ELECTRONICS ENGINEERING DEPARTMENT

Digitals Notes

Hand Notes For Electronics Engineering Department

HAND NOTES

Page Length : 97

Digitals

SUN. 17/08/08

Number Systems:

	Base/Radix	Numbers.
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. $110010_2 = x_{16}$

$\underline{0011}_{3}\ \underline{0010}_{2} = 32_{16}$

Q. $11011.01_2 = x_{16}$

$\underbrace{0001}_{1}\underbrace{1011}_{B}.\underbrace{0100}_{4}\ {}_{16}$

Q. $6728_{10} = x_2$

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

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

$1A48_{16}$

$= \underline{0001}\ \underline{1010}\ \underline{0100}\ \underline{1000}_2$

Q. Determine the possible bases of the following relations.

(1). $\sqrt{41} = 5$ max. digit is $\underline{5}$

so ~~max~~ min value of base is 6. So base ≥ 6

Let base = b.

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

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

$\Rightarrow 4b+1 = 25$

$\Rightarrow b = 6.$

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

Let base = b.

Base ≥ 4 b'coz max digit is 3.

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

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

$\Rightarrow b = 4.$

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. system 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 $y = x+1.$

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

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

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

① - ② $\Rightarrow b = 7.$ Then from ① $\Rightarrow x = 3,\ y = 4.$

Complementary Number Representation :-

Base = r

⇒ $(r-1)$'s complement

⇒ r's complement

Decimal System ($r = 10$).

9's complement of 168_{10} ⇒

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

10's complement of 168_{10} ⇒ 9's comp + 1

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

Q.

$$\begin{array}{r} 862_{10} \\ (-)\ 491_{10} \\ \hline ? \end{array} = 862_{10} + (-491_{10})$$

(i). 862 + (9's of 491) ⇒

$$\begin{array}{r} 862 \\ (+)\ 508 \\ \hline 1\ 370 \\ +1 \\ \hline 371 \end{array}$$

+1 → EOC

(ii). 862 + (10's of 491) =

$$\begin{array}{r} 862 \\ 509 \\ \hline 1\ 371_{10} \end{array}$$

EOC 1 ↑ ignore

Q.

$$\begin{array}{r} 491_{10} \\ -\ 862_{10} \\ \hline ? \\ -371_{10} \end{array} = \begin{array}{r} 491 \\ +(-862) \end{array} = \begin{array}{r} 491 \\ (+)\ 138 \\ \hline 629 \end{array}$$

138 ← 10's

NO EOC ↓ − (−ve sign)

629 ↓ 10's 371

Digital System ($r = 2$)

1's complement of 1011 → 0100_2

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

→ 0100 + 1 = 0101

Q. $x = 1000111000$

2's complement of $x = 0111001000$

Q. $x = 1011$

2's of $x = 0101$

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

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

EOC 1 01011
+1
01100

(ii). $11010 + (\text{2's of } 01110)$

$= 11010 + 10010$

EOC ignore 1 01100

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

$= 01110 + 00110$

NO EOC → 10100

Negative sign

↓ 2's

01100

$2^4 = 16$

$16 - 2 = 14$

$16 - 1 = 15$

1's comp	2's comp
+0 = 0000	+0 = 0000
−0 = 1's comp of +0	−0 = 2's comp. of +0
= 1's of 0000	= 0000
= 1111 ← (Disadv. of 1's complement)	

* Range of numbers represented using 'n' bits

(To 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 $(731)_{11}$

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

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

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

Binary Numbers :

(a). Unsigned Numbers $\rightarrow$ [n bits] — magnitude

(b). Signed Numbers → MSB [sign bit | magnitude]

↓ represented by

(i). sign magnitude

(ii). 1's comp form

(iii). 2's comp form

sign bit: $0 \rightarrow +ve$, $1 \rightarrow -ve$

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