

Assignment No = 03

Subject = Digital Logic Design

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Name = M. YASIR

ID = 15459

Q1) Ans)

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

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

Q2) Ans)

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

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

Q3) Ans)

$$ABC=0$$

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

Q4) Ans)

$$a) 0+0+0+1=1 \text{ Ans.}$$

$$b) 1 \cdot 0 \cdot 1 \cdot 0 = 0 \text{ Ans}$$

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

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

Q5) Ans)

$$a) \bar{A}\bar{B}C=1$$

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

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

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

Q6) Ans 1

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

$$b) \overline{(\overline{ABC})} \overline{(EFG)} \overline{(Hij)} \overline{(KLM)} \Rightarrow \overline{A+B} = \overline{A} \overline{B}$$

$$\overline{(\overline{ABC})} \overline{(EFG)} \overline{(Hij)} \overline{(KLM)} \Rightarrow \overline{A} = A$$

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

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

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

$$\overline{(\overline{A} \overline{B})} \overline{(\overline{C} \overline{D})} \overline{(EF)} \overline{(GH)} \Rightarrow \overline{A+B} = \overline{A} \overline{B} \text{ Ans}$$

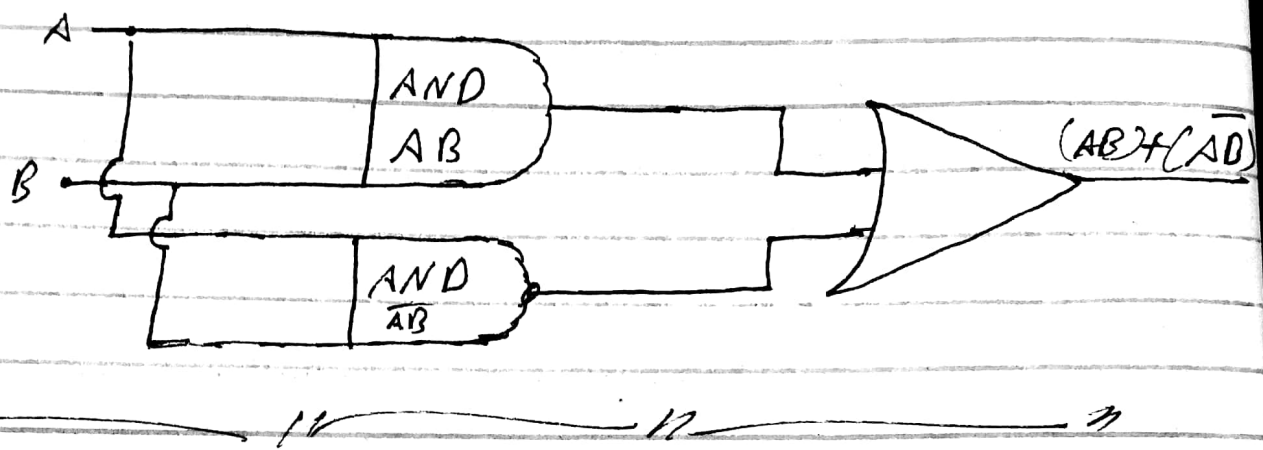
Q7) Ans 1

$$a) = (AB) + C$$

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

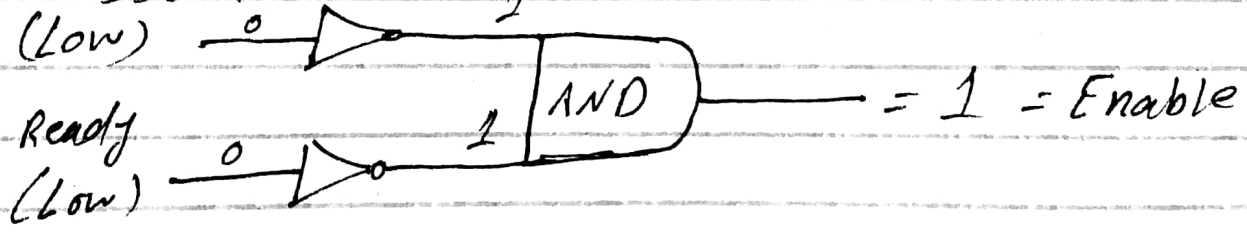
$$c) = (A+B)C$$

Q 8) Ans)

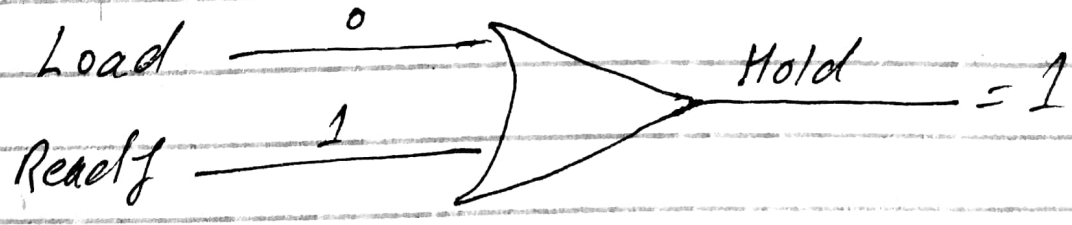


Q 9) Ans)

a) ASSER



b)



Q10) Ans)

$$\text{Record} = (\text{VCR} + \text{CAMI}) \text{RDY}$$

a)

VCR	CAMI	RDY	VCR+CAMI	(VCR+CAMI)RDY
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
1	1	1	1	1

b)

$$\text{Send} = (\text{RTS} \cdot \text{Enable}) \text{Busy}$$

RTS	Enable	BUSY	RTS·ENABLE	(RTS·ENABLE)BUSY
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	1	1	1	0	0
0	1	0	1	1	0	1	0
0	1	1	1	1	1	1	1
1	0	0	0	0	1	0	0
1	0	1	1	1	1	1	1
1	1	0	1	1	1	1	1
1	1	1	1	1	1	1	1

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

~~0~~~~0~~

Q12) Ans)

a) $A(A+B)$

Soln

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

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

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

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

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

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

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

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

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

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

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

d) Same (b)

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

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

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

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

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

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

$$g) BCD [BC + \bar{D}CD + BD]$$

$$BCD [BC + CD\bar{D} + BD\bar{D}] \Rightarrow \text{Distributive law}$$

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

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

$$BCD \quad BC$$

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

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

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

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

$$\bar{A}\bar{B}(1+CD) + \bar{A}\bar{B}CDE \quad \bar{A}\bar{B} \text{ common}$$

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

$$\bar{A}\bar{B}(1+CDE) \quad \bar{A}\bar{B} \text{ common}$$

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

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

Q Ans Q13:-

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

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

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

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

b and d are equivalent.

Ans Q14:

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

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

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

$$C\bar{D} + AD(1+C) = \text{factor AD}$$

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

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

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

$$ACD + AAC + CCD + ACC$$

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

$$ACD + AC + AC + CD$$

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

$$AC(1+D) + CD = \text{factor AC}$$

$$AC(1) + CD \Rightarrow 1+0 = \text{Rule 2}$$

$$(AC) + (CD) \text{ Ans.}$$

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

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

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

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

$$B+C (BE(1) + CE) \Rightarrow B+B = 1 \text{ Rule 6}$$

$$B+C (BE+CE)$$

$$B+C (CE (1+B)) \Rightarrow \text{factor CE}$$

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

$$B+C (CE)$$

$$B+CCE \Rightarrow \text{distributive Law}$$

$$B+CE \Rightarrow ec = e \text{ Rule 7}$$

Ans. •

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

$$AA\bar{D} + AC \Rightarrow \text{distributive Law}$$

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

$$(e) BC + DE (BC + DE)$$

$$BC + DE (BC + DE)$$

$$BC + DEBC + DEDE \text{ Distributive Law}$$

$$BC + DEBC + DE \Rightarrow DEDE = DE \text{ Rule 7}$$

$$BC + DE (1+BC) = \text{factor DE}$$

$$BC + DE (1) = 1+BC = 1 \text{ Rule 2}$$

$$BC + DE \text{ Ans}$$

$$(f) BC (\bar{C}\bar{D} + C\bar{E})$$

$$BC\bar{C}\bar{D} + BCCE \Rightarrow \text{distributive Law}$$

$$B\bar{D} (C\bar{C}) + BE (CC) \Rightarrow \text{Re arranged}$$

$$B\bar{D} (0) + BE (1) \Rightarrow C\bar{C} = 0 \text{ Rule 8}$$

$$CC = e \text{ Rule 7}$$

$$BCE \text{ Ans.}$$

Ans Q15:-

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

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

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

AD is missing c

$$= AD = AD(e + \bar{e}) \Rightarrow Ae + AD\bar{e}$$

$$e\bar{D}A + e\bar{D}\bar{A} + AD\bar{C} + AD\bar{C} \text{ Ans.}$$

(b) (AC) + (CD)

AC is missing D

$$= Ae = Ac(D + \bar{D}) \Rightarrow ACD + ACD\bar{D}$$

CD is missing A

$$= CD = CD(A + \bar{A}) = CDA + eDA\bar{A}$$

$$ACD + ACD\bar{D} + CDA + eDA\bar{A} \text{ Ans.}$$

(c) B + CE

B is missing c and E

$$\Rightarrow B = B(c + \bar{c}) = Bc + B\bar{c}$$

$$\Rightarrow Bc = Bc(E + \bar{E}) \Rightarrow BCE + Bc\bar{E}$$

$$\Rightarrow B\bar{c} = B\bar{c}(E + \bar{E}) \Rightarrow B\bar{c}E + B\bar{c}\bar{E}$$

CE is missing B

$$\Rightarrow CE = CE(B + \bar{B}) \Rightarrow CEB + CEB\bar{B}$$

$$BcE + Bc\bar{E} + B\bar{c}E + B\bar{c}\bar{E} + CEB + CEB\bar{B} \text{ Ans.}$$

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

$A\bar{D}$ is missing e

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

Ae is missing D

$$\Rightarrow Ae = Ae(D + \bar{D}) \Rightarrow AeD + Ae\bar{D}$$

$$A\bar{D}e + A\bar{D}\bar{e} + AeD + Ae\bar{D} \text{ Ans.}$$

(e) BE + DE

BE is missing E and D

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

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

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

DE is missing BC

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

$$\Rightarrow DEB = DEB(e + \bar{e}) = DEB\bar{e} + DEB e$$

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

$$BC\bar{D}E + BC\bar{D}\bar{E} + BCD\bar{E} + BCD E + DEB\bar{e} + DEB e + DE\bar{B}\bar{c} + DE\bar{B}c$$

ans.

(f) BCE

BCE is in standard SOP form.

Ans Q16:

(a) $e\bar{D}A + e\bar{D}\bar{A} + ADC + AD\bar{C}$

Sol:

$$(c + \bar{D} + A)(e + \bar{D} + \bar{A})(A + D + c)(A + D + e)$$

(b) $ACD + AC\bar{D} + eDA + e\bar{D}A$

Sol:

$$(A + e + D)(A + e + \bar{D})(c + D + A)(c + \bar{D} + \bar{A})$$

(c)

$$(B + e + E)(B + c + \bar{E})(B + \bar{e} + E)(B + \bar{e} + \bar{E})(e + E + B)(e + \bar{E} + B)$$

ans.

(d) $A\bar{D}c + A\bar{D}\bar{e} + ACD + AC\bar{D}$

$$(A + \bar{D} + c)(A + \bar{D} + \bar{e})(A + c + D)(A + c + \bar{D})$$

(e) $BeDE + Be\bar{D}E + Be\bar{D}\bar{E} + DEBC + DEB\bar{C} +$

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

ans.

(f) BCE

 $(B + C + E)$ Ans.

Ans Q 17:

(a)

A	C	D	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$\bar{A}CD$
 $A\bar{C}\bar{D}$
 $AC\bar{D}$
 ACD

(b)

A	C	D	X
0	0	0	0
0	1	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$\bar{A}CD$
 $AC\bar{D}$
 ACD

(c)

B	C	E	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1

BCE

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

(d) A C D X

$0 \ 0 \ 0 \ 0$
 $0 \ 0 \ 1 \ 0$
 $0 \ 1 \ 0 \ 0$
 $0 \ 1 \ 1 \ 0$
 $1 \ 0 \ 0 \ 1 \ ACD$
 $1 \ 0 \ 1 \ 0 \ ACD$
 $1 \ 1 \ 0 \ 1 \ ACD$
 $1 \ 1 \ 1 \ 1 \ ACD$

(e) B C D E X

$0 \ 0 \ 0 \ 0 \ 0$
 $0 \ 0 \ 0 \ 1 \ 0$
 $0 \ 0 \ 1 \ 0 \ 0$
 $0 \ 0 \ 1 \ 1 \ 1 \ \bar{B}\bar{C}DE$
 $0 \ 1 \ 0 \ 0 \ 0$
 $0 \ 1 \ 0 \ 1 \ 0$
 $0 \ 1 \ 1 \ 0 \ 0$
 $0 \ 1 \ 1 \ 1 \ 1 \ \bar{B}CDE$
 $1 \ 0 \ 0 \ 0 \ 0$
 $1 \ 0 \ 0 \ 1 \ 0$
 $1 \ 0 \ 1 \ 0 \ 0$
 $1 \ 0 \ 1 \ 1 \ 1 \ B\bar{C}DE$
 $1 \ 1 \ 0 \ 0 \ 1 \ BCDE$

$$1 \quad 1 \quad 0 \quad 1 \quad 1 \quad B \bar{C} \bar{D} E$$

$$1 \quad 1 \quad 1 \quad 0 \quad 1 \quad B C \bar{D} E$$

$$1 \quad 1 \quad 1 \quad 1 \quad 1 \quad B C D E$$

$$(f) \quad B \quad C \quad D \quad X$$

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

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

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

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

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

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

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

$$1 \quad 1 \quad 1 \quad 1 \quad B C E$$

Ans Q18

$$(a) \quad A \quad C \quad D \quad X$$

$$0 \quad 0 \quad 0 \quad 0 \quad (A + C + D)$$

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

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

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

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

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

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

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

$$(b) \quad A \quad C \quad D \quad X$$

$$0 \quad 0 \quad 0 \quad 0 \quad (A + C + D)$$

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

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

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

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

(c)

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

(d)

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

(e)

(e)

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

(f)

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

Q 19 Ans.

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

Q 20 Ans.

(a) $\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{B}\bar{C}$
 $000 \quad 001 \quad 101$
 $(\bar{A}\bar{B}) + (A\bar{B}\bar{C})$ Ans.

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

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

AC is missing B.

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

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

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

$$110 \quad 111$$

	B		
AC	0	1	
00			
01			
11	0	1	$\Rightarrow (AC)$ Ans.
10			

(e) $\bar{A}(Be + B\bar{c}) + A(BC + B\bar{c})$
 $\bar{A}BC + \bar{A}B\bar{c} + ABC + AB\bar{c}$
 011 . 010 111 110

	e		
AB	0	1	
00			
01			
11	1	1	= B Ans.
10	1	1	

(d) $\bar{A}\bar{B}\bar{c} + A\bar{B}\bar{c} + \bar{A}B\bar{c} + AB\bar{c}$
 000 100 010 110

	c		
AB	0	1	
00	1		= (c) Ans
01	1		
11	1		
10	1		

(e) $A + B\bar{c} + cD$
 A is missing BCD
 $A = A(B + \bar{B}) = AB + A\bar{B}$

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

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

$$AB\bar{C} = AB\bar{C}(D+\bar{D}) = AB\bar{C}D + AB\bar{C}\bar{D} \quad (ii)$$

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

$$AB\bar{C} = AB\bar{C}(D+\bar{D}) = AB\bar{C}D + AB\bar{C}\bar{D} \quad (iv)$$

$B\bar{C}$ is missing AD

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

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

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

CD is missing AB

$$AB = AB(C+\bar{C}) = ABC + AB\bar{C}$$

$$ABC = ABC(D+\bar{D}) = ABC\bar{D} + ABCD \quad (vii)$$

$$AB\bar{C} = AB\bar{C}(D+\bar{D}) = AB\bar{C}D + AB\bar{C}\bar{D} \quad (viii)$$

$$= \begin{matrix} A\bar{B}C\bar{D} & + & A\bar{B}C\bar{D} & + & ABCD & + & AB\bar{C}\bar{D} & + & A\bar{B}\bar{C}D & + & A\bar{B}\bar{C}\bar{D} \\ 101\bar{1} & & \bar{1}010 & & 1111 & & 11\bar{1}0 & & 1001 & & 1000 \end{matrix}$$

$$+ \begin{matrix} AB\bar{C}D & + & AB\bar{C}\bar{D} & + & B\bar{C}AD & + & B\bar{C}\bar{A}\bar{D} & + & B\bar{C}\bar{A}D & + & B\bar{C}\bar{A}\bar{D} \\ 1101 & & 1100 & & 1011 & & 1010 & & 1001 & & 1000 \end{matrix}$$

$$+ \begin{matrix} A\bar{B}C\bar{D} & + & A\bar{B}C\bar{D} & + & A\bar{B}\bar{C}D & + & A\bar{B}\bar{C}\bar{D} \\ 1110 & & 1111 & & 1101 & & 1101 \end{matrix}$$

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

$$= (\bar{A}B) + (A) \quad \text{Ans.}$$

$$(8) \quad A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + A\bar{B}C\bar{D}$$

		CD				
AB		00	01	11	10	
00		1	1			= (A \bar{B}) + (A \bar{B})
01						
11				1	1	
10						

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

AB is missing CD

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

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

$\bar{A}\bar{B}\bar{C} = \bar{A}\bar{B}\bar{C}(D + \bar{D}) = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} \text{ (2)}$

A \bar{B} is missing CD.

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

$\bar{C}\bar{D}$ is missing AB.

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

$C\bar{D}$ is missing AB

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

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

0011 0010 0001 0000 1011 1010

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

1001 1000 1100 0101 1000 0000

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

1110 0110 1010 0010

		CD				
AB		00	01	11	10	
00		1	1	1	1	= (A \bar{B}) + (A \bar{B}) + (A \bar{B}) + (A \bar{B})
01			1		1	
11		1			1	
10		1	1	1	1	

$$\begin{aligned}
 \text{(H)} \quad & \bar{A}B(\bar{C}\bar{D} + \bar{C}D) + AB(\bar{C}D + CD) + ABCD \\
 & = \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + AB\bar{C}D + ABCD + AB\bar{C}D \\
 & \quad 0100 \quad 0101 \quad 1100 \quad 1101 \quad 1001
 \end{aligned}$$

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

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

Q21 Ans:-

$$(\bar{A}\bar{B}\bar{c}) + (\bar{A}\bar{B}c) + (\bar{A}B\bar{c}) + (\bar{A}Bc) + (AB\bar{c}) + (ABc)$$

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

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

Q22 Ans:

$$\begin{aligned}
 & \bar{A}\bar{D}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{e}\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}BCD + \bar{A}\bar{B}\bar{e}\bar{D} + \bar{A}\bar{B}\bar{e}D \\
 & \quad 0001 \quad 0010 \quad 0100 \quad 0111 \quad 1000 \quad 1010 \\
 & + \bar{A}BC\bar{D} + \bar{A}B\bar{e}D + \bar{A}BCD \\
 & \quad 1100 \quad 1101 \quad 1111
 \end{aligned}$$

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

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

Q 23 Ans.

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

$$0 \ 0 \ 0 \quad \underline{1 \ 1 \ 1} \quad 0 \ 1 \ 0$$

	C	
AB	0	1
00	0	
01	0	
11		0
10		

$$= \underline{0} (A\bar{C}) (\bar{A}\bar{B}\bar{C}) \text{ Ans.}$$

(b) $(x+\bar{y}) (\bar{x}+2) (x+\bar{y}+2) (\bar{x}+\bar{y}+2) (\bar{x}+\bar{y}+2)$

$x+\bar{y}$ is missing 2

$$x+\bar{y} + 2 = x+\bar{y} + (2\bar{2}) = (x+\bar{y}+2) (\bar{x}+\bar{y}+2) 0$$

$\bar{x}+2$ is missing 4

$$\bar{x}+2 = \bar{x}+2 + (y\bar{y}) = (\bar{x}+y+2) (\bar{x}+\bar{y}+2)$$

$$= (x+\bar{y}+2) (\bar{x}+\bar{y}+2) (\bar{x}+y+2) (\bar{x}+\bar{y}+2)$$

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

$$+ (x+\bar{y}+2) (\bar{x}+\bar{y}+2)$$

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

	2	
xy	0	1
00		
01	0	0
11	0	
10	0	0

$$= (x+\bar{y})(2)(\bar{x}\bar{y}) \text{ Ans.}$$

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

A is missing B+C

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

$B + \bar{c}$ is missing A

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

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

$000 \quad 010 \quad 001 \quad 011$
 $(A + B + \bar{c}) \quad (\bar{A} + B + \bar{c}) \quad (A + \bar{B} + c) \quad (A + \bar{B} + \bar{c})$
 $001 \quad 101 \quad 010 \quad 101$

AB	c	0	1	
00		0	0	= (A) (A + B + c) <i>dr.</i>
01		0	0	
11				
10			0	

Q 24 Ans

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

$010 \quad 010$

AB	c	0	1	
00				= (A + \bar{B} + c) (\bar{A} + \bar{B} + c) <i>dr.</i>
01		0		
10				
11		0		

Ans Q 25:

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

$0000 \quad 0011 \quad 0100 \quad 0101$

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

$1000 \quad 1011 \quad 1110$

AB	cD	00	01	11	10
00		0	0	0	0
01		0	0	0	0
11		0	0	0	0
10		0	0	0	0

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

Ans Q26:

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

$A+B$ is missing e

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

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

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

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

AB	e	
	0	1
00	1	0
01	0	0
11	0	1
10	1	1

$$= (\bar{A}\bar{B}\bar{e}) + (AC) + (AB) \text{ Ans.}$$

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

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

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

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

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

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

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

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

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

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

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

0 1 1 1

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

$$= (\bar{A}\bar{C}\bar{D}) + (\bar{A}\bar{B}CD) + (BC) + (\bar{A}BC\bar{D}) + (A\bar{C}\bar{D}) \text{ Ans.}$$