

# ECE213: Digital Electronics



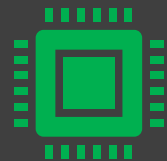
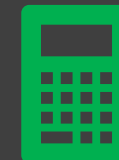
Ajmer Singh



9988921373



ajmer.17381@lpu.co.in

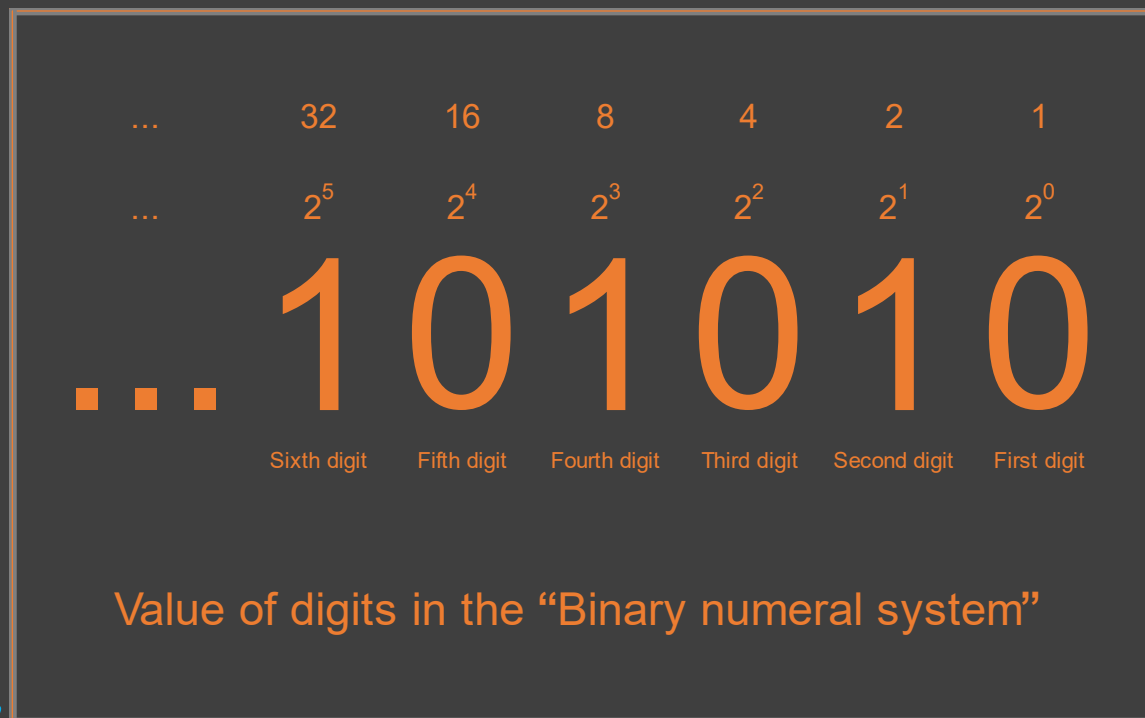




# The Course Contents

## Unit I

Number Systems : Digital Systems, Data representation and coding, Logic circuits, Implementation of digital systems, Number Systems, Codes- Positional number system, Binary number system, Methods of base conversions, Binary arithmetic, Representation of signed numbers, Fixed numbers, Binary coded decimal codes, Gray codes, Error detection code, Parity check codes, octal number system, Hexadecimal number system, Error correction code, Hamming code, Octal arithmetic, Hexadecimal arithmetic, Floating point numbers



# Number Systems

Ex Calculate  $49 - 27$  using all the complements  
 $\rightarrow 49 + (-27)$   
 A B

$$\begin{array}{r} \text{FFF} \\ - 01B \\ \hline \text{FE4} \end{array}$$

Representation of signed numbers

A)  $(049)_{10} = (0110001)_2 = (061)_8 = (031)_{16}$

B)  $(027)_{10} = (0011011)_2 = (033)_8 = (01B)_{16}$

$\begin{array}{r} 1's \\ 0110001 \\ \rightarrow + 1100100 \quad (+22) \\ \hline 10010101 \\ \xrightarrow{+1} \\ 0010110 \\ \text{18421} \end{array}$	$\begin{array}{r} 7's \\ 061 \\ \rightarrow + 744 \quad (+22) \\ \hline 025 \\ \xrightarrow{+1} \\ 026 \\ \text{8'8} \end{array}$	$\begin{array}{r} F's \\ 031 \\ \rightarrow + FE4 \quad (+22) \\ \hline 015 \\ \xrightarrow{+1} \\ 016 \\ \text{16'16} \end{array}$	$\begin{array}{r} 9's \\ 049 \\ \rightarrow 972 \quad (+22) \\ \hline 021 \\ \xrightarrow{+1} \\ 022 \end{array}$
$\begin{array}{r} 2's \\ 0110001 \\ 1100101 \quad (+22) \\ \hline 0010110 \end{array}$	$\begin{array}{r} 8's \\ 061 \\ 745 \quad (+22) \\ \hline 026 \end{array}$	$\begin{array}{r} 16's \\ 031 \\ + FE5 \quad (+22) \\ \hline 016 \\ \text{16'16} \end{array}$	$\begin{array}{r} 10's \\ 049 \\ 973 \quad (+22) \\ \hline 022 \end{array}$

# Number Systems

Representation of signed numbers

Ex Find 27-49 using complements.

$$A (027)_{10} = (0011011)_2 = (033)_8 = (013)_{16}$$

$$B (049)_{10} = (0110001)_2 = (061)_8 = (031)_{16}$$

1's	$\begin{array}{r} 1's \\ 0011011 \\ \rightarrow 1001110 \quad (-22) \\ \hline 1101001 \\ \downarrow 1's \\ 0010110 \\ \hline 15 \quad 421 \end{array}$	$\begin{array}{r} 7's \\ 033 \\ \rightarrow 716 \quad (-22) \\ \hline 751 \\ \downarrow 7's \\ 026 \end{array}$	$\begin{array}{r} F's \\ 01B \\ \rightarrow FCE \quad (-22) \\ \hline FE9 \\ \downarrow F's \\ 016 \end{array}$	$\begin{array}{r} 9's \\ 027 \\ 950 \quad (-22) \\ \hline 977 \\ \downarrow 9's \\ 022 \end{array}$
2's	$\begin{array}{r} 2's \\ 0011011 \\ 1001111 \quad (-22) \\ \hline 1101010 \\ \downarrow 2's \\ 0010101 \\ \hline 0010101 \end{array}$	$\begin{array}{r} 8's \\ 033 \\ 717 \quad (-22) \\ \hline 752 \\ \downarrow 8's \\ 025 + 1 = 026 \end{array}$	$\begin{array}{r} 16's \\ 01B \\ FCF \quad (-22) \\ \hline FE A \\ \downarrow 16's \\ 015 + 1 = 016 \end{array}$	$\begin{array}{r} 10's \\ 027 \\ 951 \quad (-22) \\ \hline 978 \\ \downarrow 10's \\ 021 + 1 = 022 \end{array}$

# Number Systems

Representation of signed numbers

Ex 49 + 27 for 8 bit comp:

$$(49)_{10} = (011000)_2$$

$$(27)_{10} = (0011011)_2$$

$$\begin{array}{r} \text{1's} \\ 011000 \\ \hline 0011011 \\ \hline 1001100 \end{array} \quad \text{---ve}$$

$$\begin{array}{r} 0011011 \\ \hline 1001100 \end{array}$$

Ex 49 + 27 or

$$-49 - 27$$

$$(-76)$$

Ex 49 + 27 for 8 bit comp = 76

Range of 1's comp.

$$-(2^{n-1} - 1) \text{ to } (2^{n-1} - 1)$$

for  $n = 7$

$$-63 \text{ to } 63$$

out of range

# Number Systems

## Representation of signed numbers

Note: The solution to out of the range issue is that we need to append two sign bit or two sign digits during the complement operation.

Ex  $49 + 27$

$$\begin{array}{r} 00110001 \\ 00011011 \\ \hline 01001100 \\ \hline 64 \cdot 8421 \end{array}$$

+ve

(+76)

# Number Systems

## Representation of signed numbers

Ex  $-49-27$  using complements

$$A(0049) = (00110001)_2 = (0061)_8 = (0031)_{16}$$

$$B(0027) = (00011011)_2 = (0033)_8 = (001B)_{16}$$

1's	$\begin{array}{r} 11001110 \\ 11100100 \\ \hline 10110010 \\ +1 \\ \hline 10110011 \\ \downarrow 1's \\ 01001100 \end{array} \quad (-76)$	7's	$\begin{array}{r} 7716 \\ 7744 \\ \hline 17662 \\ +1 \\ \hline 7663 \\ \downarrow 7's \\ 0114 \end{array} \quad (-76)$	F's	$\begin{array}{r} FFCE \\ FFE4 \\ \hline 1FFB2 \\ +1 \\ \hline FFB3 \\ \downarrow F's \\ 004C \end{array} \quad (-76)$	9's	$\begin{array}{r} 9950 \\ 9972 \\ \hline 19922 \\ +1 \\ \hline 9923 \\ \downarrow 9's \\ 0076 \end{array} \quad (-76)$
2's	$\begin{array}{r} 11001111 \\ 11100101 \\ \hline 10110100 \\ \downarrow 2's \\ 01001101 +1 \\ 01001100 \end{array} \quad (-76)$	8's	$\begin{array}{r} 7717 \\ 7745 \\ \hline 17664 \\ \downarrow 8's \\ 0113 \\ +1 \\ \hline 0114 \end{array} \quad (-76)$	16's	$\begin{array}{r} FFCE \\ FFE5 \\ \hline 1FFB4 \\ \downarrow 16's \\ 004B \\ +1 \\ \hline 004C \end{array} \quad (-76)$	10's	$\begin{array}{r} 9951 \\ 9973 \\ \hline 19924 \\ \downarrow 10's \\ 0075 \\ +1 \\ \hline 0076 \end{array} \quad (-76)$