

# NUMBER SYSTEM

## Binary Number System

⇒ Has only two digits [0 and 1]

⇒ Base Number is "2"

$$\text{Ex: } (1111000)_2$$

## CONVERSION

### [1] Binary to decimal

$$\text{Ex: } 1001$$

$$\begin{array}{r} 1 \times 2^0 = 1 \times 1 = 1 \\ 0 \times 2^1 = 0 \times 2 = 0 \\ 0 \times 2^2 = 0 \times 4 = 0 \\ 1 \times 2^3 = 1 \times 8 = 8 \end{array}$$

$$\Rightarrow 1 + 0 + 0 + 8 = 9$$

### [2] Binary to octal

Binary	011	100	101
Code	421	421	421
Octal	3	4	5

### [3] Binary to hexadecimal

Binary	1110	0101	0111	1111
Code	8421	8421	8421	8421
Hexadecimal	E	5	7	F

### 1's Complement

$$\text{Ex: } \begin{array}{ccccccc} 0 & 1 & 0 & 1 & 0 & 0 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1 & 0 & 1 & 0 & 1 & 1 \end{array}$$

### 2's Complement

Adding 1 to 1's complement is 2's complement.

## Octal Number System

⇒ Has only eight [8] digits [0 to 7]

⇒ Base Number is "8"

$$\text{Ex: } (360)_8$$

## CONVERSION

### [1] OCTAL to binary

Octal	3	4	5
Code	421	421	421
Binary	011	100	101

$$\Rightarrow (0111000101)_2$$

### [2] Octal to Hexadecimal

Octal	1110	0101	1111
Code	8421	8421	8421
Hexadecimal	E	5	F

$$\Rightarrow [E5F]_{16}$$

### [3] Octal to Decimal

$$\text{Ex: } 345$$

$$\Rightarrow (3 \times 8^2) + (4 \times 8^1) + (5 \times 8^0)$$

$$\Rightarrow (3 \times 64) + 32 + 40$$

$$= 229$$

$$\Rightarrow (229)_{10}$$

## Decimal Number System

⇒ Has only ten [10] digits [0 to 9]

⇒ Base Number is "10"

$$\text{Ex: } (240)_{10}$$

## CONVERSION

### [1] Decimal to Binary

$$\text{Ex: } (24)_{10}$$

2   24	0	
2   12	0	
2   6	0	
2   3	1	
	1	

$$\Rightarrow (11000)_{2}$$

### [2] Decimal to octal

$$\text{Ex: } (12345)_{10}$$

8   12345	1	
8   1543	7	
8   192	0	
8   24	0	
	3	

$$\Rightarrow (30071)_8$$

### [3] Decimal to hexadecimal

$$\text{Ex: } (725)_{10}$$

16   725	5	5
16   45	13	D
2   13	2	2
	2	2

$$\Rightarrow (2D5)_{16}$$

## Hexadecimal Number System

⇒ Has sixteen [16]

Alphanumeric values from (0 to 9)  
(A to F)

⇒ Base Number is "16"

$$\text{Ex: } (F0)_{16}$$

## CONVERSION

### (i) Hexadecimal to Binary

Hexa	A	2	D	E
Code	8421	8421	8421	8421
Binary	1010	0010	1101	1110

$$\Rightarrow (101000101101110)_{2}$$

### to OCTAL

$$\rightarrow (101000101101110)_{2}$$

∴ put 0's in front of 1

$$\rightarrow [121336]_8$$

### to decimal

$$\text{Ex: } (F0)_{16} = 0(F \times 16^3) + (0 \times 16^0)$$

$$= (15 \times 16) + 0 = (240)_{10}$$

### 2's Complement example.

$$\text{Ex: } \begin{array}{cccccc} 0 & 1 & 0 & 1 & 0 & 0 \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1 & 0 & 1 & 0 & 1 & 1 \end{array}$$

$$\begin{array}{r} 10110100 \\ -10101011 \\ \hline 10111001 \end{array}$$