Obtain a simplifi	$\begin{array}{c} 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$	$ \begin{array}{c c} 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice erms for the out \begin{array}{c} 2')(X' + Y' + Z \\ ms for the out C')(X' + Y + Z' \\ \hline 10 for a Boce 11 10 \end{array} $	0 1 0 1 0 1 0 1 	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z Obtain a simplifi	$\begin{array}{c} 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$	$ \begin{array}{c c} 1\\ 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice erms for the ou \begin{array}{c} z')(X' + Y' + Z\\ ms for the ou\\ Z)(X' + Y + Z' \\ \hline ion for a Boce \end{array} $	0 1 0 1 0 1 0 1 	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z Obtain a simplifi	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$ \begin{array}{c c} 1\\ 0\\ 0\\ 1\\ 1\\ erms for whice erms for whice erms for the out \begin{array}{c} 2')(X' + Y' + Z \\ ms for the out C')(X' + Y + Z' \\ \hline 10 for a Boce 11 10 \end{array} $	0 1 0 1 0 1 0 1 	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			
41.	X'YZ' + X'YZ + XY Now by adding a X'Y'Z + X'YZ' + XY Now by multiplyi + Y + Z)(X + Y + Z Now by multiplyi + Y + Z)(X + Y' + Z Obtain a simplifi	0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 0 0 1 1 $rms for which even for which even for the out z')(X' + Y' + Z')$ $rms for the out z')(X' + Y + Z')$ $rms for the out z')(X' + Y + Z')$ $rms for the out z')(X' + Y + Z')$	0 1 0 1 0 1 0 1 	1 1 0 0 1 in F1, we get the we get the	1 0 0 1 get desired s get desired properties e desired properties	X'YZ' X'YZ XY'Z' XYZ' XYZ' sum-of-produ sum-of-produ oduct of sums	X + Y' + Z $X + Y' + Z'$ $X' + Y + Z$ $X' + Y + Z'$ $X' + Y' + Z$ $X' + Y' + Z'$ cts expression which cts expression which s expression which is s expression which is	is (X (X			

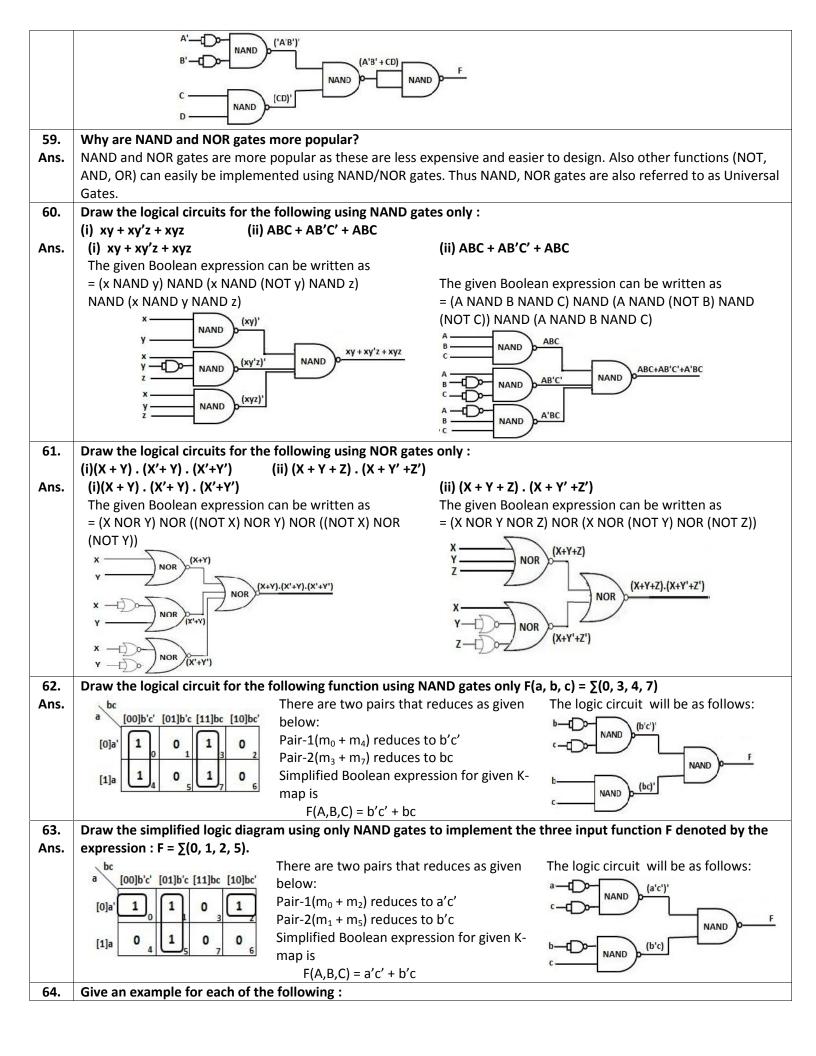


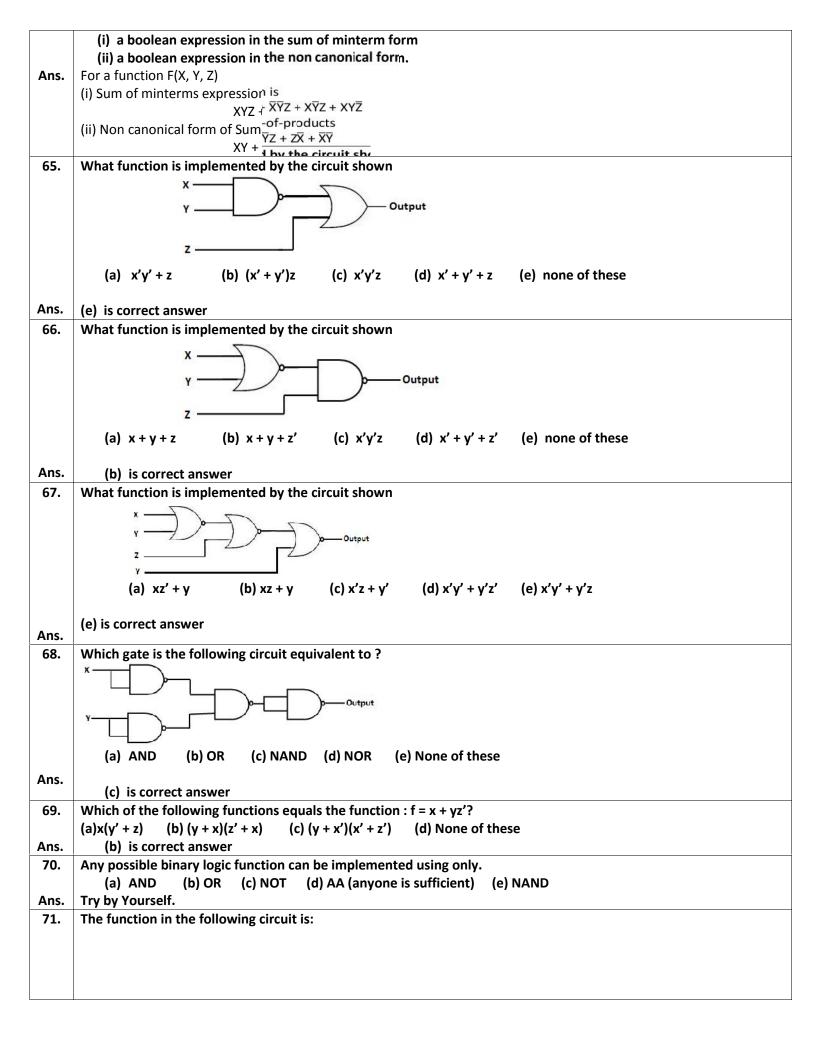




			A'B BC	A'B+E	
51.	-			-	gh input, when there is even number of low inputs.
Ans.	Following	truth tabl	e gives a hig	gh input, s	when From truth table we get following function :
	there is e	ven numbe	er of low inp	outs :	F = X'Y'Z + X'YZ' + XY'Z'
	Х	Y	Z	F	Logic circuit for the function F is as following :
	0	0	0	0	
	0	0	1	1	
	0	1	0	1	
					X'YZ+X'YZ'+X'YZ'
	0	1	1	0	
	1	0	0	1	
	1	0	1	0	
	1	1	0	0	
	1	1	1	0	
52.	Design a ci	rcuit (3 in	put) which	gives a hi	gh input only when there is even number of low or high inputs.
Ans.			e gives a hig		
	-		er of low or		
	X	Y	Z	F	Logic circuit for the function F is as following :
	0	0	0	0	
	0	0	1	1	ž alost
	-				x'vz'
	0	1	0	1	
	0	1	1	0	
	1	0	0	1	
	1	0	1	0	
	1	1	0	0	
	1	1	1	0	xyz'
53.	-	-			an function $f(x, y) = x \cdot y + x' \cdot y'$
Ans.	The circuit	diagram fo	or above ex	pression	will be as follows:
		x —		×.y ~	
		YТ		14	x.y+x'.y'
				X'.Y'	
54.	Draw the l		t for this Bo	olean ea	uation : y = A'B'C'D + AB'C'D + ABC'D + ABCD'
Ans.		-	+ ABC'D + AI		The logic circuit for above Boolean equation will be as follows:
A113.	_	-	2'D + ABCD'		B
		ABC'D + ABC			
	- B C D +	ADC D + A	БСЛ		
					ARCD'
55.	Draw logic	circuit for	the follow	ing using	k-maps :
	-		, 3, 5, 9, 10)		(ii) $F(A, B, C) = \pi(0, 2, 4, 5)$
	(iii) F(A, B,				(iv) $F(A, B, C) = \pi(1, 3, 5, 7)$
Ans.			, , , , , , , , , 3, 5, 9, 10)		(1,1) + (1,1) = (1,1
AII5.	(I) F(M, D, C	., 0, - 2(1,	, J, J, J, J, IUJ		







Ans.	
	(a) abcd (b) ab + cd (c) (a + b)(c + d) (d) a + b + c + d (e) (a' + b')+(c' + d')
	(e) is correct answer
72.	Given $F = A'B + (C' + E)(D + F')$, use de Morgan's theorem to find F'.
	(a) $ACE' + BCE' + D'F$ (b) $(A + B')(CE' + D'F)$ (c) $A + B + CE'D'F$
	(d) ACE' + AD'F + B'CE' + B'D'F (e)NA
Ans.	A'B + (C' + E)(D + F') = (A'B)' + ((C' + E)(D + F'))'
	= (AB') + (C' + E)'(D + F')'
	= (AB') + (C + E')(D' + F)
	= (A + B')(CE' + D'F) So , F' = (A + B')(CE' + D'F)
73.	The function in the following circuit is :
75.	
	x
	Y
	(a) x' + y' + z' (b) x + y + z (c) x'z' + y'z' (d) xy + z (e) z
Ans.	(c) is correct.
74.	Try Harder Simplify the following: {[(AB)'C]D]}'
	(a) $(A' + B')C + D$ (b) $(A + B')C' + D'$ (c) $A' + (B' + C')D$ (d) $A' + B' + C' + D'$ (e) $A + B + C + D$
Ans.	Try by Yourself.
75.	Give the relationship that represents the dual of the Boolean property A + 1 = 1?
	[Note. * = AND, + = OR and ' = NOT]
A == 0	(a) $A \cdot 1 = 1$ (b) $A \cdot 0 = 0$ (c) $A + 0 = 0$ (d) $A \cdot A = A$ (e) $A \cdot 1 = 1$ The relationship that represents the dual of the Bealean property $A + 1 = 1$ is $A = 0 = 0$
Ans. 76.	The relationship that represents the dual of the Boolean property $A + 1 = 1$ is $A \cdot 0 = 0$ Simplify the Boolean expression ($A + B + C$)($D + E$)' + ($A + B + C$)($D + E$) and choose the best answer.
70.	(a) $A + B + C$ (b) $D + E$ (c) $A'B'C'$ (d) $D'E'$ (e) None of these
Ans.	(A+B+C)(D+E)' + (A+B+C)(D+E)= (A+B+C)((D+E)+(D+E)') (Distributive Law)
	= (A+B+C).(1) (X+X'=1)
	= A+B+C
	So, simplification of the Boolean expression (A + B + C)(D + E)' + (A + B + C)(D + E) yields A+B+C
77.	Which of the following relationship represents the dual of the Boolean property $x + x'y = x + y$?
	(a) $x'(x + y) = x'y'$ (b) $x(x'y) = xy$ (c) $x * x' + y = xy$ (d) $x'(xy') = x'y'$ (e) $x(x' + y) = xy$
Ans.	The relationship $x * x' + y = xy$ represents the dual of the Boolean property $x + x'y = x + y$
78.	Given the function F(X, Y, Z) = XZ + Z(X' + XY), the equivalent most simplified Boolean representation for F is : (a)Z + YZ (b) Z + XYZ (c) XZ (d) X + YZ (e) None of these
Ans.	(a) Z + YZ (b) Z + XYZ (c) XZ (d) X + YZ (e) None of these XZ + Z(X'+ XY)= XZ + X'Z + XYZ (distributive Law)
Alls.	$= Z(X+X') + XYZ \qquad (distributive Law)$
	= Z(1) + XYZ (Complementarity Law)
	= Z+XYZ (Identity Law)
	The equivalent most simplified Boolean representation for F is Z+XYZ
79.	Simplification of the Boolean expression $(A + B)'(C + D + E)' + (A + B)'$ yields which of the following results?
	(a) A + B) (b) A'B' (c) C + D + E (d) C'D'E' (e) A'B'C'D'E'
Ans.	(A + B)'(C + D + E)' + (A + B)'=(A+B)'((C+D+E)+1) (Distb. Law)
	=(A+B)'.1 (Identity Law)
	=(A+B)' (Identity Law)
	=A'B' (DeMorgan's Law)
	So, simplification of the Boolean expression $(A + B)'(C + D + E)' + (A + B)'$ yields A'B
80.	Given that F = A'B' + C + D' + E', Which of the following represents the only correct expression for F'?

(a) F' = A + B + C + D + E(b) F' = ABCDE (c) F' = AB(C + D + E)(d) F' = AB + C' + D' + E'(e) F' = (A + B)CDEAns. F = A'B' + C' + D' + E'Taking complement on both sides: F' = (A'B' + C' + D' + E')'=(A'B')'.(C')'(D')'(E')' =(A+B).C.D.E So, (A + B)CDE represents correct expression for F' An equivalent representation for the Boolean expression A' + 1 is 81. (b) A' (c) 1 (d) 0 (a) A Ans. An equivalent representation for the Boolean expression A' + 1 is 1 Simplification of the Boolean expression AB + ABCD + ABCDE + ABCDEF yields which of the following results? 82. (a) ABCDEF (b) AB (c) AB + CD + EF (d) A + B + C + D + E + F (e) A + B(C + D(E + F))Ans. AB + ABC + ABCD + ABCDE + ABCDEF =(AB +ABC) + (ABCD +ABCDE) + ABCDEF (Commutative Law Law) =AB + ABCD + ABCDEF (Absorption Law) =AB +(ABCD +ABCDEF) (Commutative Law Law) (Absorption Law) =AB +ABCD =AB So, simplification of the Boolean expression AB + ABCD + ABCDE + ABCDEF yields AB 83. Given the following Boolean function F = A*BC* + A*BC + AB*C (a) Develop an equivalent expression using only NAND operations, and the logic diagram. (b) Develop an equivalent expression using only NOR operations, and the logic diagram. Ans. (a) Develop an equivalent expression using only NAND operations, and the logic diagram. The given Boolean expression can be written as = (A NAND B NAND C) NAND (A NAND B NAND C) NAND (A NAND B NAND C) The logic diagram is as following : (ABC)' NAND F A NAND (ABC) NAND (ABC)' NAND (b) Develop an equivalent expression using only NOR operations, and the logic diagram. Try by Yourself. 84. For the logic function of $F(A, B, C, D) = \sum (0, 1, 3, 4, 5, 7, 8, 10, 12, 14, 15)$. (a) Show the truth table (b) Write the SOP form (c) Write the POS form (d) Simplify by K-map. Ans. (a)Show the truth table Truth table for the given function is as following : С F Minterms Α В D Maxterms 0 0 0 0 1 A'B'C'D' A+B+C+D 0 0 0 1 1 A'B'C'D A+B+C+D' 0 0 1 0 A'B'CD' A+B+C'+D 0 1 1 A'B'CD A+B+C'+D' 0 1 0 1 0 0 1 A'BC'D' A+B'+C+D 1 0 1 1 A'BC'D A+B'+C+D' 0 0 1 1 0 A'BCD' A+B'+C'+D0 1 1 1 A'BCD A+B'+C'+D'1 0 1 0 0 1 AB'C'D' A'+B+C+D 0 0 1 AB'C'D A'+B+C+D' 1 0 1 0 AB'CD' A'+B+C'+D 1 1 0 1 1 1 AB'CD A'+B+C'+D'1 1 0 0 1 ABC'D' A'+B'+C+D

	1	1	0	1		ABC'D	A'+B'+C+D'	
	1	1	1	0	1	ABCD'	A'+B'+C'+D	
	1	1	1	1	1	ABCD	A'+B'+C'+D'	
	(b) Write t	he SOP f	orm					
	Adding all	the minte	erms for	which ou	itput is 1,	we get		
	A'B'C	'D' + A'B'	C'D + A'E	3'CD + A'	BC'D' + A'	'BC'D + A'BC	D + AB'C'D' + A	AB'CD' + ABC'D' + ABCD' + ABCD
	This is desi	ired Cano	nical Su	m-of-Pro	duct form).		
	(c) Write t	he POS fo	orm					
	By multiply	ying Maxt	terms fo	r the out _l	put Os, we	e get		
	(A+B+C	C'+D)(A+I	B'+C'+D)	(A'+B+C-	+D')(A'+E	3+C'+D')(A'+	-B'+C+D')	
	This is desi	ired Cano	nical Pro	oduct-of-	Sum form).		
	(d) Simplif	y by K-m	ар					
	AB	00]C'D' [01]		[10]CD'				-map, we get 2 pairs and 2 Quads.
	[00]A'B'			0	•		educes to ABC	
		- 0	1 3	2	•	,	luces to ACD' a	
	[01]A'B	1 4 1	7 لا ۽	0 6			•	ces to C'D' as A and B removed.
	[11]AB	1 0	13 1	1 4				es to A'D as B and C removed.
	[10]AB'	1 0	0	1			•	given K-map is
		8	9 11	٥			: + ACD' + C'D' -	
85.	(a) Im					pression usi	ng only NAND	gates.
	(1) -		•	C')(A + B)				
			on a NOR	tunctior	n by only	NAND gates	5.	
Ans.	Try by You	rselt.						

TYPE C : LONG ANSWER QUESTION

1(a)	State and verify De Morgan's law in Boolean Algebr	а.
Ans.	DeMorgan's theorems state that (i) $(X + Y)' = X'.Y'$	(ii) (X.Y)'= X' + Y'
	(i) (X + Y)'= X'.Y'	
	Now to prove DeMorgan's first theorem, we will use	complementarity laws.
	Let us assume that P = x + Y where, P, X, Y are logical	variables. Then, according to complementation law
	$P + P' = 1$ and $P \cdot P' = 0$	
		complementarity law must hold for variables P. In other words, if
	P i.e., if $(X + Y)' = X'.Y'$ then	
	(X + Y) + (XY)' must be equal to 1.	(as X + X' = 1)
	(X + Y) . (XY)'must be equal to 0.	(as X . X'= 0)
	Let us prove the first part, i.e.,	
	(X + Y) + (XY)' = 1	
	(X + Y) + (XY)' = ((X + Y) + X').((X + Y) + Y')	(ref. X + YZ = (X + Y)(X + Z))
	= (X + X' + Y).(X + Y + Y')	
	= (1 + Y).(X + 1)	(ref. X + X'=1)
	= 1.1	(ref. 1 + X =1)
	= 1	
	So first part is proved.	
	Now let us prove the second part i.e.,	
	$(X + Y) \cdot (XY)' = 0$	
	$(X + Y) \cdot (XY)' = (XY)' \cdot (X + Y)$	(ref. X(YZ) = (XY)Z)
	= (XY)'X + (XY)'Y	(ref. $X(Y + Z) = XY + XZ$)
	= X(XY)' + X'YY'	
	= 0.Y + X' . 0	(ref. X . X'=0)
	= 0 + 0 = 0	
	So, second part is also proved, Thus: $X + Y = X'$. Y'	

(ii) (X.Y)' = X' + Y'Again to prove this theorem, we will make use of complementary law i.e., X + X' = 1and X . X' = 0If XY's complement is X + Y then it must be true that (a) XY + (X' + Y') = 1 and (b) XY(X' + Y') = 0To prove the first part L.H.S = XY + (X'+Y')= (X'+Y') + XY(ref. X + Y = Y + X)= (X'+Y'+X).(X'+Y'+Y)(ref. (X + Y)(X + Z) = X + YZ)= (X + X' + Y').(X' + Y + Y')= (1 + Y').(X' + 1)(ref. X + X'=1)= 1.1 (ref. 1 + X = 1)= 1 = R.H.SNow the second part i.e., $XY.(\overline{X} + \overline{Y}) = 0$ L.H.S = (XY)'.(X'+Y')= XYX' + XYY'(ref. X(Y + Z) = XY + XZ) = XX'Y + XYY'(ref. X . X'=0) = 0.Y + X.0= 0 + 0 = 0 = R.H.S.XY.(X' + Y') = 0and XY + (X' + Y') = 1(XY)' = X' + Y'. Hence proved. 1(b). Draw a Logical Circuit Diagram for the following Boolean Expression X'.(Y' + Z)Ans. The Logical Circuit Diagram for the Boolean Expression is as following: × -> X'.(Y'+Z) Y'+Z 1(c) Convert the following Boolean expression into its equivalent Canonical Sum of Product Form (SOP). (X' + Y + Z').(X' + Y + Z).(X' + Y' + Z')Ans. Given (X' + Y + Z').(X' + Y + Z).(X' + Y' + Z')(1 + 0 + 1) (1 + 0 + 0) (1 + 1 + 1) $= M_4.M_5.M_6.M_7$ $= \pi(4, 5, 6, 7)$ \Rightarrow SOP is equal to(excluding position of minterms) $= \Sigma(0, 1, 2, 3)$ $= m_0 + m_1 + m_2 + m_3$ = X'Y'Z + X'Y'Z + X'YZ' + X'YZ1(d) Reduce the following Boolean expression using K-map $F(A, B, C, D) = \sum (0,2,3,4,5,6,7,8,10,12)$ Ans. CD AR [00]C'D' [01]C'D [11]CD [10]CD' There are 1 Pair and 2 Quads that reduce as given below: 1 0 1 1 [00]A'B' Pair($m_8 + m_{10}$) reduces to AB'D' 1 1 0 [01]A'D 1 Quad-1($m_0 + m_4 + m_{12} + m_8$) reduces to C'D' Quad- $2(m_2 + m_3 + m_6 + m_7)$ reduces to A'C [11]AB 1 0 14 0 0 Simplified Boolean expression for given K-map is [10]AB' 1 0 1 0 F(A,B,C,D) = AB'D' + C'D' + A'CState De Morgan's Theorems and verify the same using truth table. 2(a). De Morgan's First theorem. It states that (X+Y)'=X'.Y' Ans. De Morgan's Second theorem. It states that (X.Y)'=X'+Y' Truth Table for first theorem. Truth Table for second theorem. Х Υ X' Y X+Y (X+Y)' X'.Y' Х Υ X' Y X.Y (X.Y)' X'+Y' 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 1 1 1 0 1 0 0 0 1 0 0 1 1

	1	0	0	1	1	0	0		1	0	0	1	0	1	1	
	1	1	0	0	1	0	0		1	1	0	0	1	0	0]
		_	•	•		at (X+Y)' =	-				-	-	_	at (X.Y)' =	-	
2(b).	-					roduct of										F(X Y 7)
-().	= Σ(0, 2	-		int can	onicari	louuce of						5 Juli	011100		23510111	• (*,• •) = /
Ans.				on : F()	X. Y. Z) =	= ∑(0, 2, 4	. 5)									
-			•	-	n:π(1,3		, - ,									
			-			$= M_1.M_3$.M ₆ .M ₇									
			•			m = (X +)										
			-	-		m = (X +)	-									
		M6 =	(1 + 1	+ 0)'S	Maxter	m = (X' +	Y' + Z)									
		M7 =	(1 + 1	+ 1)'S	Maxter	m = (X' +	Y' + Z')									
	Equiv	alent I	POS w	ill be												
				F(X, Y	, Z) = (X ·	+ Y + Z). (X + Y' +	Z'). (X' +	+ Y' + Z	′.). (X′ +	+ Y' + Z	")				
2(c).	Write t	ne equ	uivale	nt Boo	lean ex	pression	for the	followir	ng Logi	ic Circ	uit.					
			A —			5										
			в —	->)) F										
			c —		\neg	$\overline{\mathcal{L}}$										
	T I		P		<u> </u>											
Ans.					•	n for the	-		cuit is:	F = AE	3 + C L)				
2(d).	Reduce			-		pression 6, 7, 8, 9,	-	•								
Ans.			F(A, D	э, с, р	- II(3, 1	0, 7, 8, 9,	12, 13,	, 14, 13)								
A113.)														
	AB		[01]C+D	' [11]C'+D	[10]C'+D	Ther	e are 1	Pair and	2 Oua	ads tha	at redu	ice as	given be	elow:		
	[00]A+B	1	1	1	1 ,) reduce					0			
	[01]A+B'	1	0	0,	0	-		. M ₇ . M				(B' +)	C')			
	[11]A'+B'	6		0	0	Quad	d- 2(M ₈	. M ₉ . M	12 . M ₁	3) redu	ices to	(A' +	C)			
		1	2 13	3 45	14	Simp	lified B	oolean e	expres	sion fo	or give	n K-ma	ap is			
	[10]A'+B	6	<u>ا</u> و_	1	1 ₁₀		F(A,B,C	,D) = (A	+ B' + I	D'). (B'	′ + C′).	(A' + (C)			
3(a).		-			-	nem using	-									
Ans.		-				ates that	(X+Y)'=	X'.Y'			_			t states tl	hat (X.Y)	'=X'+Y'
	Truth		1					Т		1	1	1	heorem	1		1
	X	Y	X'	Y'	X+Y	(X+Y)'	X'.Y'	_	X	Y	X'	Y'	X.Y	(X.Y)′	X'+Y'	-
	0	0	1	1	0	1	1	_	0	0	1	1	0	1	1	
	0	1	1	0	1	0	0	_	0	1	1	0	0	1	1	-
	1	0	0	1	1	0	0	_	1	0	0	1	0	1	1	-
		1	0	0	1	0	0		1	1	0	0	1	0	0	
2(6)						at (X+Y)' = (A + B + (at (X.Y)' =	= X + Y	
3(b). Ans.	-	•	•	•••		(А+В+ (В+С).(А			A + B	+ C) a	ligebra	alcally				
A115.	-				C)(A + C)(B + B		трт	-	C + C	′=1 R	+ B'=1	١				
			(A' + C	<i>,</i> ,	сдыв	1		(0.0	-1, 0		/				
	= L	,		-,												
3(c).	Obtain	a simp	olified	form	for a Bo	olean ex	oressio	n :								
. ,		-				, 4, 5, 7, 8			using	K-map	meth	od.				
	XY									•						
	ľ			[11]ZW [1	38	Ther	e are 1	Pair and	l 1 Oct	et tha	at redu	ice as	given be	elow:		
	[00]X'Y'	1 0	1 1	0.3	0 2			15) reduc								
	[01]X'Y	1 4	1 5	1,	0 6									ices to Z'		
	[11]XY	1	1	1	0	•		oolean e	•	sion fo	or give	n K-ma	ap is			
_	[TT]							\ \ \ \ \ \ \ \ \ \								
Ans.	-	12	1	-45	14		F(X, Υ,Ζ,	W) = YZY	W + Z′							
Ans. 3(d).	[10]XY'	12 1 2	1 9	0 11	0 ₁₀	Boolean	(, , , ,									

Y	NOR (X'+Y)								
2	NOR	NOH (X'+Y)	(Y'+Z)						
V-DD-Y									
z	NOR (Y'+Z)'								
Express	in the PC)S form,	the Boole	ean functi	on F(A, E	<u>8, C</u>), the truth	table for w	hich is given below	<i>ı</i> :
		Α	В	С	F				
		0	0	0	0				
		0	0	1	1				
		0	1	0	0				
		0	1	1	1				
		1	0	0	0				
		1	0	1	1				
		1	1	0	0				
		1	1	1					
				Sum form		-	~1		
)(A + B' + (he law us		+ C)(A' + B' + 0)	-)		
			•		•	(+ YZ = (X + Y)	$(Y \pm 7)$		
	·Z) = XY +		(a) A(1 +	2) - XI + 7	(2)	(+12 - (/ +1)	(// + 2)		
	-		make a fo	ollowing t	ruth tabl	e:			
X	Y	Z	Y + Z	XY	XZ	X(Y + Z)	XY + X	Z	
0	0	0	0	0	0	0	0		
0	0	1	1	0	0	0	0		
0	1	0	1	0	0	0	0		
0	1	1	1	0	0	0	0		
1	0	0	0	0	0	0	0		
-	•								
1	0	1	1	0	1	1	1		
			1 1	01	1 0	<u> </u>	1		
1 1 1	0 1 1	1 0 1	1	1 1	0 1				
1 1 1 From tru	0 1 1 uth table	1 0 1 it is prov	1	1	0 1	1	1		
1 1 From tru (b) X + Y	0 1 1 uth table Z = (X + Y	1 0 1 it is prov ′)(X + Z)	1 1 e that X(1 1 Y +Z) = XY	0 1 + XZ	1	1		7
1 1 From tru (b) X + Y X	0 1 uth table Z = (X + Y Y	1 0 1 it is prov ')(X + Z) Z	1 1 e that X(1 1 Y +Z) = XY X + YZ	0 1 + XZ XZ	1 1 X + Y	1 1 X + Z	(X + Y)(X + Z)]
1 1 From tru (b) X + Y X 0	0 1 1 1 1 1 1 1 1 2 (X + Y 0	1 0 1 it is prov ()(X + Z) Z 0	1 1 e that X(YZ 0	1 1 Y +Z) = XY X + YZ 0	0 1 + XZ 0	1 1 X+Y 0	1 1 X + Z 0	0	
1 1 From tru (b) X + Y X 0 0	0 1 1 uth table Z = (X + Y 0 0	1 0 1 it is prov ()(X + Z) Z 0 1	1 1 e that X(YZ 0 0	1 1 Y +Z) = XY X + YZ 0 0	0 1 + XZ 0 0	1 1 X + Y 0 0	1 1 X+Z 0 1	0 0	
1 1 From tru (b) X + Y X 0 0 0	0 1 1 1 1 1 1 X Y 0 0 1	1 0 1 it is prov ')(X + Z) Z 0 1 0	1 1 e that X(YZ 0 0 0	1 1 Y +Z) = XY X + YZ 0 0 0	0 1 + XZ 0 0 0	1 1 X + Y 0 0 1	1 1 X + Z 0 1 0	0 0 0	-
1 1 From tru (b) X + Y X 0 0 0 0 0	0 1 1 1 1 1 1 Z = (X + Y 0 0 0 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1	1 1 e that X(0 0 0 0 1	1 1 Y +Z) = XY X + YZ 0 0 0 1	0 1 + XZ 0 0 0 0 0	1 1 X + Y 0 0 1 1 1	1 1 X + Z 0 1 0 1 1	0 0 0 1	
1 1 From tru (b) X + Y X 0 0 0 0 1	0 1 1 yth table Z = (X + Y Y 0 0 1 1 1 0	1 0 1 it is prov ')(X + Z) Z 0 1 0 1 0 1 0	1 1 e that X(0 0 0 0 1 0	$\frac{1}{1} \\ Y + Z) = XY \\ \frac{X + YZ}{0} \\ 0 \\ 0 \\ 1 \\ 1$	0 1 + XZ 0 0 0 0 0 0 0	1 1 X + Y 0 0 1 1 1 1	1 1 X + Z 0 1 0 1 1 1	0 0 0 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 1 1	0 1 1 1 1 1 Z = (X + Y 0 0 0 1 1 1 0 0 0	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1	1 1 e that X(0 0 0 0 1 0 0 0	1 1 Y +Z) = XY X + YZ 0 0 0 1 1 1 1	0 1 + XZ 0 0 0 0 0 0 0 0 1	1 1 X+Y 0 0 1 1 1 1 1 1	1 1 X + Z 0 1 0 1 1 1 1 1	0 0 0 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 1 1 1	0 1 1 1 1 1 2 = (X + Y 0 0 0 1 1 1 0 0 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 0	1 1 e that X(0 0 0 1 0 0 0 0 0 0 0	1 1 Y +Z) = XY X + YZ 0 0 0 1 1 1 1 1	0 1 + XZ 0 0 0 0 0 0 0 1 0	1 1 X+Y 0 0 1 1 1 1 1 1 1	1 1 X + Z 0 1 1 1 1 1 1	0 0 0 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 1 1 1 1	0 1 1 1 1 1 2 = (X + Y 7 0 0 0 1 1 1 0 0 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 0 1	1 1 e that X(0 0 0 1 0 0 0 0 0 1 0 0 1	1 1 Y +Z) = XY X + YZ 0 0 0 1 1 1 1 1 1 1	0 1 + XZ 0 0 0 0 0 0 0 1 0 1 1	1 1 X+Y 0 0 1 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 0 1 1 1 1 1	0 0 0 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 1 1 1 From tru	0 1 1 1 1 1 2 = (X + Y 0 0 1 1 0 0 1 1 0 0 1 1 1 1 1 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0	1 1 e that X(7Z 0 0 0 0 1 0 0 0 0 1 e that X +	1 1 Y +Z) = XY X + YZ 0 0 0 1 1 1 1 1	0 1 + XZ 0 0 0 0 0 0 0 1 0 1 1	1 1 X+Y 0 0 1 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 1 1 1 1 1	0 0 0 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 1 1 1 From tru Prove x	0 1 1 1 1 1 2 = (X + Y Y 0 0 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0	1 1 e that X(7Z 0 0 0 0 1 0 0 0 0 1 e that X +	1 1 Y +Z) = XY X + YZ 0 0 0 1 1 1 1 1 1 1	0 1 + XZ 0 0 0 0 0 0 0 1 0 1 1	1 1 X+Y 0 0 1 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 1 1 1 1 1	0 0 0 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 1 1 1 From tru Prove x LHS = x +	0 1 1 1 1 1 2 = (X + Y Y 0 0 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 + X'Y = X + X + Y 0 0 1 1 + X + Y 0 0 0 1 + X + Y 0 0 0 1 + X + Y 0 0 0 1 + X + Y 0 0 0 1 + X + Y 0 0 0 - X + Y 0 0 - X + Y 0 0 - X + Y 0 - X - X - X - X - X - X - X - X	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0 + y algeb	1 1 e that X(7Z 0 0 0 0 1 0 0 0 0 1 e that X +	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + YZ) = (X + YZ) $	0 1 + XZ 0 0 0 0 0 1 0 1 Y)(X + Z)	1 1 X + Y 0 0 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 1 1 1 From tru Prove x LHS = x +	0 1 1 1 1 1 2 = (X + Y Y 0 0 1 1 0 0 1 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0 + y algeb	1 1 e that X(7Z 0 0 0 0 1 0 0 0 0 1 e that X +	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + Y) \\ (X +$	0 1 + XZ 0 0 0 0 0 1 0 1 Y)(X + Z)	1 1 X+Y 0 0 1 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 1 1 1 From tru Prove x LHS = x + = (x	$ \begin{array}{c} 0 \\ 1 \\ 1 \\ y \\ z = (x + y) \\ y \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ y \\ x'y = x \\ + x'y \\ + x')(x + y \\ + y \\ \end{array} $	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0 + y algeb	1 1 e that X(7Z 0 0 0 0 1 0 0 0 0 1 e that X +	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + Y) \\ (X +$	0 1 + XZ 0 0 0 0 0 1 0 1 Y)(X + Z) YZ = (X +	1 1 X + Y 0 0 1 1 1 1 1 1 1 1	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 1 1 1 From tru 1 From tru Prove x LHS = x + = (x = x - = RH	$ \begin{array}{c} 0 \\ 1 \\ 1 \\ y \\ z = (x + y) \\ z = (x + y) \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \\ 0 \\ 1 \\ 1 \\ y \\ x'y = x \\ + x'y = x \\ + x'y \\ + x')(x + y \\ $	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 0 1 0 1 it is prov + y algeb	1 1 e that X(VZ 0 0 0 1 0 0 1 0 0 1 e that X + raically.	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + Y) \\ (X +$	$ \begin{array}{c c} 0 \\ 1 \\ + XZ \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ Y)(X + Z) \\ YZ = (X + + x' = 1) \end{array} $	1 1 X + Y 0 1 1 1 1 1 1 1 Y)(X + Z) Distr	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 0 0 0 0 1	0 1 1 1 1 1 2 = (X + Y Y 0 0 1 1 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 1 x y = x - + x y + x' y = (X + Y) y 0 0 1 1 1 0 0 1 1 + x' y = x - + x y = x - + y = x - + y 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1 1 e that X(VZ 0 0 0 1 0 0 1 e that X + raically.	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + $	$ \begin{array}{c c} 0 \\ 1 \\ + XZ \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ Y)(X + Z) \\ YZ = (X + + \cdot x' = 1) \\ + y).(x' + - \cdot x' = 1) \\ \hline $	1 1 X + Y 0 1 1 1 1 1 1 1 Y)(X + Z) Distr	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	
1 1 From tru (b) X + Y X 0 0 0 0 0 0 1	0 1 1 1 1 1 2 = (X + Y Y 0 0 1 1 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 1 x y = x - + x y + x' y = (X + Y) y 0 0 1 1 1 0 0 1 1 + x' y = x - + x y = x - + y = x - + y 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1	1 0 1 it is prov ()(X + Z) Z 0 1 0 1 0 1 0 1 0 1 1 0 1 it is prov + y algeb y)	1 1 e that X(VZ 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 e that X + raically.	$\frac{1}{1} \\ Y + Z) = XY \\ \hline X + YZ \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ - YZ = (X + (X$	$ \begin{array}{c c} 0 \\ 1 \\ + XZ \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 1 \\ Y)(X + Z) \\ YZ = (X + + \cdot x' = 1) \\ + y).(x' + - \cdot x' = 1) \\ \hline $	1 1 X + Y 0 1 1 1 1 1 1 1 Y)(X + Z) Distr	1 1 X + Z 0 1 0 1 1 1 1 1 1 1	0 0 1 1 1 1 1 1	

	[00]w'x' 1 0 0 [01]w'x 1 4 0 [11]wx 1 1 0 [10]wx' 1 8 0	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2 6 14 6	Simplifi F(w	ed Boolea /, x, γ, z) =	
4(e). Ans.	Represent the		expression	ı (x + y)(y +	z)(z + x) w	vith the help of NOR gates only.
Alls.	yNOR	(x+y)				
		NO	R (x+y)(y+z)	(z+x)		
	Y-NOR) Z				
	2	(y+z)'				
	2					
	×NOR	(z+x)'				
4(f).	Write sum of p	products fo	orm of fur	nction F(x,	y, z). The t	ruth table representation for the function F is given below :
		x	У	Z	F	
		0	0	0	0	
		0	0	1	0	
		0	1	0	1	
		0	1	1	0	
		1	0	0	1	
		1	0	1	0	
		1	1	0	0	
Ans.	The desired Ca		-	-	_	inσ·
		, 4, 7) = x'y				115,
5(a).	State and prov		-		One) algel	bracalv.
Ans:	-	-				i) $(X,Y)' = X' + Y'$
	(i) (X + Y)'= X'.					
	Now to prove I	DeMorgan	's first the	orem, we v	will use co	mplementarity laws.
	Let us assume				-	riables. Then, according to complementation law
				nd P.P'=		
				ariables he	en this con	nplementarity law must hold for variables P. In other words, if
	P i.e., if (X + Y)			ual to 1		
	-	Y) + (XY)'m Y) . (XY)'mı	•			(as X + X'= 1) (as X . X'= 0)
	Let us prove th		•	iai to 0.		$(as \land . \land - 0)$
		') + (XY)' =				
	•	, , ,		+X').((X + Y	') +Y')	(ref. X + YZ = (X + Y)(X + Z))
		=	= (X + X'+ '	Y).(X + Y +Y	')	
		=	= (1 + Y).(>	(+1)		(ref. X + X'=1)
		-	= 1.1			(ref. 1 + X =1)
	_		= 1			
	So first part is					
	Now let us pro	ve the seco (X + Y) . (-	.e.,		
		. , .	(XY)' = (XY)')' (X + V)		(ref. $X(YZ) = (XY)Z$)
		(// • • •) • ((+ (XY)'Y		(ref. X(Y + Z) = XY + XZ)
			. ,	' + X'YY'		
			= 0 .Y +			(ref. X . X'=0)
			= 0 + 0	= 0		
	So, second par					
5(b).	Given the follo	wing truth	h table, dı	riven a Sum	n of Produ	ct (SOP) and Product of Sum (POS) form of Boolean

	expres	sion fr				-		- / · · · - ·		
				X	Y	Z		G(X, Y, Z)		
				0	0	0		0		
				0	0	1		1		
				0	1	0		1		
				0	1	1		0		
				1	0	0		0		
				1	0	1		1		
				1	1	0		0		
				1	1	1		1		
Ans.	The de	sired C	Canon	ical Su	um-of-Pr	oduct for	m is a	s following		
								XY'Z + XYZ		
	The de	sired C		_				s following		
								-	+ Z)(X' + Y' + Z)	
5(c).	Obtair	a sim							on using Karnaugh's Map :	
-(-).	0.010		-				-	., 13, 15).		
Ans.	uv	wz							Quad that reduce as given below:	
/ 1151	uv	[00]w'z	[01]w	/z [11]w	vz [10]wz'			$+ m_4$) reduce		
	[00]u'	v' 1	0	1 1	<mark>в 0</mark>			+ m ₁₃) redu		
	[01]u'ı	1	1] 1	7 0 6		• •		n ₁₅) reduces to wz	
	[11]uv	0	4	1					ression for given K-map is	
	[II]u		12	1 3	0 15 14	5111	•		' + vw'z + wz	
	[10]uv	<i>'</i> 0	8 0	9 1	0 ₁₀		1 (u, v	, w, zj – u v		
5(d).	Draw t	the log	ic circ	uit fo		Adder us	ing NC	OR gates on		
Ans.										
,			A		C					
		V	T	Mr.						
	~17		L_		>-s					
	BZ			1						
		T	5							
			0-1							
		Half add	er usind		ogic					
5(e).	Intern					cuit as Bo	olean	Expression		
5(0).	merp	A					Joicun			
		·	≫-		T.					
		۔ م		- - г	ノゲ	-				
			~	$) \square$						
Ans.	The eq	- wivalei	nt Bor	olean	evnressi	on for the	o giver	n Logic Circi	is: $F = (W + X')(Y' + Z)$	
6(a).									using truth tables.	
Ans.			-		-	ates that		•	using truth tables.	
Ans.		-				states th				
		-				states th	at (A. 1) - 1 + 1		
	Truth 7	i able li	X'	1	1	(11.11)	V/ V/	_		
	Truth	V		Y'	X+Y	(X+Y)'	X'.Y'	_		
	X	Y		4		1	1			
	X 0	0	1	1	0	-	-			
	X 0 0	0	1 1	0	1	0	0			
	X 0	0	1	01		0 0	0 0			
	X 0 0 1 1	0 1 0 1	1 1 0 0	0 1 0	1 1 1	0	0	_		
	X 0 0 1 1	0 1 0 1	1 1 0 0	0 1 0	1 1 1	0	0			
6(b).	X 0 1 1 From 1	0 1 0 1 fruth T	1 1 0 0 able i	0 1 0 t is pro	1 1 1 oved tha	0 0 t (X+Y)' =	0 0 X'.Y'	algebraica		
	X 0 1 1 From 1	0 1 0 1 Truth T X + Y'Z	1 1 0 able i	0 1 0 t is pro	1 1 1 oved tha	0 0 t (X+Y)' =	0 0 X'.Y'	algebraica		
Ans.	X 0 1 From 1 Prove Try by	0 1 0 1 Truth T X + Y'Z Yourse	1 0 0 able i	0 1 0 t is pro + Y' + 2	1 1 oved tha Z')(X + Y	0 0 t (X+Y)' = ' + Z)(X +	0 0 X'.Y' Y + Z)	algebraica W)(V'U + W		
6(b). Ans. 6(c). Ans.	X 0 1 From T Prove Try by Write	0 1 0 1 Truth T X + Y'Z Yourse the du	1 0 0 able i = (X elf. al of t	0 1 0 t is pro + Y' + 2	1 1 oved tha Z')(X + Y	0 0 it (X+Y)' = ' + Z)(X + xpression	0 0 X'.Y' Y + Z)			
Ans. 6(c).	X 0 1 From T Prove Try by Write The du	0 1 0 Truth T X + Y'Z Yourse the du	1 0 0 able i = (X elf. al of t	0 1 t is pro + Y' + 2 the Bo	1 1 oved tha Z')(X + Y oolean ex olean ex	0 0 it (X+Y)' = ' + Z)(X + xpression	0 X'.Y' Y + Z) (U + V is UW	w)(V'U + W + (V' + U)W		

	wz			There	are 3 Pairs and	1 Octet that reduce as given below:
Ans.		w'z [11]wz [10)]wz'		$(m_0 + m_1)$ reduce	-
	[00]u'v' 1 0	$1 1 1_3$	2		(m ₁₂ + m ₁₃) redu	
	[01]u'v 0 4	1 5 1 7	D 6		(m ₁₀ + m ₁₄) redu	
	[11]uv 1	1 1 C	1).			$m_7 + m_9 + m_{11} + m_{13} + m_{15}$) reduces to z
	- 12	1 15	14	-		pression for given K-map is
	[10]uv 0 8		1 10	-		w' + uvw' + uwz' + z
6(e).	Represent the	Boolean e	expression			f NOR gates only.
Ans.	x T				-	
		7.00				
			x+Y.Z'			
	X					
	2-20-2					
6(f).	Write the Proc	duct of Sur	n form of	the funct	ion H(U, V, W),	truth table representation of H is as follows :
		U	V	w	H	
		0	0	0	1	
		0	0	1	0	
		0	1	0	1	
		0	1	1	0	
		1	0	0	0	
		1	0	1	1	
		1	1	0	0	
• • •		1	1	1	1	
Ans.	The desired Ca	inonical Pr	oduct-of-S	Sum form	is as following;	
	Η = π(1	L, 3, 4, 6) =	(U + V + V	N')(U + V'	+ W')(U' + V + V	V')(U' + V' + W)
7(a).	State and prov	e the abso	orption lav	w algebra	ically.	
Ans.	Absorption law	v states that	at (i) X + X	Y=X an	d (ii) X(X + Y)	= X
	(i) $X + XY = X$					(ii) $X(X + Y) = X$
		X + XY = X($LHS = X(X + Y) = X \cdot X + XY$
	LHS = 1 =	X.1	[1 + Y = 1]		$LHS = X(X + Y) = X \cdot X + XY$ $= X + XY$
	LHS = 1 =		[-		$LHS = X(X + Y) = X \cdot X + XY$ $= X + XY$ $= X(1 + Y)$
	LHS = 1 =	X.1	[-		$LHS = X(X + Y) = X \cdot X + XY$ $= X + XY$ $= X(1 + Y)$ $= X \cdot 1$
-6.5	LHS = 1 = =	X . 1 X = RHS.	[Hence pro	oved.		$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS.	[Hence pro	oved.		$LHS = X(X + Y) = X \cdot X + XY$ $= X + XY$ $= X(1 + Y)$ $= X \cdot 1$
7(b).	LHS = 1 = =	X . 1 X = RHS. owing trut m it :	[Hence pro	oved. erive a su	m of product (S	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. wing trut m it : A	[Hence pro h table, de B	oved. erive a sur	m of product (S G(A, B, C)	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. wing truth m it : 0	[Hence pro h table, de B 0	erive a sur C	m of product (S G(A, B, C) 0	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. owing trut m it : A 0 0	[Hence pro h table, de B 0 0	erive a sur C 0 1	m of product (S G(A, B, C) 0 1	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. wing trut m it : 0 0 0	[Hence pro h table, de B 0 0 1	erive a sur C 0 1 0	m of product (S G(A, B, C) 0 1 1	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. wing truth mit : A 0 0 0 0	[Hence pro h table, de B 0 0 1 1 1	erive a sur C 0 1 0 1	m of product (S G(A, B, C) 0 1 1 0	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS.	[Hence pro	erive a sur C 0 1 0 1 0 1 0	m of product (S G(A, B, C) 0 1 1 0 0 0	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS. mit : A 0 0 0 0 0 1 1	[Hence pro	erive a sur C 0 1 0 1 0 1 0 1 0 1	m of product (S G(A, B, C) 0 1 1 0 0 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo	X . 1 X = RHS.	[Hence pro h table, de 0 0 1 1 1 0 0 0 1	erive a sur C 0 1 0 1 0 1 0 1 0 1 0	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 0 0 1 0	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
7(b).	LHS = = = Given the follo expression fro	X . 1 X = RHS.	[Hence pro	erive a sur C 0 1 0 1 0 1 0 1 0 1 0 1	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
	LHS = = = Given the follo	X . 1 X = RHS. wing truth mit : A 0 0 0 0 1 1 1 1 1 1 1 1	[Hence pro	c c c c c c c c c c c c c c c c c c c	m of product (S G(A, B, C) 0 1 0 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 0 1 0 1 0 1 0 1 1 0 1 1 0 1 0 1 1 0 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
	LHS = = = Given the follo expression fro	X . 1 X = RHS. wing truth m it : A 0 0 0 0 1 1 1 1 1 0 G = $\sum(1, 2)$	[Hence pro	crive a sur crive a sur C 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 is as following; C' + AB'C + ABC	$LHS = X(X + Y) = X \cdot X + XY$ = X + XY = X(1 + Y) = X \cdot 1 = X = RHS. Hence proved.
	LHS = 1 = = Given the follo expression fro The desired Ca The desired Ca	X . 1 X = RHS. wing truth mit: A 0 0 0 1 1 1 1 G = $\sum(1, 2)$	[Hence pro h table, de B 0 0 1 1 0 0 1 1 1 0 0 0 1 1 1 0 0 2, 5, 7) = A oduct-of-S	crive a sur c 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 is as following; C' + AB'C + ABC is as following;	LHS = $X(X + Y) = X \cdot X + XY$ = $X + XY$ = $X(1 + Y)$ = $X \cdot 1$ = $X = RHS$. Hence proved. OP) and Product of Sum (POS) form of Boolean
Ans.	LHS = $\frac{1}{2}$ = $\frac{1}{2}$ Given the following from the comparison from the desired Campa from the desired Campa from the desired Campa from the following from the	X . 1 X = RHS. wing truth mit : A 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	[Hence pro	erive a sur C 0 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 is as following; C' + AB'C + ABC is as following; C')(A' + B + C)(A'	LHS = X(X + Y) = X . X + XY = X + XY = X(1 + Y) = X . 1 = X = RHS. Hence proved. OP) and Product of Sum (POS) form of Boolean
Ans.	LHS = $\frac{1}{2}$ Given the following expression from the desired Cartillo	X . 1 X = RHS. wing truth mit: A 0 0 0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	[Hence pro	erive a sure C 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 is as following; C' + AB'C + ABC is as following; C')(A' + B + C)(A polean Express	LHS = $X(X + Y) = X \cdot X + XY$ = $X + XY$ = $X(1 + Y)$ = $X \cdot 1$ = $X = RHS$. Hence proved. OP) and Product of Sum (POS) form of Boolean
7(b). Ans. 7(c).	LHS = $\frac{1}{2}$ Given the following expression from the desired Cartillo	X . 1 X = RHS. wing truth mit: A 0 0 0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0	[Hence pro	erive a sure C 0 1 1 1 1 1 1 1 1 1 1 1 1 1	m of product (S G(A, B, C) 0 1 1 0 0 1 0 1 is as following; C' + AB'C + ABC is as following; C')(A' + B + C)(A'	LHS = X(X + Y) = X . X + XY = X + XY = X(1 + Y) = X . 1 = X = RHS. Hence proved. OP) and Product of Sum (POS) form of Boolean

	There are 3 Pairs and 2 Quads that reduce as given below:
	ab [00]c'd' [01]c'd [11]cd [10]cd' Pair-1($m_0 + m_2$) reduces to a'b'd'
	$\begin{bmatrix} 00 \end{bmatrix}_{a}'b' \begin{bmatrix} 1 \\ 0 \end{bmatrix}_{1} \begin{bmatrix} 0 \\ -3 \end{bmatrix} \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ Pair-2(m ₅ + m ₇) reduces to a'b'd
	[01]a'b 1 1 0 Pair-3($m_{12} + m_{14}$) reduces to acd'
	Quad-1($m_0 + m_1 + m_4 + m_5$) reduces to a c
	[11]ab $0_{12} 0_{13} 0_{15} 1_{14}$ Quad-2(m ₈ + m ₉ + m ₁₀ + m ₁₁) reduces to ab'
	[10]ab' 1 1 1 Simplified Boolean expression for given K-map is
	F(a, b, c, d) = a'b'd' + a'b'd + acd' + a'c' + ab'
7(d).	Draw the logic circuit for a Half Adder using NAND gates only.
Ans.	
-()	Half adder using NAND logic
7(e).	Interpret the following Logic Circuit as Boolean Expression :
Ans.	The equivalent Boolean expression for the given Logic Circuit is: $F = (W + X') \cdot (Y' + Z)$
8(a).	State Absorption Laws. Verify one of the Absorption Law using truth table.
Ans.	Absorption law states that (i) $X + XY = X$ and (ii) $X(X + Y) = X$
	Truth Table for X + XY = X
	X Y XY X+XY
	0 0 0 0
	0 1 0 0
	1 0 0 1
	$\begin{array}{ c c c c c }\hline 1 & 1 & 1 & 1 \\ \hline \end{array}$
	From Truth Table it is proved that X + XY = X
8(b).	Verify X.Y' + Y'.Z = X.Y'.Z + X.Y'.Z' + X'.Y'.Z algebraically.
Ans.	RHS = X.Y'.Z + X.Y'.Z' + X'.Y'.Z
	= X.Y'(Z + Z') + X'.Y'.Z
	= X.Y' + X'.Y'.Z
	= X.Y' + Y'(X + X'.Z) (X + X' = 1) = X.Y' + Y'.Z
	= X.1 + 1.2 = LHS
8(c).	Write the dual of the Boolean expression A + B' . C
Ans.	The dual of the given Boolean expression is A.(B' + C)
8(d).	Obtain a simplified form for a boolean expression
	F(U, V, W, Z) = ∑(0, 1, 3, 4, 5, 6, 7, 9, 10, 11, 13, 15) using Karnaugh Map.
Ans.	WZ [00]W'Z' [01]W'Z [11]WZ [10]WZ' There are 3 Pairs and 1 Octet that reduce as given below:
	Pair-1($m_0 + m_4$) reduces to U'W'Z'
	Pair-2($m_6 + m_7$) reduces to 0 vw
	$\begin{bmatrix} 01 \end{bmatrix} UV \begin{bmatrix} 1 \\ 4 \end{bmatrix} \begin{bmatrix} 1 \\ 5 \end{bmatrix} \begin{bmatrix} 1 \\ 7 \end{bmatrix} \begin{bmatrix} 1 \\ 6 \end{bmatrix}$ Pair-3(m ₁₀ + m ₁₁) reduces to UV'W Pair-3(m ₁₀ + m ₁₁) reduces to UV'W
	[11]UV 0 12 1 1 0 OCtet $(m_1 + m_3 + m_5 + m_{7+}m_9 + m_{11} + m_{13} + m_{15})$ reduces to Z
	$\begin{bmatrix} 10 \end{bmatrix} UV' & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 9 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1 \end{bmatrix} \end{bmatrix} \begin{bmatrix} 14 \\ 1 \\ 1$
8(e).	Represent the Boolean expression X . Y' + Z with the help of NOR gates only.
0(8).	$\mathbf{x} = \mathbf{x} = $

s.	x2	NOR	NOR X.Y'+Z												
3			t of Curr	form of	the functi	on 11/11	\/ \A/\ +~+h +.		station of U is as f						
).	write th	e Produc	U	V	W	ON H(U,		able represei	ntation of H is as fo	DIIOWS					
			0	0	0										
			0	0	1	1									
			0	1	0	0									
			0	1	1	1									
			1	0	0	0									
			1	0	1	1									
			1	1	0	0									
			1	1	1	0									
5.	The desi	red Cano	nical Pro		Sum form i	s as follo	owing;								
							+ V' + W)(U' +	V' + W')							
a).	í.						uth table.								
s.				(a) X(Y +	Z) = XY + X	Z (b) >	K + YZ = (X + Y)	(X + Z)							
	Distributive law state that (a) X(Y +Z) = XY + XZ (b) X + YZ = (X + Y)(X + Z) (a) X(Y +Z) = XY + XZ To prove this law, we will make a following truth table :														
	X	Y	Z	Y + Z	XY	XZ	X(Y + Z)	XY + XZ							
	0	0	0	0	0	0	0	0							
	0	0	1	1	0	0	0	0							
	0	1	0	1	0	0	0	0							
	0	1	1	1	0	0	0	0							
	1	0	0	0	0	0	0	0							
	1	0	1	1	0	1	1	1							
	1	1	0	1	1	0	1	1							
		-		_	 Y +Z) = XY	-	L	L							
		Z = (X + Y	•		1 +2) - 11	τ Λ Δ									
	X	<u>Y - (X + 1</u>	Z	YZ	X + YZ	XZ	X + Y	X + Z	(X + Y)(X + Z)						
	0	0	0	0	0	0	0	0	0						
	0	0	1	0	0	0	0	1	0						
	0	1	0	0	0	0	1	0	0						
	0	1	1	1	1	0	1	1	1						
	1	0	0	0	1	0	1	1	1						
	1	0	1	0	1	1	1	1	1						
	1	1	0	0	1	0	1	1	1						
	1	1	1	1	1	1	1	1	1						
	From tru	th table	it is prov	e that X +	- YZ = (X +										
)).			•	Z, algeb		,, -/									
s.	LHS = XY				•										
	= XY	′ + Z(Y + Y	(*)		(Y + Y' =	1)									
	= XY	′ + Z													
-	Obtain t	he simpli	ified forr	n of a bo	olean exp	ression	using Karnaug	h map "							
:).															
).		-			10, 11, 14)		-							

	wx yz	[01]y'z [11]	brz [10]'				
	[00]w'x' 0					nd 1 Quad that reduce as given below: duces to x'yz	
	0	1	3 2		-	$m_{10} + m_{14}$) reduces to yz'	
	[01]w'x 0	5	0 1 7 6			n expression for given K-map is	
	[11]wx 0	0 ₁₃ (0 1 1 14	F(w	ι, x, y, z) = ›	x'yz + yz'	
	[10]wx' 0		1 1				
9(d).	Represent the F	Boolean e	xpression	(X + Y)(Y +	- Z)(X + Z) v	with help of NOR gate only.	_
Ans.	· · ·	+Y)'			=,(=, -		
	Y NOR DE						
	x	D NOR OF	<u>x+Y)(Y+Z)(X+Z</u>)				
)'					
	x-Jacob	1					
	2.	(+Z)'					
9(e).	Given the follow	-	-			sums form of the function F(x, y, z):	
	-	X	<u>у</u>	Z	F	_	
	-	0	0	0	0	_	
	_	0	1	0	1	_	
	_	0	1	1	0	-	
		1	0	0	0		
		1	0	1	1		
		1	1	0	0		
Ans.		1	1	1	1		
	The desired Can				s as tollowi x' + y + z')(-	
10(a).	State and verify			<u>x + y + 2 /(</u>	<u>x + y + 2)(</u>	(X + Y + Z)	_
()-	-		-	starting wi	th a Boolea	an relation, another Boolean relation can be derived by :	
	1 .Chan	ging each	OR sign(+) to an AN	D sign(.).		
			-	(.) to an OF			
		0	,	d each 1 b	,	. (c) 1 + 0 = 1 (d) 1 + 1 = 1	
	Now according						
	•	• •		•	•	. 0 = 0, which are same as postulate III.	
1	So i, ii, iii, iv are	-		ζ,	()	•	
10(b).	Prove algebraic	• •	•	• •	+ xy'z' + xy	$\mathbf{y'z} = \mathbf{x'} + \mathbf{y'}$	
Ans.	LHS = x'y'z' + x'y	•	• •	•	<i>,</i> ,		
	= x'y'(z' + z) $= x'y' + x'y - z''$		z') + xy'(z'	+ Z)	(Z' +	+ z = 1, z + z' = 1)	
	= x' y + x y + x y + y + y + y + y + y + y +	•					
	= x' + xy'	,			(y'	' + y = 1)	
	= x' + (x')'y'					= (x')')	
	= x' + y'				(a ·	+ a'b = a + b $x' + xy' = x' + y'$	
10(-)	= RHS			0 14 42 4	3 4F1 - L+	to in the simulified forms which if black	
10(c). Ans.	1993	2(0, 1, 3,	4, 5, 7, 8,	9, 11, 12, 1	.3, 15), Obt	tain the simplified form using K-Map.	
A115.	ab [00]c'd' [01]c'd [11]cd [1	0]cd'	There a	re 1 Ouad a	and 1 Octet that reduce as given below:	
	[00]a'b' 1 0 1	1 3	0 2			$_{11} + m_{15}$) reduces to cd	
	[01]a'b 1 4 1	1	0 6			$m_4 + m_5 + m_8 + m_9 + m_{12} + m_{13}$) reduces to c'	
	[11]ab 1 :	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0 14	•		n expression for given K-map is	
	[10]ab' 1		0 ₁₀	F(a	, b, c, d) = c	cd + c'	
10(d).				after anoth	ner. What i	is the output if the input is 1?	
. ,			_		_	<i>i</i> i	

Ans.	0													
10(e).	-	e followi	ing circuit	t:										
_0(0).	Given the following circuit :													
	What is the output if													
	(i) both inputs are FALSE													
	(ii) one is FALSE and the other is TRUE ?													
Ans.		(ii) FAL												
11(a).	State an	d verify A	Absorptic	on law in	Boolean	Algebra.								
Ans.	Absorpti	on law st	ates that	(i) X + X	Y=X an	id (ii) X	(X + Y) = X							
	Truth T	able for >	X + XY = X				Truth T	able for X(X ·	+ Y) =	Х				
		Х	Y	XY	X + XY			X	Y	X +Y	X(X + Y)			
		0	0	0	0			0	0	0	0			
	-	0	1	0	0		0	1	1	0				
		1	0	0	1			1	0	1	1			
		1	1	1	1			-	1	1	1			
					X + XY =					ved tha	t X(X + Y) = X			
11(b).	Draw a l	ogical Ci	rcuit Diag	gram for	the follo	wing Boo	lean Expression	on : A . (B + 0	C')					
Ans.	A		L_	A.(B+C')										
11(c).	Convert		-	-		nto its ec	uivalent Cano	onical Produ	ct of S	Sum For	m(POS) :			
A	A.B'.C + A'.B.C + A'.B.C'													
Ans.	Given A.B'.C + A'.B.C + A'.B.C' (10, 1) (0, 1, 1) (0, 1, 0)													
	(1 0 1) (0 1 1) (0 1 0)													
	$= m_5 + m_3 + m_2$ = $\sum (2, 3, 5)$													
	= 2(2, 3, 5) ⇒ POS is equal to (excluding positions of minterms)													
	$\Rightarrow \text{POS is equal to (excluding positions of miniterins)} \\ = \pi(0, 1, 4, 6, 7)$													
	$= M_0.M_1.M_4.M_6.M_7$													
	= (A + B + C).(A + B + C').(A' + B + C).(A' + B' + C).(A' + B' + C).(A' + B' + C')													
11(d).	Reduce	the follov				ising K-m								
		F(A,	B, C, D) =	=∑(0, 1,	2, 4, 5, 8,	9, 10, 11)							
Ans.	$F(A, B, C, D) = \sum (0, 1, 2, 4, 5, 8, 9, 10, 11)$													
	There are 1 Pair and 2 Quad that reduce as given below:													
	$\begin{bmatrix} 00]A'B' \\ 1 \\ 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 0 \\ 3 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}$ Pair (m ₂ + m ₁₀) reduces to B'CD'													
	$\begin{bmatrix} 01]A'B \\ 1 \\ 4 \end{bmatrix} \begin{bmatrix} 1 \\ 5 \end{bmatrix} \begin{bmatrix} 0 \\ 7 \end{bmatrix} \begin{bmatrix} 0 \\ 6 \end{bmatrix} \begin{bmatrix} 0 \\ 6 \end{bmatrix} \begin{bmatrix} 0 \\ 6 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} \begin{bmatrix} 0 \\$													
	[11]AB 0_{12} 0_{13} 0_{15} 0_{14} Quad-2 (m ₀ + m ₁ + m ₄ + m ₅) reduces to AB' Simplified Boolean expression for given K-map is													
	$\begin{bmatrix} 10 \end{bmatrix} AB' \begin{bmatrix} 1 \\ 3 \end{bmatrix} \begin{bmatrix} 1$													
12/2)	State ar	d vorify r	Jistributi			• • • •	•							
12(a). Ans.		-				Algebra		(X + 7)						
A113.	Distributive law state that (a) $X(Y + Z) = XY + XZ$ (b) $X + YZ = (X + Y)(X + Z)$ (a) $X(Y + Z) = XY + XZ$													
		-		nake a f	ollowing	e :								
	X	Y	Z	Y + Z	XY	XZ	X(Y + Z)	XY + XZ						
	0	0	0	0	0	0	0	0						
	0	0	1	1	0	0	0	0						
	0	1	0	1	0	0	0	0						
	0	1	1	1	0	0	0	0						
	1	0	0	0	0	0	0	0						
	1	0	1	1	0	1	1	1						
	1	1	0	1	1	0	1	1						

					1									
	1	1	1	1	1	1	1	1						
		ith table i Z = (X + Y	•	e that X((Y +Z) = XY -	+ XZ								
	X	Y	Z	ΥZ	X + YZ	XZ	X + Y	X + Z	(X + Y)(X + Z)					
	0	0	0	0	0	0	0	0	0					
	0	0	1	0	0	0	0	1	0					
	0	1	0	0	0	0	1	0	0					
	0	1	1	1	1	0	1	1	1					
	1	0	0	0	1	0	1	1	1					
	1	0	1	0	1	1	1	1	1					
	1	1	0	0	1	0	1	1	1					
	1 From tru	1 Ith table i	1	1	1	1	1	1	1					
12(b).					+ YZ = (X +)		lean Evores	sion Δ' (B + (
Ans.		Draw a Logical Circuit Diagram for the following Boolean Expression: A'.(B + C)												
_	A [.] .(B+C)													
	в с] +()											
12(C).	Convert the following Boolean expression into its equivalent Canonical Sum of Product Form(SOP). (U' + V' + W').(U + V' + W').(U + V + W)													
Ans.	Given (l		•		U + V + W)	0.0.	•••							
	-				-)								
	(1 + 1 + 1) $(0 + 1 + 1)$ $(0 + 0 + 0)= M0.M3.M7$													
	$=\pi(0,3,7)$													
	SOP is equal to(excluding position of Maxterms)													
	$= \sum (1, 2, 4, 5, 6)$													
	$= m_1 + m_2 + m_4 + m_5 + m_6$ = U'V'W + U'VW' + UV'W + UVW'													
							-							
12(d).	Reduce		-	-	ression usi	-	-							
Ans.) CD	г(А,	в, с, ој -	- 2(0, 3,	4, 5, 7, 9, 1			d that reduce	a as given helow:					
AII3.	AB CD There are 4 Pair and 1 Quad that reduce as given below: Pair-1(m_4 + m_5) reduces to A'BC'													
	$[00]A'B'$ 0 1 1 0 Pair-1($m_4 + m_5$) reduces to A BC Pair-2($m_7 + m_{13}$) reduces to A CD													
	Pair-3(m_9 + m_{11}) reduces to AB'D													
	$\begin{bmatrix} 01]A'B \\ 1 \\ 4 \\ 1 \\ 5 \\ 7 \\ 6 \\ 6 \\ 7 \\ 6 \\ 6 \\ 6 \\ 6 \\ 7 \\ 6 \\ 6$													
	[11]AB 1_{12} 1_{13} 0_{15} 1_{14} Quad($m_1 + m_5 + m_9 + m_{13}$) reduces to C'D													
	Simplified Boolean expression for given K-man is													
	Ļ	8	11 ارت	0 ₁₀	-		•	A'CD + AB'D +	- ABD' + C'D					
13(a).	-			raically:	X'.Y + X.Y'	= (X' + \	").(X + Y)							
Ans.	RHS = (X' + Y').(X + Y)													
	= (X' + Y').X + (X' + Y').Y													
	= X'.X + X.Y' + X'.Y + Y'.Y = 0 + X.Y' + X'.Y + 0													
	$= 0 + X \cdot Y + X \cdot Y + 0$ = X.Y' + X'.Y													
	= LHS (Verified)													
13(b).		-	-	ean Exp	ression for	the foll	owing Logic	Circuit.						
		-Do-J)	-	•										
	v w-		LD	2										
Ans.	The equi	ivalent Bo	oolean Ex	pressior	n for the giv	en Logi	c Circuit is: I	= (U' + V).(V	′ + W)					
13(c).	Write th	e SOP <u>f</u> oi	rm of a B	oolean f	unction G,	which i	s represent	ed in a truth t	table as follows:					
			Р	Q	R	G								
			0	0	0	0								
	L		U	0	0	U								

	Reduce t PQ [00] [00]P'Q' [01]P'Q [11]PQ [10]PQ' State and Absorpti	the follo F(P) [R'S' [01]R'S 0 0 1 1 1 4 1 5 1 2 1 13 0 0 1 9 d verify on law s	P, Q, R, S (11)RS (10)R 1 3 1 1 7 1 1 1 0 1 1 1 1 1 0 1 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	polean exponence $J = \Sigma(1, 2)$ $J_{10}^{(1)}$ $J_{10}^{(2)$	xpress 2, 3, 4, T P P C C S using t	ion usi 5, 6, 7 here a air-1(n air-2(n octet (r implifi F(P truth t	ing K-m , 9, 11, re 2 Pai $n_2 + m_6)$ $n_4 + m_{12}$ $m_1 + m_3$ - ed Bool , Q, R, S able.	ap: 12, 13, 15) r and 1 Octet the reduces to QR'S) reduces to P'RS	, m ₁₁ + m ₁₁ or given l + S					
15(a).	Reduce t	he follo F(P $[R'S' \ [01]R'S \]$ $\begin{bmatrix} 0 & 0 \\ 1 \\ 1 \\ 2 \\ 1 \\ 2 \\ 1 \\ 2 \\ 1 \\ 3 \\ 0 \\ 0 \end{bmatrix}$	P, Q, R, S (11)RS (10)R 1 3 1 1 7 1 1 1 0 1 1 1 1 1 0 1 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	polean exponence $z = \sum_{k=1}^{k} z_{k}$	xpress 2, 3, 4, T P P C C S using t	ion usi 5, 6, 7 here a air-1(n air-2(n octet (r implifi F(P truth t	ing K-m , 9, 11, re 2 Pai $n_2 + m_6)$ $n_4 + m_{12}$ $m_1 + m_3$ - ed Bool , Q, R, S able.	ap: 12, 13, 15) r and 1 Octet that reduces to QR'S) reduces to P'RS $+ m_5 + m_7 + m_9 + m_9$ ean expression for) = QR'S' +' P'RS'	, 5' m ₁₁ + m ₁₁ or given l	₃ + m ₁₅) reduces to S				
15(a).	Reduce t	he follo F(P $[R'S' \ [01]R'S \]$ $\begin{bmatrix} 0 & 0 \\ 1 \\ 1 \\ 2 \\ 1 \\ 2 \\ 1 \\ 2 \\ 1 \\ 3 \\ 0 \\ 0 \end{bmatrix}$	P, Q, R, S (11)RS (10)R 1 3 1 1 7 1 1 1 0 1 1 1 1 1 0 1 1 1 1 0 1 1 1 1 0 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	polean exponence $z = \sum_{k=1}^{k} z_{k}$	xpress 2, 3, 4, T P P C C S using t	ion usi 5, 6, 7 here a air-1(n air-2(n octet (r implifi F(P truth t	ing K-m , 9, 11, re 2 Pai $n_2 + m_6)$ $n_4 + m_{12}$ $m_1 + m_3$ - ed Bool , Q, R, S able.	ap: 12, 13, 15) r and 1 Octet that reduces to QR'S) reduces to P'RS $+ m_5 + m_7 + m_9 + 1$ ean expression for	, 5' m ₁₁ + m ₁₁ or given l	₃ + m ₁₅) reduces to S				
	Reduce t PQ [00] [00]P'Ω' [01]P'Ω [11]PQ [10]PQ'	he follo F(P) [R'S' [01]R'S $0 \ 0 \ 1 \ 1 \ 5 \ 1 \ 2 \ 1 \ 3 \ 0 \ 0 \ 1 \ 1 \ 3 \ 1 \ 3 \ 0 \ 0 \ 1 \ 1 \ 3 \ 1 \ 3 \ 0 \ 0 \ 1 \ 3 \ 1 \ 1$	Proving Bo P, Q, R, S [11]RS [10]F 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	polean e $J = \Sigma(1, 2)$	xpress 2, 3, 4, T P P C S	ion usi 5, 6, 7 here a air-1(n air-2(n ctet (r implifi F(P	ng K-m , 9, 11, re 2 Pai n ₂ + m ₆) n ₄ + m ₁₂ n ₁ + m ₃ - ed Bool , Q, R, S	ap: 12, 13, 15) r and 1 Octet that reduces to QR'S) reduces to P'RS $+ m_5 + m_7 + m_9 + 1$ ean expression for	, 5' m ₁₁ + m ₁₁ or given l	₃ + m ₁₅) reduces to S				
Ans.	Reduce t	he follo F(P $F(P = 1)^{R'S'} [01]^{R'S} = 0 = 0 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1$	pwing Bo p, Q, R, S [11]RS [10]F 1 1 1 7 1 1 1 1	polean e $= \Sigma(1, 2)$	xpress 2, 3, 4, T P P C	ion usi 5, 6, 7 here a air-1(n air-2(n octet (r implifi	ing K-m , 9, 11, re 2 Pai n ₂ + m ₆) n ₄ + m ₁₂ m ₁ + m ₃ - ed Bool	ap: 12, 13, 15) r and 1 Octet that reduces to QR'S) reduces to P'RS $+ m_5 + m_7 + m_9 + 1$ ean expression for	, 5' m ₁₁ + m ₁₁ or given l	₃ + m ₁₅) reduces to S				
Ans.	Reduce t	the follo F(P $\frac{ R'S' }{1}$ $\begin{bmatrix} 01 R'S \\ 0 \\ 1 \\ 1 \\ 1 \end{bmatrix}$	pwing Bo p, Q, R, S [11]RS [10]F 1 1 1 1	polean e $= \sum_{1, 2} (1, 2)$	xpress 2, 3, 4, T P P C	ion usi 5, 6, 7 here a air-1(n air-2(n Octet (r	ing K-m , 9, 11, re 2 Pai n ₂ + m ₆) n ₄ + m ₁₂ m ₁ + m ₃ -	ap: 12, 13, 15) r and 1 Octet the reduces to QR'S) reduces to P'RS $+ m_5 + m_7 + m_9 + m_1$, 5' m ₁₁ + m ₁₃	₃ + m ₁₅) reduces to S				
Ans.	Reduce t	the follo F(P	pwing Bo p, Q, R, S [11]RS [10]F 1 3	olean e) = Σ(1, 2	xpress i 2, 3, 4, T P P	ion usi 5, 6, 7 here a air-1(n air-2(n	i ng K-m , 9, 11, re 2 Pai n ₂ + m ₆) n ₄ + m ₁₂	ap: 12, 13, 15) r and 1 Octet the reduces to QR'S) reduces to P'RS	, 5					
Ans.	Reduce t	he follo F(P	wing Bo , Q, R, S	olean e) = Σ(1, 2	xpress 2 , 3, 4, T P	ion usi 5, 6, 7 here a air-1(n	i ng K-m , 9, 11, re 2 Pai n ₂ + m ₆)	ap: 12, 13, 15) r and 1 Octet the reduces to QR'S	,	e as given below:				
Ans.	Reduce t	he follo F(P	wing Bo , Q, R, S	olean e) = Σ(1, 2	xpressi 2, 3, 4, ⊤	ion usi 5, 6, 7 here a	ing K-m , 9, 11, re 2 Pai	ap: 12, 13, 15) r and 1 Octet tha		e as given below:				
Δns	Reduce t	he follo F(P	wing Bo , Q, R, S	olean e) = Σ(1, 2	xpressi 2, 3, 4,	ion usi 5, 6, 7	ing K-m , 9, 11,	ap: 12, 13, 15)	at reduce	as given helow.				
		he follo	wing Bo	olean e	xpress	ion usi	ing K-m	ap:						
14(d).					-	-	-	· · · · · · · · · · · · · · · · · · ·						
14(4)	L	י ∩ו≖ – ו	$H = \pi(0, 5, 6) = (A + B + C).(A' + B + C').(A' + B' + C)$ Reduce the following Boolean expression using K-map:											
	The desired Canonical Product-of-Sum form is as following; $H = \pi(0, 5, 6) = (0, + R + C) (0' + R + C') (0' + R' + C)$													
Ans.	The deci-		_		f_Sum ·	_	_	wing:						
		\vdash	1	1	_	1	1							
			1	1		0	0							
		-	1	0		1	0							
		-	1	0		0	1							
		\vdash	0	1		1	1							
		\vdash	0	1		1 0	1							
		\vdash	0	0	_	0	0							
		-	A	B		C	H							
14(c).	write th	e rus ic			1			s represented in	a truth t	table as follows:				
All3.	•			•				-		•				
Ans.	The eaui	valent B	Boolean I	Expressi	on for t	the giv	en Logi	c Circuit is: F = (X	+ Y').(X'	+ Z)				
	NF	< ゴ)-											
14(b).	Write the equivalent Boolean Expression for the following Logic Circuit.													
	From Tru						-							
	1	1	0	0	0	0	0	0	0					
	1	0	0	1	0	1	0	1	1					
	0	1	1	0	1	0	0	1	1					
	0	0	1	1	0	0	1	1	1					
Ans.	X	Y	X'	Y'	Χ'Υ	XY'	X'Y'	X'Y + XY' + X'Y'		, 				
14(a).	Verify X'		1				1		-					
		0 0 9 8 9	0 11 0 10	215) = A'CD +' A'BD'	+ BD					
		12 23	<u></u> 1; 0 14	<u>1</u>	S	•		ean expression f	-	K-map is				
				<u>1</u>				$m_9 + m_{13}$) reduc						
				ĥ		-		reduces to A'BD						
		gc'o' (01)c'o (-				reduces to A'CD		-				
Ans.	\ CD									e as given below:				
13(d).	Reduce t							ap: F(A, B, C, D) :		5, 6, 7, 13, 15)				
)'R' + PQR' + PQF	2					
Ans.	The desi	red Cano	onical Su	um-of-Pr	oduct [·]	form is	s as follo	owing;						
			1	1		1	1							
			1	1		0	1							
			1	0		0	1							
			0	1		1	1							
			0	1		0	1							
			0	0		1	0							

			1			-			1					
	0	0	0	0			0	0	0	0				
	0	1	0	0			0	1	1	0				
	1	0	0	1			1	0	1	1				
	1	1	1	1			1	1	1	1				
	From Truth Ta	ble it is pr	oved tha	t X + XY = >	κ	From T	ruth Tabl	e it is pr	oved tha	t X(X + Y) = X				
15(b).	Write the equivalent Boolean Expression for the following Logic Circuit.													
		Ð												
Ans.	The equivalent	Boolean E	xpressio	n for the gi	ven Logic Circ	uit is: F =	• PQ' + P'f	۲						
15(c).	Write the POS form of a Boolean function H, which is represented in a truth table as follows:													
		U	V	W	G									
		0	0	0	1									
		0	0	1	1									
		0	1	0	0									
		0	1	1	0									
		1	0	0	1									
		1	0	1	1									
		1	1	0	0									
		1	1	1	1									
Ans.	The desired Car	The desired Canonical Product-of-Sum form is as following;												
	G = π(2	, 3, 6) = (U	+ V' + W).(U + V' +	W').(U' + V' +	W)								
15(d).	Reduce the foll	owing Bo	olean exj	pression us	sing K-map:									
	H(U, V, W, Z) = ∑(0, 1, 4, 5, 6, 7, 11, 12, 13, 14, 15)													
Ans.	WZ IOOIW'Z' IOI)	W'Z [11]WZ [10]V	A/7'		There are 2 Pair and 1 Octet that reduce as given below: Pair-1($m_0 + m_1$) reduces to U'V'W'									
				•										
		J 1 3	2		m ₁₁ + m ₁₅) red									
		5 7			$m_4 + m_5 + m_6$					es to V				
	[11]UV 1 1	1 1 1	14	•	ied Boolean e	•	-	n K-map) is					
	and a second second second second			F(1	F(U, V, W, Z) = U'V'W' + UWZ + V									
	[10]UV' 0 8 0	, <u>1</u>) 10		(0, v, vv, z) = 0	J V VV I	0002 0							

NOTE: " ' " is used instead of " ".