MID TERM PAPER:

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Subject:

Digital Logic Design.

Q1:- Convert each of the following.

ⓐ $45.25_{10} = (?)_2$

$45.25_{10} = (\ \ )_2$

2	45
2	22 - 1
2	11 - 0
2	5 - 1
2	2 - 1
	1 - 0

$0.25 \times 2 = 0 + 0.5 = 0$

$0.5 \times 2 = 1 + 0.0 = 1$

$(101101.01)_2$

ⓑ $01111111.1010_2 = (?)_{10}$

$01111111.1010_2 = (\ \ )_{10}$

$= 0\times2^{7} + 1\times2^{6} + 1\times2^{5} + 1\times2^{4} + 1\times2^{3} + 1\times2^{2} + 1\times2^{1} + 1\times2^{0} + 1\times2^{-1}$
$+ 0\times2^{-2} + 1\times2^{-3} + 0\times2^{-4}$

$= 2^{6} + 2^{5} + 2^{4} + 2^{3} + 2^{2} + 2 + 2^{-1} + 2^{-3}$

$= 64 + 32 + 16 + 8 + 4 + 2 + \frac{1}{2} + 1/8$

$= 126 + 1/2 + 1/8$

$= (126.625)_{10}$

(c) $(3A6F)_{16} = (?)_2$

$= (3A6F)_{16}$

$= (0011101001101111)_2$

$= (11101001101111)_2$

(d) $10101010_2 = \pm(?)_{10}$

$= 1\times 2^7 + 0\times 2^6 + 1\times 2^5 + 0\times 2^4 + 1\times 2^3 + 0\times 2^2 + 1\times 2^1 + 0\times 2^0$

$= 2^7 + 2^5 + 2^3 + 2^1$

$= 128 + 32 + 8 + 2$

$= 170$

$= \pm(170)_{10}.$

(e) $-1_{10} = (?)_2$

$$\begin{array}{r|l} 2 & 1 \\ \hline & 0-1 \end{array}$$

$= -(01)_2$

$= (11)_2$

(f) $156_{10} = (?)_{BCD}$

$= (000101010110)_{BCD}$

(g) $(1001010)_2 = (?)_{Gray}$

$= (1101111)_{Gray}$.

(h)

Q2. Calculate each of the following.

(a) $9B_{16} + 8A_{16}$

$$\begin{array}{r} {}^{1}\\ 19B \\ +\ 8A \\ \hline 127 \end{array}$$

$A = 11$

$B = 12$

$A + B = 23$

$$\begin{array}{r|l} 16 & 23 \\ \hline & 1-7 \end{array} \qquad \begin{array}{r|l} 16 & 18 \\ \hline & 1-2 \end{array}$$

$(127)_{16}$.

(b) $F7_{16} - D6_{16}$

$$\begin{array}{r} F7 \\ -\ D6 \\ \hline 21 \end{array}$$

$(21)_{16}$

(c) $(1100)_2 + (1011)_2$ (use modulo-2)

$$\begin{array}{r} (1100)_2 \\ +\ (1011)_2 \\ \hline 10111 \end{array}$$

$(10111)_2$

(d) $(01111111)_2 - (00000111)_2$ (use 2's complement).

$\underbrace{(01111111)_2}_{x} - \underbrace{(00000111)_2}_{y}$

(i) 00000111 ↓

$$\begin{array}{r} 11111000 \\ +1 \\ \hline 11111001 \end{array}$$

11111000 ← 1's complement.

11111001 ← 2's complement.

(ii)
$$
\begin{array}{r}
1111111\ \\
01111111 \\
+\ 11111001 \\
\hline
01111000
\end{array}
$$

(iii)
$$
\begin{array}{r}
01111000 \\
10000111 \\
+1 \\
\hline
10001000
\end{array}
$$

$10000111 \leftarrow$ 1's complement.

$10001000 \leftarrow$ 2's complement.

So $(01111111)_2 - (00000111)_2$

$= (01111000)_2$

Q3.) Determine the output waveforms for the XOR and XNOR gates, given the input waveforms, A and B in figure 1.

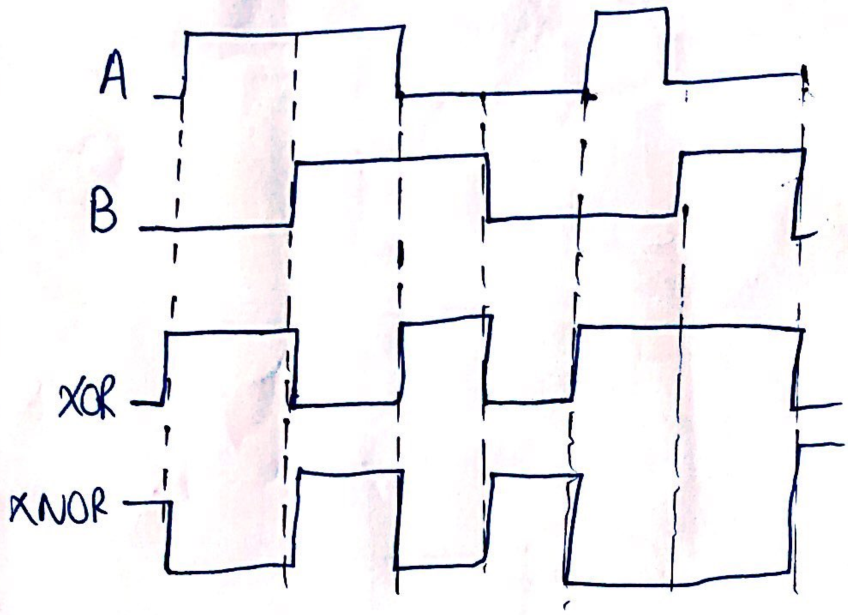
XOR

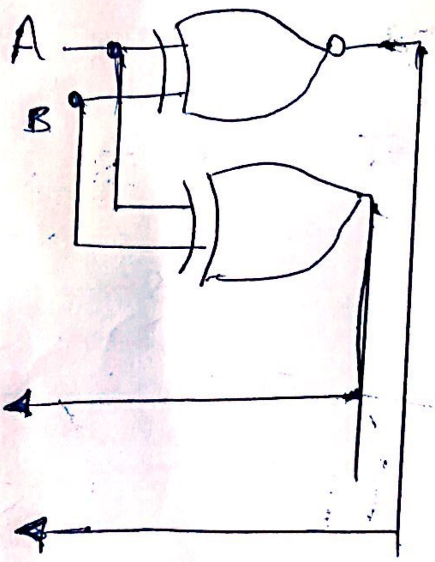
$$A \oplus B = \overline{AB} + AB$$

XNOR

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

A	B	XOR	XNOR
1	0	1	0
1	1	0	1
0	1	1	0
0	0	0	1
1	0	1	0
0	1	1	0

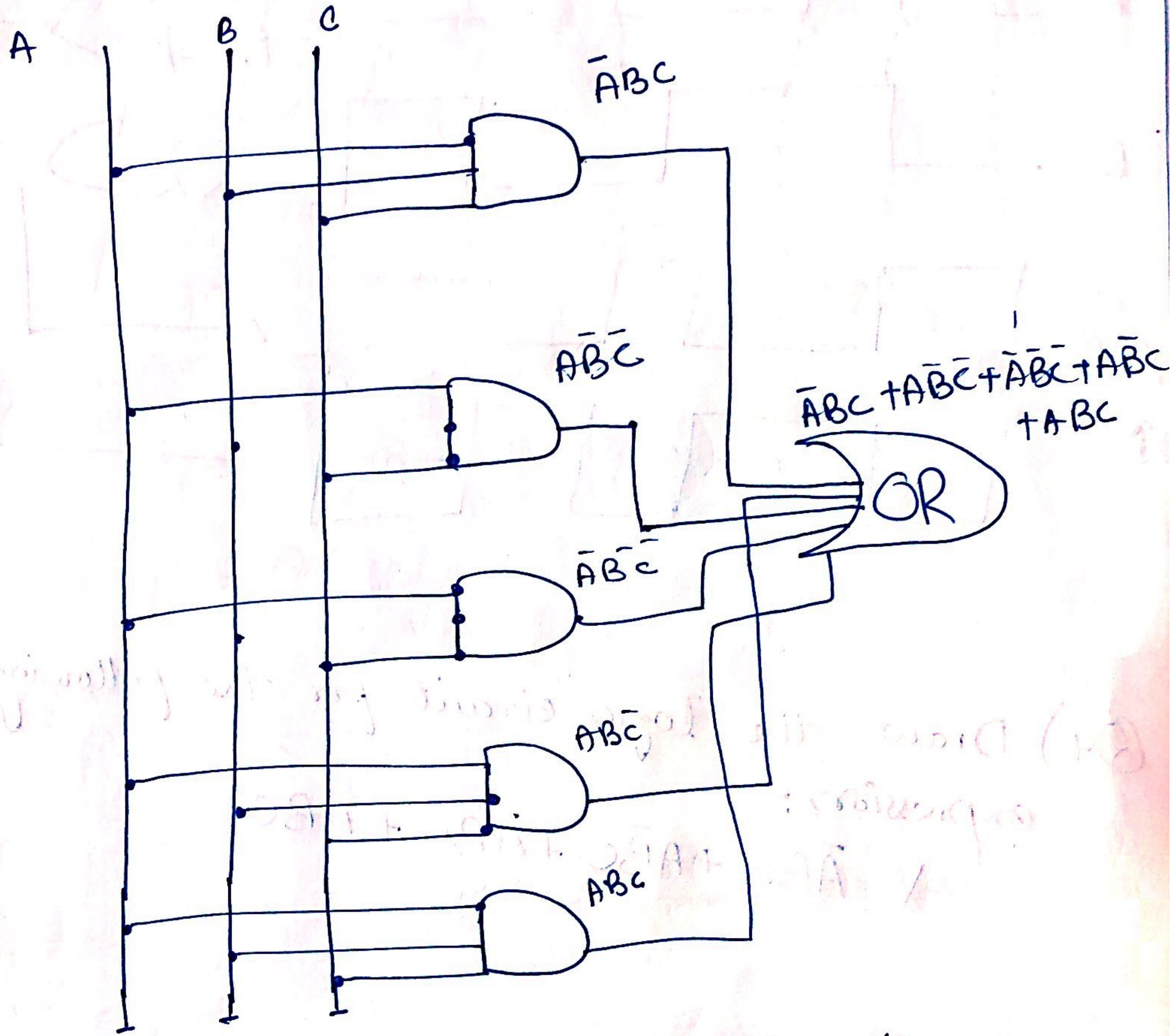




Q4) Draw the logic circuit for The following expression

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

→ P.T.O.



Q4 (b) Using Boolean algebra, simplify the expression given in part(a).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Q5 Convert the following expressions to Standard SOP form: $A = X + Y + Z$

Solution:-

$A = X + Y + Z$

Double negation $(x')' = x$

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

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

Apply Boolean Properties $\boxed{x + x' = 1}$

$A = x\cdot 1\cdot 1 + 1\cdot y\cdot 1 + 1\cdot 1\cdot z'$

$A = x\cdot(y+y')\cdot(z+z') + (x+x')\cdot(y)(z+z') + (x+x') + (y+y')(z)$

$A = (xy+xy')(z+z') + (xy+x'y)\cdot(z+z') + (xz'+x'z')+(y+y')$

$A = xyz + xy'z' + xyz + x'yz' + xyz' + x'y'z'$

Apply Boolean property $\boxed{x+x=x}$

$A = xyz + xy'z' + x'yz' + xyz' + x'y'z'.$

Q5 (b) Convert the standard SOP expression obtained in part (a) to standard SOP form.

From part (a)

$A = XZ' + YZ'$

$A = (X+Y)\cdot Z'$

POS Form.

Q5 (c) Develop a single truth table for the standard SOP and standard POS expressions obtained in part (a) ~~to standard POS form~~ (b) respectively.

TRUTH TABLE :-

X	Y	Z	Z'	SOP $XZ' + YZ'$	POS $(X+Y) \cdot Z'$
0	0	0	1	0	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	0	0	0
1	0	0	1	1	1
1	0	1	0	0	0
1	1	0	1	1	1
1	1	1	0	0	0

Q6 Use a karanaugh map to find the
(a) minimum SOP form for the following
expression: $X = \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + AB\bar{C} + ABC + A\bar{B}C$

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

- Karnough Map:-

A \ BC	00	01	11	10
0	1			1
1	1	1	1	1

$\boxed{X = A + C'}$ Minimum SOP.

(b) Minimum POS:-

$X = \underline{A + C'}$

$\bar{X} = \underline{A + C'}$

$\bar{X} = A' \cdot C$

$\boxed{X = A + C'}$ POS.