

# ECE213: Digital Electronics



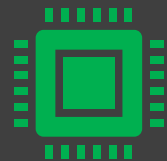
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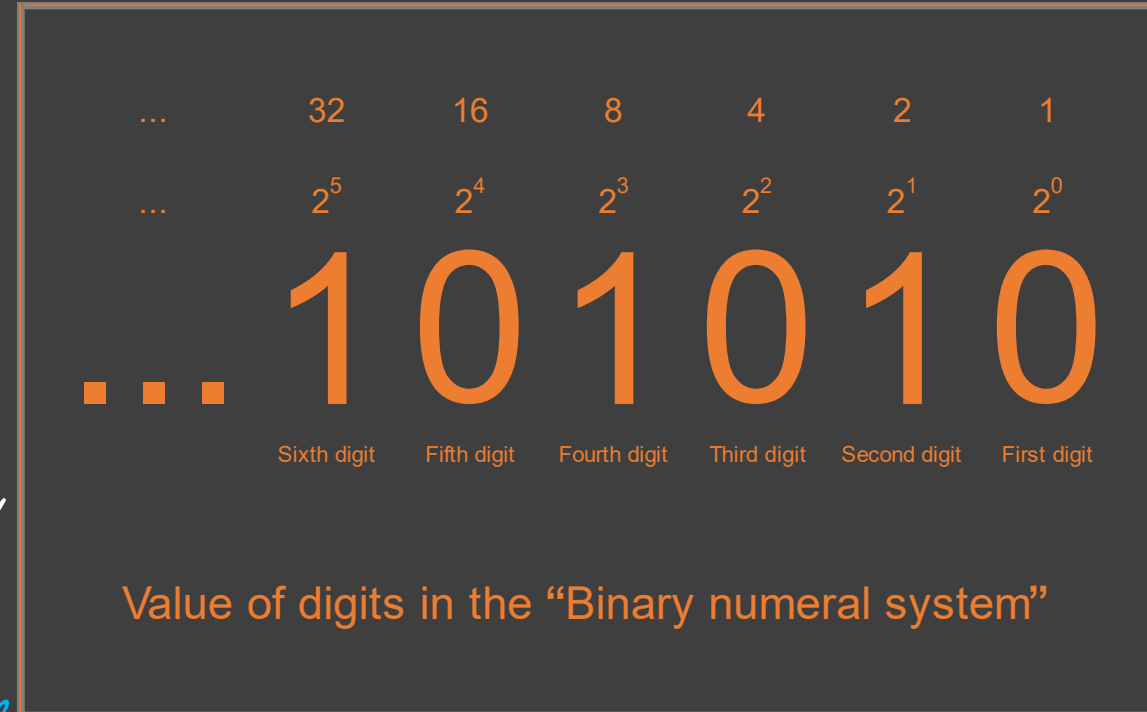




# The Course Contents

## 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

Representation of signed numbers

$(11010)_2 \rightarrow (\quad)_{10}$   
unsigned Number

★  $101101$ , this number is in 2's complement representation.  
Find the number.

Ans  
we  $\rightarrow$   $101101$   
 $\downarrow$  1's  
 $010010$  2's  $\rightarrow$

add 1 to 1's  
$$\begin{array}{r} 010010 \\ + 1 \\ \hline 010011 \end{array}$$
  
 $2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0$

-19

$$16 + 2 + 1 = \textcircled{-19}$$

# Number Systems

Representation of signed numbers

★ 7's & 8's comp.

Ex Find 7's & 8's comp of  $(68)_{10}$

Ans Oct 
$$\begin{array}{r} 8 \overline{) 68} \\ 8 \overline{) 8} - 4 \\ \hline 1 \quad 0 \end{array} \quad (104)_8 \quad \rightarrow \quad 0104$$

Find 7's & 8's comp of  $(-68)_{10}$

$$(68)_{10} = (104)_8$$

Apply the sign bit  $\rightarrow 0104$

7's comp

$$\begin{array}{r} 7777 \\ 0104 \\ \hline (7673)_{7's} \end{array}$$

8's

$$\begin{array}{r} 7673 \\ + 1 \\ \hline (7674)_{8's} \end{array}$$

# Number Systems

Representation of signed numbers

Ex  $F'p$  Compl  $16'x$  Compl

For  $(168)_{10}$  find the  $F'p$  and  $16'x$  c.

$$\left\{ \begin{array}{r} 16 \overline{) 168} \\ \underline{160} \phantom{0} \\ 8 \end{array} \right. \quad (168)_{10} = (A8)_{16}$$

Append sign bit/digit  
0A8

$\xrightarrow{F'p}$  0A8

$\xrightarrow{16'x}$  0A8

Ex For  $(-168)_{10}$  find the  $F'p$  and  $16'x$  complement

$$(168)_{10} = (A8)_{16}$$

Append sign bit  
(0A8)<sub>16</sub>

$$\begin{array}{r} F'p \text{ ---} \\ FFF \\ - 0A8 \\ \hline (F57)_{F'p} \end{array}$$

$$\begin{array}{r} 16'x \\ F57 \\ + 1 \\ \hline (F58)_{16'x} \end{array}$$

# Number Systems

Representation of signed numbers

Ex (DLC) To find the 9's and 10's

Ex Find 9's and 10's comp of  $(769)_{10}$   
Appear sign digit.  $0769 \xrightarrow{9's} 0769$   
 $\searrow_{10's} 0769$

Ex Find 9's and 10's complement of  $(-769)$   
Appear sign digit  $0769$

For 9's com

$$\begin{array}{r} 9999 \\ - 0769 \\ \hline (9230)_{9's} \end{array}$$

For 10's complement

$$\begin{array}{r} 9230 \\ + 1 \\ \hline (9231)_{10's} \end{array}$$

# Number Systems

Representation of signed numbers

Ex find the 8-bit 1's or 2's complement of  $(42)_{10}$

$$\begin{array}{r} 2 \overline{) 42} \\ (42)_{10} = (101010)_2 \end{array}$$

Append sign bit  $00101010$

1's  $\rightarrow 00101010$

2's  $\rightarrow 00101010$

Ex find the 8-bit 1's or 2's complement of  $(-42)_{10}$

$$(42)_{10} = (101010)_2$$

Append sign bit 00101010

for 1's comp

$$\begin{array}{r} 11111111 \\ - 00101010 \\ \hline \end{array}$$

$\rightarrow 11010101$  this is the num.

this is the num.

for 2's comp

$$\begin{array}{r} 11010101 \\ + 1 \\ \hline 11010110 \end{array}$$

# Number Systems

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

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

Representation of signed numbers

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

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

$\begin{array}{r} 1's \\ 0110001 \\ \rightarrow + 1100100 \quad (+22) \\ \hline 10010101 \\ \rightarrow +1 \\ \hline 0010110 \\ \text{18421} \end{array}$	$\begin{array}{r} 7's \\ 061 \\ \rightarrow + 744 \quad (+22) \\ \hline 025 \\ \rightarrow +1 \\ \hline 026 \\ \text{8'8} \end{array}$	$\begin{array}{r} F's \\ 031 \\ \rightarrow + FE4 \quad (+22) \\ \hline 015 \\ \rightarrow +1 \\ \hline 016 \\ \text{16'16} \end{array}$	$\begin{array}{r} 9's \\ 049 \\ \rightarrow 972 \quad (+22) \\ \hline 021 \\ \rightarrow +1 \\ \hline 022 \end{array}$
$\begin{array}{r} 2's \\ 0110001 \\ 1100101 \quad (+22) \\ \hline 0010110 \end{array}$	$\begin{array}{r} 8's \\ 061 \\ 745 \quad (+22) \\ \hline 026 \end{array}$	$\begin{array}{r} 11's \\ 031 \\ + FE5 \quad (+22) \\ \hline 016 \\ \text{16'16} \end{array}$	$\begin{array}{r} 10's \\ 049 \\ 973 \quad (+22) \\ \hline 022 \end{array}$