



ELECTRONICS ENGINEERING DEPARTMENT

Digitals Notes

Hand Notes For Electronics Engineering Department

HAND NOTES

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Note : *We also providing IIT JEE, Advance, NEEt, JEE UG, GATE, IES, PSUs & Competitive Exam Materials [Handnotes, Shortnotes & Books], All Reports [Seminar Reports & PPT]*

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Digitals

SUN.

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Number Systems:

	<u>Base/Radix</u>	<u>Numbers</u>
1. Decimal	10	0, 1, ..., 9
2. Binary	2	0, 1
3. Octal	8	0, 1, ..., 7
4. Hexadecimal	16	0, 1, ..., 9, A, B, C, D, E, F.

Each Hexa digit \rightarrow 4 bits,

$$3f_{16} \rightarrow 0011\ 1111_2$$

Each octal digit \rightarrow 3 bits

$$316_8 \rightarrow 011\ 001\ 110_2$$

Q. $110010_2 = x_{16}$

$$\begin{array}{r} \leftarrow \\ 0011\ 0010 \\ \hline 3\ \ \ 2 \\ \hline \end{array} = 32_{16}$$

Q. $11011.01_2 = x_{16}$

$$\begin{array}{r} \leftarrow \quad \rightarrow \\ 0001\ 1011\ .\ 0100 \\ \hline 1\ \ \ B\ \ .\ 4 \\ \hline \end{array}_{16}$$

Q. $6728_{10} = x_2$

$$6728_{10} \rightarrow 6728_{16} \rightarrow x_2$$

$$\Rightarrow \begin{array}{r|l} 16 & 6728 \\ 16 & 420 - 8 \\ 16 & 26 - 4 \\ & 1 - 10(A) \end{array} \uparrow$$

$$1A48_{16}$$

$$= 0001\ 1010\ 0100\ 1000_2$$

Q. Determine the possible bases of the following relations.

(1). $\sqrt{41} = 5$

\downarrow min
so max value of base is 6, so base ≥ 6

Let base = b.

$$\sqrt{4 \times b^1 + 1 \times b^0} = 5 \times b^0_{10}$$

$$\Rightarrow \sqrt{4b+1} = 5$$

$$\Rightarrow 4b+1 = 25$$

$$\Rightarrow b = 6.$$

Q. $\frac{302}{20} = 12.1$,

Let base = b.

$$\Rightarrow \frac{3b^2 + 2}{2b} = b + 2 + \frac{1}{b}$$

Base ≥ 4 b'coz max digit is 3.

$$\Rightarrow \frac{3b^2 + 2}{2b} = \frac{b^2 + 2b + 1}{b}$$

$$\Rightarrow b = 4.$$

Q. $\frac{44}{4} = 11$

Let base = b. Observed base ≥ 5 , b'coz maximum value of digit = 4.

$$\frac{4b+4}{4} = b+1 \Rightarrow b+1 = b+1$$

The above relation is valid in all the no. systems with base ≥ 5 .

Q. In a positional weight system x & y are two successive digits and $xy = 25_{10}$ & $yx = 31_{10}$. Determine the values of base x & y.

Here $b = ?$, $x = ?$ & $y = ?$

and $y = x + 1$.

$$(x)(x+1) = 25_{10} \quad ((x+1)b + x) = 31_{10} \quad (1)$$

$$\Rightarrow [x \times b + (x+1) = 25]_{10} \Rightarrow x(b+1) + b = 31 \rightarrow (2)$$

$$\Rightarrow x(b+1) + 1 = 25 \rightarrow (1)$$

$$(1) - (2) \Rightarrow b = 7. \text{ Then from (1) } \Rightarrow x = 3, y = 4.$$

Complementary Number Representation :-

Base = 2

⇒ (2-1)'s Complement

⇒ 2's complement

Decimal system (2=10)

9's complement of $168_{10} \Rightarrow$

$$\begin{array}{r} 999 \\ - 168 \\ \hline 831_{10} \end{array}$$

10's complement of $168_{10} \Rightarrow$ 9's comp + 1

$$\begin{array}{r} 999 \\ - 168 \\ \hline 831 + 1 = 832_{10} \end{array}$$

Q. $862_{10} - 491_{10} = ?$

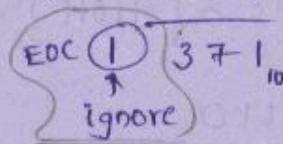
$$= 862_{10} + (-491_{10})$$

(i). $862 + (9\text{'s of } 491)$

$$\begin{array}{r} 862 \\ + 508 \\ \hline 1370 \\ \text{+1} \rightarrow \text{EOC} \\ \hline 371 \end{array}$$

(ii). $862 + (10\text{'s of } 491)$

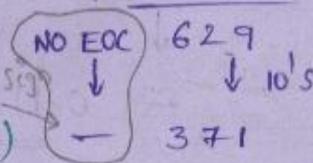
$$\begin{array}{r} 862 \\ + 509 \\ \hline 1371 \end{array}$$



Q. $491_{10} - 862_{10} = ?$

$$= 491 + (-862)$$

$$\begin{array}{r} 491 \\ + 138 \leftarrow 10\text{'s} \\ \hline 629 \\ \downarrow 10\text{'s} \\ - 371 \end{array}$$



Digital System (2=2)

1's complement of 1011 ⇒ 0100₂

2's complement of 1011 ⇒ 1's of 1011 + 1

⇒ 0100 + 1 = 0101

Q. $x = 1000111\underline{000}$ ←
 2's complement of $x = 011100\underline{1000}$

Q. $x = 1011$
 2's of $x = 0101$

Q. $11010_2 - 01110_2 = +(-01110)$

(i). $11010 + (1's \text{ of } 01110) = 11010 + 10001$

(ii). $11010 + (2's \text{ of } 01110)$
 $\begin{array}{r} \text{EOC } \textcircled{1} \ 01011 \\ \quad \quad \quad \rightarrow +1 \\ \hline 01100 \end{array}$

$\begin{array}{r} 11010 \\ + 10010 \\ \hline \text{EOC ignore } \textcircled{1} \ 01100 \end{array}$

Q. $01110_2 - 11010_2 = +(2's \text{ of } 11010)$

$\begin{array}{r} 01110 \\ + 00110 \\ \hline \end{array}$

$\begin{array}{r} \text{NO EOC} \rightarrow \square \ 10100 \\ \quad \quad \quad \downarrow 2's \\ \hline 01100 \end{array}$

$2^4 = 16$
 $16 - 2 = 14$

$16 - 1 = 15$

1's comp 2's comp

$+0 = 0000$ $+0 = 0000$

$-0 = 1's \text{ comp of } +0$ $-0 = 2's \text{ comp. of } +0$

$= 1's \text{ of } 0000$ $= 0000$

$= 1111$ ← (Disadv. of 1's complement)

* Range of numbers represented using 'n' bits

Go represent (16) numbers
1's comp. form $\Rightarrow + (2^{n-1} - 1)$ to $- (2^{n-1} - 1)$

Let $n=4 \Rightarrow +7$ to $-7 \rightarrow (14)$

2's comp. form $\Rightarrow + (2^{n-1} - 1)$ to -2^{n-1}

Let $n=4 \Rightarrow +7$ to $-8 \rightarrow (15)$

Q. How many bits are required to represent -64_{10} in a). 1's comp. form b). 2's form

1's form $\Rightarrow + (2^{n-1} - 1)$ to $- (2^{n-1} - 1)$

Let $n=7 \Rightarrow +63$ to -63

✓ $n=8 \Rightarrow +127$ to -127

2's form $\Rightarrow + (2^{n-1} - 1)$ to -2^{n-1}

✓ Let $n=7 \Rightarrow +63$ to -64

Q. 10's comp for $(731)_{10}$

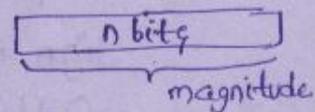
$$\begin{array}{r} A A A \\ 7 3 1 \\ (-) \hline 3 7 9 \end{array}$$

Q. 9's comp of $(731)_{10}$

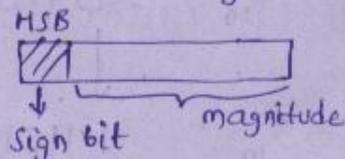
$$\begin{array}{r} 999 \\ (-) 731 \\ \hline 268 \end{array}$$

Binary Numbers :

(a). Unsigned Numbers \rightarrow



(b). Signed Numbers
↓ represented by



(i). sign magnitude

(ii). 1's comp form

(iii). 2's comp form

0 \Rightarrow +ve

1 \Rightarrow -ve

These three representations are same for unsigned (+ve) numbers.