



NAME: AMIT SINGH

ID: 15478

SUBJECT: DIGITAL LOGIC DESIGN

SEMESTER: 3<sup>RD</sup>

**PROGRAMME:** BS (SOFTWARE ENGINEERING)

Date: \_\_\_\_\_

①

Q1:

Ans:

$$A + B + C + D = 0$$

$$A = 0, B = 0, C = 0, D = 0$$

Q2:

Ans:

$$A + B + C + D = 1$$

if either  $A = 1$  or  $B = 1$  or  $C = 1$  or  $D = 1$   
Ans

Q3:

$$ABC = 0$$

if either  $A = 0$  or  $B = 0$  or  $C = 0$

Q4:

(a)  $0 + 0 + 0 + 1 = 1$  Ans

(b)  $1 \cdot 0 \cdot 1 \cdot 0 = 0$  Ans

(c)  $1 \cdot 0 + 1 \cdot 0 + 0 \cdot 1 + 0 \cdot 1$

$$0 + 0 + 0 + 0 = 0 \text{ Ans}$$

Q5

(a)  $\overline{ABC} = 1$

only if  $A = 0, B = 0 \Rightarrow \overline{A} = 1, \overline{B} = 1, C = 1$  Ans

APM

Date: .....

(2)

$$b) \overline{A+B} + C = 0$$

only if  $A=1, B=1 \Rightarrow \overline{A}=0, \overline{B}=0, C=0$  Ans

Q6:

Ans

$$a) \overline{(ABC)} \overline{(EFG)} + \overline{(HIJ)} \overline{(KLM)}$$

$$\overline{(ABC)} \overline{(EFG)} \overline{(HIJ)} \overline{(KLM)}$$

$= \overline{A+B} = \overline{AB}$

$$\overline{(ABC)} \overline{(EFG)} \overline{(HIJ)} \overline{(KLM)}$$

$= \overline{A} = A$

$$= \overline{(A+B+C)} \overline{(E+F+G)} \overline{(H+I+J)} \overline{(K+L+M)}$$

$= \overline{ABC} = \overline{A+B+C}$  Ans

$$b) \overline{(A+B)} \overline{(C+D)} \overline{(E+F)} \overline{(G+H)}$$

Sol:  $\overline{(A+B)} \overline{(C+D)} \overline{(E+F)} \overline{(G+H)}$

$\Rightarrow \overline{A} = A$

APM

Date: .....

②

③

$$(\overline{AB})(\overline{CD})(\overline{EF})(\overline{GH}) \rightarrow \overline{A+B} = \overline{A} \overline{B}$$

Ans

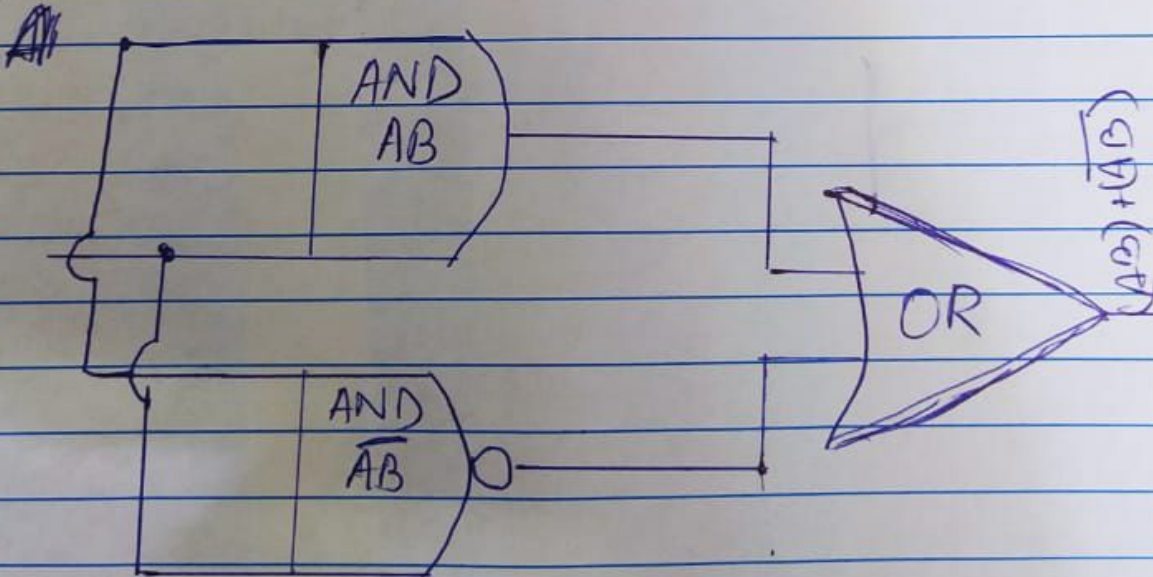
Q7

Ans a)  $= (AB) + C$

b)  $= \overline{(\overline{A} \overline{B})} \text{ or } (A+B)$

c)  $= (A+B) C$

Q8



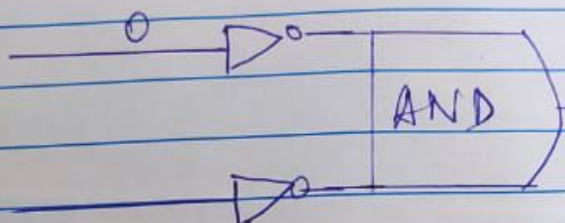
Date: .....

(9)

Q9

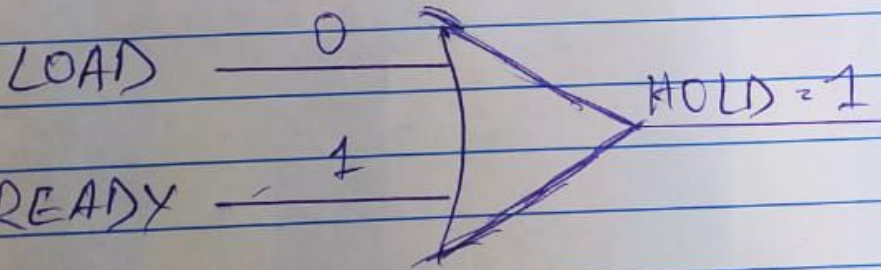
Ans a)

ASSER  
(Low)



Ready  
(Low)

b)



Q10) Ans Record = (VER + CAMI) RBY

VER	CAMI	RBY	VER + CAMI	(VER + CAMI) RBY
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0

0 APM

5

Date: .....

b)

RTS	ENABLE	BUSY	RTS ENABLE	RTS ENABLE
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	1	0
1	1	1	1	1

Q11

Ans a)

A	B	C	(A+B)	(B+C)	(C+A)	(A+B)(B+C)	(A+B)(B+C)(C+A)
0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0
0	1	0	1	0	1	0	0
0	1	1	1	1	1	1	1
1	0	0	1	0	1	0	0
1	0	1	1	1	0	0	0
1	1	0	1	1	1	1	1
1	1	1	1	1	1	1	1

APM

Date: \_\_\_\_\_

(6)

b)

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

Q12

Ans a)

$$A(A+B)$$

$$AA + AB \Rightarrow \text{Distributive Law}$$

$$A + AB \Rightarrow AA = A \text{ Rule 7}$$

$$A \Rightarrow A + AB = A \text{ Rule 10}$$

b)

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

$$A(A + B) \Rightarrow A + AB = A + B \text{ Rule 11}$$

$$AA + AB \Rightarrow \text{Distributive Law}$$

APM

Date: \_\_\_\_\_

(7)

$$A + AB \Rightarrow \text{Rule 7 } AA = A$$

$$A \Rightarrow \text{Rule 10, } A + AB = A \text{ Ans}$$

c)  $BC + \bar{B}C$

$$CC \Rightarrow A + \bar{A} = 1 \text{ Rule 6}$$

$$C \Rightarrow AA = A, \text{ Rule 7 Ans}$$

d) Same as b

e)  $\bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C$

$$\bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C = \text{Rearranged}$$

$$(A + \bar{A})(\bar{B}C) + \bar{A}BC = \text{Refactor } \bar{B}C \text{ (distributive)}$$

$$1(\bar{B}C) + \bar{A}BC = A + \bar{A} = 1 \text{ Rule 6}$$

$$\bar{B}C + \bar{A}BC = A \cdot 1 = A \text{ Rule 4}$$

$$(\bar{A} + \bar{B})C = \text{Refactor } C \text{ (distributive)}$$

$$\bar{A}C + \bar{B}C = \text{Distributive Law}$$

Ans

APM



Date: \_\_\_\_\_

(8)

$$7) BC + (\overline{BC}) D + BC$$

$$BC + (\overline{B+C}) D = BC + BC = BC$$

$$BC + \overline{BD} + CD = \text{Distributive Law}$$

$$BC + CD + \overline{BD} = \text{Rearranged}$$

$$BC + \overline{BD} = C + CD = C \text{ Rule } = 10$$

Ans

$$8) BCD [BC + \overline{D} (CD + BD)]$$

$$BCD [BC + CD\overline{D} + BD\overline{D}] \rightarrow \text{Distributive Law}$$

$$BCD [BC + (0) + B(0)] \Rightarrow D\overline{D} = \text{Rule 8}$$

$$BCD (BC) \Rightarrow A(0) = 0 \text{ Rule 3}$$

$$BCD \quad BC$$

$$BCD \Rightarrow (BC)(BC) = BC$$

Ans

APM

Date: .....

(9)

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

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

$$\bar{A}\bar{B} (1) + A\bar{B}CD + A\bar{B}CDE \quad 1 + C = 1 \text{ Rule 2}$$

$$\bar{A}\bar{B} (1 + CD) + A\bar{B}CDE = \bar{A}\bar{B}$$

$$\bar{A}\bar{B} (1) + A\bar{B}CDE \quad 1 + CD = 1 \text{ Rule 2}$$

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

$$\bar{A}\bar{B} (1) \quad 1 + CDE = 1 \text{ Rule 2}$$

$$\bar{A}\bar{B} \text{ Ans}$$

Q 13:

$$\text{Ans a) } = (C\bar{C}\bar{D}) + B)A + A\bar{B}C = C\bar{D}A + BA + A\bar{B}C$$

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

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

$$d) = (\bar{A}\bar{B}) + (A\bar{C}\bar{D}) \quad b \text{ and } d \text{ are equivalent}$$

APM

Date: .....

(10)

Ans Q14:

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

$$= CA + C\bar{D} + DA + D\bar{D}$$

$$C\bar{D} + CA + DA + 0 \Rightarrow D\bar{D} = 0 \text{ Rule 8}$$

$$C\bar{D} + AD(1+C) \Rightarrow AD$$

$$C\bar{D} + AD(1) \Rightarrow 1+C = 1 \text{ Rule 2}$$

$$(C\bar{D}) + (AD) \text{ Ans}$$

$$b) (A+C)(CD+AC)$$

$$ACD + AAC + CCD + ACE$$

$$ACD + AC + CD + AC \Rightarrow AA = A \text{ Rule 7}$$

$$ACD + AC + AC + CD$$

$$ACD + AC + CD \Rightarrow AE + AC = AE$$

$$AC(1+D) + CD \Rightarrow AC$$

APM

Date: .....

(11)

$$A C (1) + C D \Rightarrow 1 + D = 1 \text{ Rule 2}$$

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

e)

$$B + C [B D + (C + \bar{D}) E]$$

$$B + C [B D + (C E + \bar{D} E)] \text{ distributive law}$$

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

$$B + C (B \bar{E} (D + \bar{D}) + C E) \Rightarrow \text{Factor } B \bar{E}$$

$$B + C (B \bar{E} (1) + C E) \Rightarrow A + \bar{A} = 1 \text{ Rule 6}$$

$$B + C (C E (1 + B)) \Rightarrow \text{Factor } C E$$

$$B + C (C E (1)) \Rightarrow 1 + B = 1 \text{ Rule 2}$$

$$B + C (C E)$$

$$B + C C E \Rightarrow \text{distributive law}$$

$$B + C C E \Rightarrow C C = C \text{ Rule 7}$$

Ans

APM

Date: .....

(12)

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

$$A\bar{A}D + AC \Rightarrow \text{distributive law}$$

$$A\bar{A}D + AC \Rightarrow AA = A \text{ Rule 7}$$

$$7) B\bar{C}(\bar{C}\bar{D} + E)$$

$$B\bar{C}\bar{C}\bar{D} + B\bar{C}E \Rightarrow \text{distributive law}$$

$$\bar{B}\bar{D}(\bar{C}\bar{C}) + BE(\bar{C}\bar{C}) \Rightarrow \text{Rearranged}$$

$$\bar{B}\bar{D}(0) + BE(\bar{C}) \Rightarrow \bar{C} = 0 \text{ Rule 8}$$

$$\bar{C}\bar{C} = \bar{C} \text{ Rule 7}$$

BEE Ans

Q15)

$$a) \bar{C}\bar{D} + AD$$

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

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

AD is missing C

$$= AD = AD(C + \bar{C}) \Rightarrow ADC + AD\bar{C}$$

APM

Date: .....

13

$$\overline{C}DA + C\overline{D}A + AD\overline{C} + A\overline{D}\overline{C} \quad \text{Ans}$$

b)  $(AC) + (CD)$

AC is missing D

$$= AC = AC(D + \overline{D}) \Rightarrow ACD + A\overline{C}D$$

CD is missing A

$$= CD = CD(A + \overline{A}) \Rightarrow CDA + C\overline{D}A$$

$$ACD + A\overline{C}D + CDA + C\overline{D}A \quad \text{Ans}$$

c)  $B + CE$

B is missing C and E

$$\Rightarrow B = B(C + \overline{C}) = BC + \overline{B}C$$

$$\Rightarrow BC = BC(E + \overline{E}) \Rightarrow BCE + B\overline{C}E$$

$$\Rightarrow \overline{B}C = \overline{B}C(E + \overline{E}) \Rightarrow \overline{B}CE + \overline{B}\overline{C}E$$

CE is missing B

APM

Date: .....

(14)

$$\Rightarrow CE = CE(B + \bar{B}) \Rightarrow CEB + C\bar{E}B$$
$$BCE + B\bar{C}\bar{E} + B\bar{C}E + B\bar{C}\bar{E} + CEB \rightarrow$$
$$+ C\bar{E}\bar{B}$$

Ans

d)  $\bar{A}\bar{D} + AC$

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

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

AC is missing D

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

$$\bar{A}\bar{D}C + \bar{A}\bar{D}\bar{C} + A\bar{C}D + ACD \quad \text{Ans}$$

e)  $BC + DE$

BC is missing E and D

$$\Rightarrow BC = BC(D + \bar{D}) \Rightarrow BCD + BC\bar{D}$$

$$\Rightarrow BCD = BCD(E + \bar{E}) = BCDE + BC\bar{D}\bar{E}$$

$$\Rightarrow BC\bar{D} = BC\bar{D}(E + \bar{E}) = BC\bar{D}E + BC\bar{D}\bar{E}$$

DE is missing BC

$$\Rightarrow DE = DE(B + \bar{B}) = DEB + DE\bar{B}$$

APM

Date: \_\_\_\_\_

15

$$\Rightarrow DEB = DEB(C + \bar{C}) = DEBC + DEB\bar{C}$$

$$\Rightarrow DE\bar{B} = DE\bar{B}(C + \bar{C}) = DE\bar{B}C + DE\bar{B}\bar{C}$$

$$BCDE + BCDC + BCDE + BCDE + DEBC + DEB\bar{C} + DEB\bar{C}$$

1) BCE

BCE is in standard SOP form

Q16

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

Sol:-

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

Ans

b)  $ACD + A\bar{C}\bar{D} + C\bar{D}A + C\bar{D}A$

Sol:-

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

Ans

c)  $BCE + BCE + B\bar{C}E + B\bar{C}\bar{E} + CEB + C\bar{E}\bar{B}$

Sol:-

$$(B + C + E)(B + C\bar{E})(B + \bar{C} + E)(B + \bar{C} + \bar{E}) \rightarrow$$
$$(C + E + B)(C + E + B)$$

APM



Date: \_\_\_\_\_

(16)

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

Sol:-

$$[A\bar{B} + C](A + \bar{B} + \bar{C})(A + C + D)(A + C + \bar{D}) \quad \text{Ans}$$

$$e) BC\bar{D}\bar{E} + BC\bar{D}E + BCDE + BCDE + DEBC + DE\bar{B}C + DE\bar{B}\bar{C} + DE\bar{B}C + DE\bar{B}\bar{C}$$

Sol:-

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

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

$$f) B\bar{C}E$$

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

Ans Q17:

(a)

A	C	D	X	
0	0	0	0	
0	0	1	0	
0	1	0	1	$\bar{A}\bar{C}\bar{D}$
0	1	1	0	
1	0	0	0	
1	0	1	1	$A\bar{C}\bar{D}$
1	1	0	1	$A\bar{C}D$
1	1	1	1	$A\bar{C}\bar{D}$

(b)

A	C	D	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	1	$\bar{A}CD$
1	0	0	0	
1	0	1	0	
1	1	0	1	$A\bar{C}\bar{D}$
1	1	1	1	$A\bar{C}D$

(c)

B	C	E	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	$\bar{B}CE$
1	0	0	1	$B\bar{C}E$
1	1	0	1	$B\bar{C}\bar{E}$
1	1	1	1	$BCE$

(d)

A	C	D	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	0	
1	0	0	1	$A\bar{C}\bar{D}$
1	1	0	1	$ACD$
1	1	1	1	$ACD$

(e)

B	C	D	E	X	
0	0	0	0	0	
0	0	0	1	0	
0	0	1	0	0	
0	0	1	1	1	$\bar{B}CDE$
0	1	0	0	0	
0	1	0	1	0	
0	1	1	0	0	$\bar{B}CDE$
0	1	1	1	1	
1	0	0	0	0	
1	0	0	1	0	$\bar{B}CDE$
1	0	0	0	0	
1	0	0	1	0	
1	0	1	0	0	
1	0	1	1	1	$\bar{B}CDE$
1	1	0	0	1	$BC\bar{D}E$
1	1	0	1	1	$BC\bar{D}E$
1	1	1	0	1	$BC\bar{D}E$
1	1	1	1	1	$BCDE$

(E)

B	C	E	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	0	
1	0	0	0	
1	0	1	0	
1	1	0	0	
1	1	1	1	$BCE$

Ans Q.18:

(a)	A	C	D	X	
	0	0	0	0	$(A+C+D)$
	0	0	0	0	$(A+C+\bar{D})$
	0	1	1	0	$(\bar{A}+C+D)$
	0	1	0	1	
	1	0	1	1	
	1	0	0	0	$(A+\bar{C}+D)$
	1	1	1	1	
	1	1	0	1	

(b)	A	C	D	X	
	0	0	0	1	
	0	0	1	0	$(A+C+D)$
	0	1	0	1	$(A+C+D)$
	0	1	1	1	
	1	0	0	0	$(A+C+D)$
	1	0	1	1	
	1	1	0	1	
	1	1	1	1	

(c)	B	C	E	X	
	0	0	0	0	$(B+C+E)$
	0	0	1	0	$(B+C+E)$
	0	1	0	0	$(B+C+E)$
	0	1	1	0	$(B+C+E)$
	1	0	0	1	$(B+C+E)$
	1	0	1	1	
	1	1	0	1	

(d)	A	C	D	X	
	0	0	0	1	$(A+C+D)$
	0	0	1	1	
	0	1	0	1	
	0	1	1	1	
	1	0	0	1	
	1	0	1	1	
	1	1	0	1	
	1	1	1	1	

(e)	B	C	D	E	X	
	0	0	0	0	1	$(B+C+D+E)$
	0	0	0	1	0	$(B+C+D+E)$
	0	0	1	0	0	$(B+C+\bar{D}+E)$
	0	0	1	1	1	$(B+C+D+\bar{E})$
	0	1	0	0	0	$(B+C+D+E)$
	0	1	0	1	1	
	0	1	0	0	1	
	0	1	1	1	1	
	1	0	0	0	1	$(\bar{B}+C+D+E)$
	1	0	0	1	1	
	1	0	1	0	1	
	1	0	1	1	1	
	1	1	0	0	1	$(\bar{B}+\bar{C}+D+E)$
	1	1	0	1	0	
	1	1	1	0	1	
	1	1	1	1	1	

(f)	B	C	E	X	
	0	0	0	0	$(B+C+E)$
	0	0	1	1	
	0	1	0	1	
	0	1	1	1	
	1	0	0	1	
	1	0	1	1	
	1	1	0	1	
	1	1	1	1	

Ans Q 19

A	B	C	D	X	
0	0	0	0	1	$(\overline{A}\overline{B}\overline{C}\overline{D})$
0	0	0	1	1	$(\overline{A}\overline{B}C\overline{D})$
0	0	1	0	0	$(\overline{A}+B+\overline{C}+D)$
0	0	1	1	1	$(\overline{A}\overline{B}CD)$
0	1	0	0	0	$(A+B+C+D)$
0	1	0	1	1	$(\overline{A}B\overline{C}D)$
0	1	1	0	1	$(\overline{A}B\overline{C}\overline{D})$
0	1	1	1	0	$(\overline{A}+\overline{B}+\overline{C}+D)$
1	0	0	0	0	$(\overline{A}+B+C+D)$
1	0	0	1	1	$(A\overline{B}C\overline{D})$
1	0	1	0	0	$(\overline{A}+B+C+D)$
1	0	1	1	0	$(\overline{A}+\overline{B}+\overline{C}+D)$
1	1	0	0	1	$(\overline{A}+\overline{B}+C+D)$
1	1	0	1	0	$(\overline{A}+B+C+D)$
1	1	1	0	0	$(\overline{A}+\overline{B}+C+D)$
1	1	1	1	0	$(\overline{A}+\overline{B}+\overline{C}+D)$

Ans Q 20

$$(a) \quad \overline{A}\overline{B}\overline{C} + \overline{A}\overline{B}C + \overline{A}B\overline{C} \quad ABC$$

0	0	0	0	0	0	1
0	0	0	1	0	1	1
0	1	0	0	1	1	1
1	1	0	0	1	1	1
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1	0	1	1

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

$$(b) \quad AC(\bar{B} + C) = AC\bar{B} + AC$$

AC is missing B

$$\Rightarrow AC = AC(B + \bar{B}) \Rightarrow ACB + AC\bar{B}$$

$$\Rightarrow AC\bar{B} + ACB + AC\bar{B} \Rightarrow AC\bar{B} + AC\bar{B} = AC\bar{B}$$

$$\Rightarrow AC\bar{B} + ACB$$

$$1 \ 1 \ 0 \quad 1 \ 1 \ 1$$

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

$$\Rightarrow (AC)$$

Ans

$$(c) \quad \bar{A}(BC + B\bar{C}) + A(BC + B\bar{C})$$

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

$$0 \ 1 \ 1 \quad 0 \ 1 \ 0 \quad 1 \ 1 \ 1 \quad 1 \ 1 \ 0$$

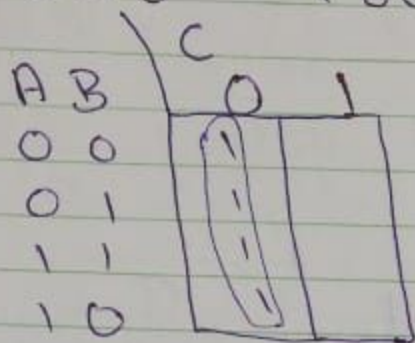
AB	C	0	1
00			
01		1	1
11		1	1
10			

$$= (B)$$

Ans

$$(d) \quad \overline{A}B\overline{C} + A\overline{B}\overline{C} + \overline{A}B\overline{C} + A\overline{B}\overline{C}$$

$$000 \quad 100 \quad 101 \quad 110$$



= (C) Ans.

$$(e) \quad A + B\overline{C} + eD$$

A is missing BCD

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

$$A\overline{B} = A\overline{B}(C+\overline{C}) = A\overline{B}C + A\overline{B}\overline{C}, \quad AB = AB(C+e)$$

$$ABC = A\overline{B}C(D+\overline{D}) = ABCD + A\overline{B}C\overline{D} \quad (1)$$

$$A\overline{B}C = A\overline{B}C(B+D) = A\overline{B}CB + A\overline{B}CD \quad (2)$$

$$A\overline{B}\overline{C} = A\overline{B}\overline{C}(D+\overline{D}) = A\overline{B}\overline{C}D + A\overline{B}\overline{C}\overline{D} \quad (3)$$

$$A\overline{B}C = AB(D+\overline{D}) = AB\overline{D} + ABCD \quad (4)$$

$B\overline{C}$  is missing AD

$$B\overline{C} = B\overline{C}(A+A) = B\overline{C}A + B\overline{C}\overline{A}$$

$$B\overline{C}A = B\overline{C}A(D+\overline{D}) = B\overline{C}AD + B\overline{C}A\overline{D} \quad (5)$$

$$B\overline{C}\overline{A} = B\overline{C}\overline{A}(B+\overline{B}) = B\overline{C}\overline{A}B + B\overline{C}\overline{A}\overline{B} \quad (6)$$

CD is missing AB

$$AB = AB(C+e) = ABC + A\overline{B}C$$

$$AB = ABC(D+\overline{D}) = ABCD + ABC\overline{D}$$



$$\begin{aligned}
 &= \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + A\bar{B}CD + ABC\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} \\
 &\quad \begin{matrix} 1011 & 1011 & 1111 & 1110 & 1001 & 1000 \end{matrix} \\
 &+ \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{B}\bar{C}AD + \bar{B}\bar{C}A\bar{D} + \bar{B}\bar{C}\bar{A}D + \bar{B}\bar{C}\bar{A}\bar{D} \\
 &\quad \begin{matrix} 1101 & 1100 & 1011 & 1010 & 1001 & 1000 \end{matrix} \\
 &+ \bar{A}BCD + \bar{A}BC\bar{D} + \bar{A}BCD + \bar{A}B\bar{C}\bar{D} \\
 &\quad \begin{matrix} 1110 & 1111 & 1101 & 1101 \end{matrix}
 \end{aligned}$$

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

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

Ans.

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

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

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

(g)  $\bar{A}\bar{B} + \bar{A}B + CD + e\bar{D}$

AB is missing CD

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

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

$\bar{A}\bar{B}$  is missing  $CD$

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

$CD$  is missing  $AB$

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

$$= \begin{matrix} \bar{A}\bar{B}\bar{C}\bar{D} & \bar{A}B\bar{C}\bar{D} & \bar{A}\bar{B}C\bar{D} & \bar{A}B\bar{C}D & \bar{A}\bar{B}CD \\ 0011 & 0010 & 0001 & 0000 & 1011 \end{matrix}$$

$$+ \begin{matrix} \bar{A}\bar{B}C\bar{D} & \bar{A}B\bar{C}D & \bar{A}\bar{B}CD & \bar{A}B\bar{C}\bar{D} & \bar{A}\bar{B}C\bar{D} \\ 1001 & 1000 & 1100 & 0101 & 1000 \end{matrix}$$

$$+ \begin{matrix} \bar{A}BCD & \bar{A}\bar{B}C\bar{D} & \bar{A}\bar{B}C\bar{D} & \bar{A}\bar{B}C\bar{D} \\ 1110 & 0110 & 1010 & 0010 \end{matrix}$$

$$= \begin{array}{c|cccc} & \begin{matrix} CD \\ 00 & 01 & 11 & 10 \end{matrix} \\ \begin{matrix} AB \\ 00 \\ 01 \\ 11 \\ 10 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} \end{array} = (\bar{A}\bar{B}) + (\bar{A}B) + (\bar{A}\bar{B}) + (\bar{A}B) = (\bar{A}\bar{B})$$

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

$$= \begin{matrix} \bar{A}B\bar{C}\bar{D} & \bar{A}B\bar{C}D & \bar{A}B\bar{C}\bar{D} & \bar{A}B\bar{C}D \\ 0100 & 0101 & 1100 & 1100 \end{matrix}$$

$$\begin{array}{c|cccc} AB & \begin{matrix} CD \\ 00 & 01 & 11 & 10 \end{matrix} \\ \begin{matrix} 00 \\ 01 \\ 11 \\ 10 \end{matrix} & \begin{matrix} 0 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} & \begin{matrix} 1 \\ 1 \\ 1 \\ 1 \end{matrix} \end{array} = (B) + (\bar{A}\bar{B}C\bar{D})$$

Q21:

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

000
001
011
101

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

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

Ans Q22:

$$\overline{A}BCD + \overline{A}B\overline{C}\overline{D} + ABCD + ABCD + ABCD$$

0001
0010
0110
0111
0000

$$+ ABCD + AB\overline{C}\overline{D} + ABCD$$

1100
1101
1111

AB	CD			
	00	01	11	10
00		1		1
01				1
11	1	1	1	
10	1			1

$$(\overline{A}\overline{B}CD) + (A\overline{C}\overline{D}) + (\overline{A}\overline{B}) + (AB) + (A\overline{C}\overline{D}) + (ABCD)$$

$$Q23: (A+B+C) (\overline{A}+\overline{B}+\overline{C}) (A+\overline{B}+\overline{C})$$

000
111
010

(a)

AB	C	
	0	1
00	0	0
01		0
11		0

$$= (A+C) (\overline{A}\overline{B}\overline{C})$$

Ans.



Date: / /

29

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

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

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

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

Ans.

Ans Q 24:

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

A	B	e
0	0	0
0	1	0
1	0	0
1	1	0

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

Ans.



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

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

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

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

Ans.

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

$\bar{A} + B$  is missing C and D

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

$\bar{A} + \bar{B} + C$  is missing D

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

$B + \bar{C} + D$  is missing A

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

Date: / /

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

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

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

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

$$= (ACD) + (ABC\bar{D}) + (ABC\bar{D}) + (AC\bar{B}D)$$