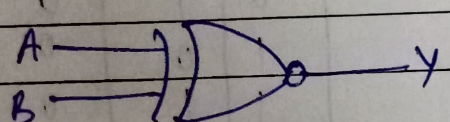
A	B	$\bar{A}$	$\bar{B}$	$\bar{A}B$	$A\bar{B}$	$Y = \bar{A}B + A\bar{B}$
0	0	1	1	0	0	0
0	1	1	0	1	0	1
1	0	0	1	0	1	1
1	1	0	0	0	0	0

⇓

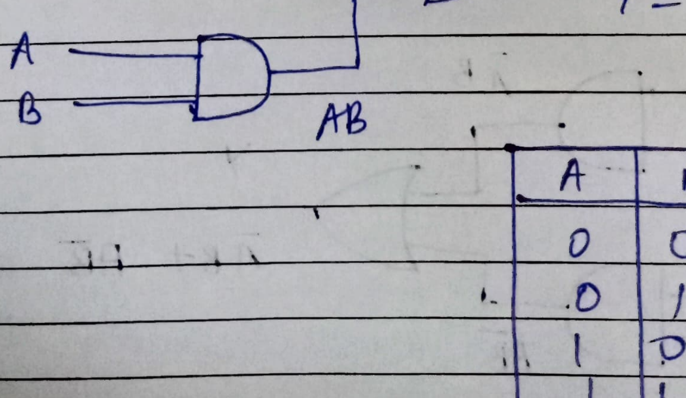
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

$\bar{A}\bar{B}$	AB
1	0
0	0
0	0
0	1

→ Exclusive-NOR (XNOR)



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



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

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

→ Boolean Postulates / Algebra :

For minimisation, we use boolean algebra.

0	00
1	01
2	10
3	11
4	100

(i) $0 \cdot 0 = 0$
(ii) $1 \cdot 1 = 1$
(iii) $1 \cdot 0 = 0$
(iv) $\bar{1} = 0$
(v) $1 + 1 = 1$
(vi) $0 + 0 = 0$
(vii) $0 + 1 = 1$
(viii) $\bar{0} = 1$

→ Boolean Theorems :

$$\left.\begin{array}{ll} \text{(i)} & 0 \cdot x = 0 \\ \text{(ii)} & 1 \cdot x = x \\ \text{(iii)} & x \cdot x = x \\ \text{(iv)} & x \cdot \bar{x} = 0 \end{array}\right\} \text{AND}$$

$$\left.\begin{array}{ll} \text{(i)} & 1 + x = 1 \\ \text{(ii)} & 0 + x = x \\ \text{(iii)} & x + x = x \\ \text{(iv)} & x + \bar{x} = 1 \end{array}\right\} \text{OR}$$

→ Prove the expression -

(i) $XY + \bar{X}Z + YX = XY + \bar{X}Z$

$L \cdot H \cdot S = XY + \bar{X}Z + YX$

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

Number System

Q- convert $(101101)_2$ to decimal.

$= 2^5\times1+2^4\times0+2^3\times1+2^2\times1+2^1\times0+2^0\times1$
$= 32+8+4+1 = (45)_{10}$

Q- $(1011.0111)_2$ to decimal.

$= 2^3\times1+2^2\times0+2^1\times1+2^0\times1$
$= 8+2+1 = 11$
$= (11.437)_{10}$

$0\times2^{-1}+1\times2^{-2}+1\times2^{-3}+1\times2^{-4}$
$0+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}$

Q- $(143)_{10}$ to binary
$(10001111)_2$

$(101)_{10}$ to binary

Q- $(0.4375)_{10}$ to binary

$(25.375)_{10}$

$$\begin{array}{rl} 0.375 & \\ \times 2 & 0 \\ \hline 0.750 & \\ \times 2 & 1 \\ \hline 0.500 & \\ \times 2 & 1 \\ \hline 0.000 & \end{array}$$

$$\begin{array}{r|l} 2 & 25 \\ \hline 2 & 12-1 \\ \hline 2 & 6-0 \\ \hline 2 & 3-0 \\ \hline 2 & 1-1 \\ \hline & 0-1 \end{array}$$

$(11001.011)_2$

Q- $(754)_8 \to (\ )_{10}$

$7\times8^2+5\times8^1+4\times8^0$
$7\times64+40+4$
$448+40+4 = (492)_{10}$

$$\begin{array}{r} 64 \\ \times 7 \\ \hline 448 \end{array}$$

Q- $(321.32)_8 \to (\ )_{10}$

$8^2\times3+8^1\times2+8^0\times1+8^{-1}\times3+8^{-2}\times2$
$64+3+8\times2+1\times1+\frac{3}{8}+\frac{\cancel{2}}{\cancel{64}}\frac{1}{32}$
$= 192+16+1+$
$= (209.40625)_{10}$

$$8 \,|\, 175$$
$$8 \,|\, 21 - 7$$
$$8 \,|\, 2 - 5$$
$$0 - 2$$

Q- $(175)_{10} \to (\ )_8$ $(257)_8$

Q- $(0.40625)_{10} \to ()_8$ $(0.32)_8$

→ **Octal to binary** -

Q- $(305)_8 \to ()_2$ $(011\ 000\ 101)_2$

→ **Binary to Octal** -

Q- $(101011011.011010111)_2$
$= 5332.07$

Q- $(305.7)_8 \longrightarrow$ decimal through binary
$\to (011000101 \ .111) \longrightarrow (197.875)_{10}$

→ **Hexadecimal** (0 - 15) (16 numbers in total)

0 - 9
10 - A
11 - B
12 - C
13 - D
14 - E
15 - F

Hexadecimal to decimal

(1) $(\overset{3}{7}\overset{2}{5}\overset{1}{B}\overset{0}{F})_{16} \to (\ )_{10}$
$= 15 \times 16^0 + 11 \times 16^1 + 5 \times 16^2 + 7 \times 16^3$
$= 15 + 176 + 1280 + 28672 = (30143)_{10}$

(2) $(5245)_{10} \rightarrow (\ )_{16}$

$= (147D)_{16}$

16	5245
16	327 — 13
16	20 — 7
16	1 — 4
16	0 — 1

(3) $(85E7)_{16} \rightarrow (\ )_2$

$(1000\ 0101\ 1110\ 0111)_2$

(4) $(10100111.01011101)_2$

$(A7.5D)_{16}$

(5) $(1AF)_{16} \rightarrow (\ )_8$

$(0001\ 1010\ 1111)_2$

$= (11010111 1)$

$= (657)_8$

$1\times2^0 + 1\times2^1 + 1\times2^2$

$1 + 2 + 4$

$= 7$

→ 1's complement

1011010 → 0100101 1's

+1 2's

0100110

Q- Find 2's complement of 110110

1's 001001

+1

001010 → 2's complement

→ Binary Addition

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 10

Q-

$$\begin{array}{r} 101 \\ +\,110 \\ \hline 1011 \\ \hline \end{array}$$

→ Binary Subtraction

0 - 0 = 0
1 - 1 = 0
1 - 0 = 1
0 - 1 = 1

Q-

$$\begin{array}{r} 1101 \\ -\,1001 \\ \hline 100 \\ \hline \end{array}$$

Q-

$$\begin{array}{r} {}^{10} \\ 1\cancel{0}11 \\ -\,101 \\ \hline 110 \\ \hline \end{array}$$

Q-

$$\begin{array}{r} 1\;10 \\ 1\cancel{0}\cancel{0}1 \\ -\,111 \\ \hline 0010 \\ \hline \end{array}$$

_/_/_

Imp

→ Subtraction using 1's complement-

$X - Y$

(i) Take 1's complement of subtrahend (Y).
(ii) Add 1's complement of Y to X.
(iii) If addition results in output carry. Remove carry and add it to the result.
(iv) Also, if the signbit is 0, then the result is +ve. If the signbit is 1, the result is 1's complement of step3.

0 → +ve
1 → 1's complement of step3 and -ve

Q- $(111001)_2 - (110001)_2$

$Y = 110001$
$Y' = 001110$

$X + Y' =$

```
   111001
 + 001110
 --------
 1 000111
      + 1
 --------
  001000
```

$\boxed{0}01000$
↓
signbit (0) ∴ The result is +ve

Q- Perform the following subtraction using 1's complement

$(01010)_2 - (00011)_2$

$Y = 00011$
$Y' = 11100$

$$
\begin{array}{rr}
X + Y' = & \overset{1}{0}1010 \\
& 11100 \\
\hline
& (1)00110 \\
& +1 \\
\hline
& 00111
\end{array}
$$

Q- $(\overset{37}{100101})_2 - (\overset{54}{110110})_2$

$Y = 110110$
$Y' = 001001$

$$
\begin{array}{rr}
X + Y' = & 100101 \\
& 001001 \\
\hline
& 101110 \\
\text{1's} & -010001 \\
\end{array}
$$

$= -17.$

$1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 + 0 \times 2^4 + 1 \times 2^5$
$= 1 + 4 + 32$
$= 37$

$$
\begin{array}{r}
37 \\
17 \\
\hline
54
\end{array}
$$

→ Subtraction using 2's complement - $(X - Y)$

(i) Take 2's compliment of Y
(ii) Add 2's of Y to X.
(iii) If the addition result in output carry then discard this carry.
(iv) If the answer obtained in step 3 has its

2^1 2^0
1 1 100

most significiant bit 0, then it is the desired result and result is +ve.
If MSB is 1, then desired result is 2's c of step3 and result is -ve.

Q- $(111001)_2 - (110001)_2$

$Y = 110001$

2's of Y = 001110
+1
001111

X + 2's of Y = 111001
001111
(1)001000

ignore carry

$\boxed{001000}$
final ans

Q- $(100101)_2 - (110110)_2$

2's of Y = 001001
+1
001010

X + 2's of Y = 100101
+ 001010
(0)01111

2's

010000
+1
010001 final answer.

step 4

$+2^2 \times 1 + 2^1 \times 1 + 2^0 \times 1$

$2^3 \times$

$2^4 \times 1 + 1 \times 2^0$

16 + 1

= -17

010001