

ECE213: Digital Electronics



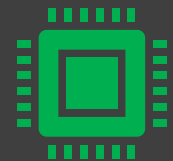
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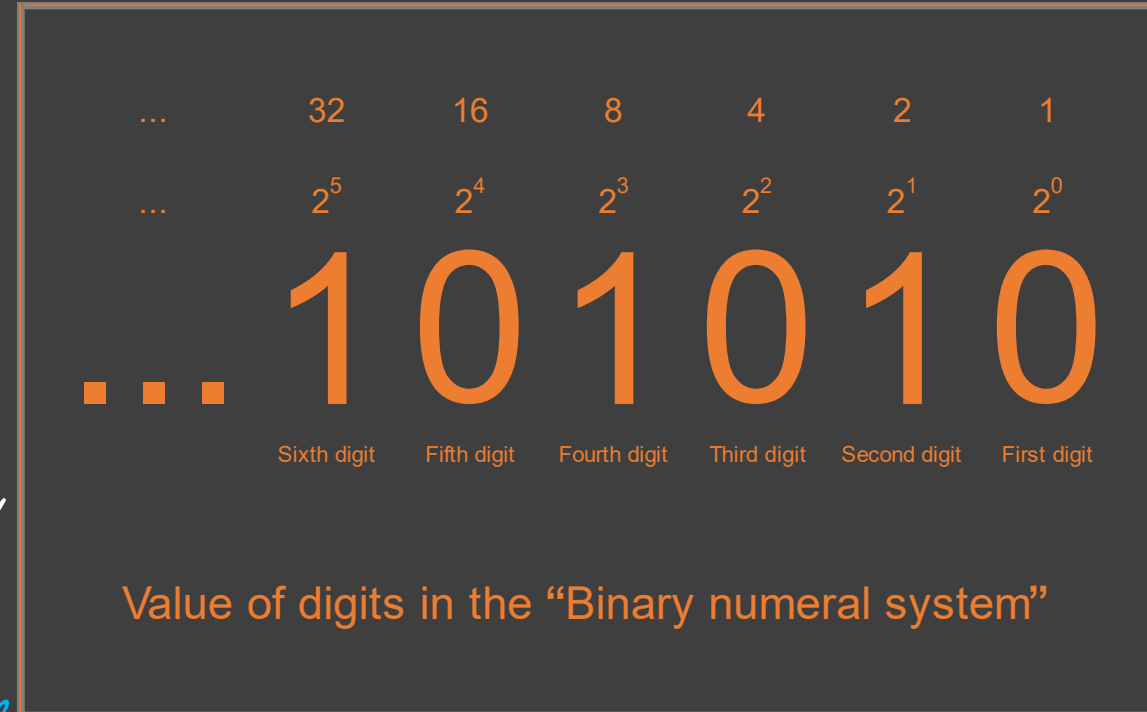




The Course Contents

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



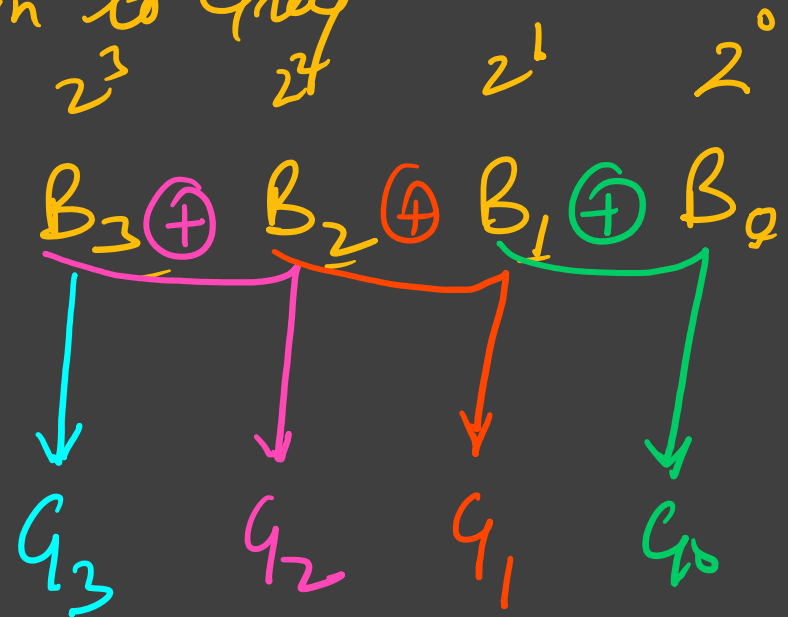
Number Systems

Gray codes

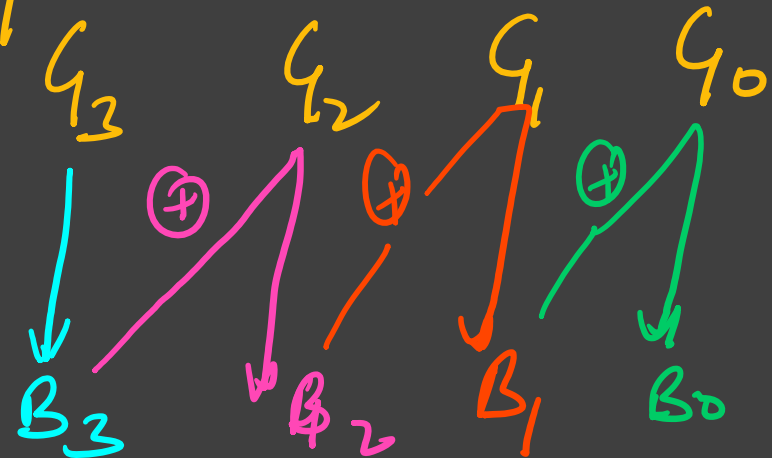
0 0 0 \rightarrow 1-bit
 0 0 1 \rightarrow 2-bit
 1 0 \rightarrow 1-bit
 0 1 1 \rightarrow 3-bit
 1 0 0 \rightarrow 1-bit
 1 0 1 \rightarrow 2-bit
 1 1 0 \rightarrow 1-bit
 1 1 1 \rightarrow 4-bit
 1 0 0 0
 1 0 0 1
 1 0 1 0

1 0 1 1
 1 1 0 0
 1 1 0 1
 1 1 1 0
 0 1 1 1 \rightarrow 5-bit
 1 0 0 0 0
 1 0 0 0 1
 1 0 0 1 0
 1 0 0 1 1

Bin to Gray



Gray to Bin





Number Systems

Gray codes

	Bin	Gray	Bin
1-bit	0 0 0 0	0 0 0 0	0 0 0 0
1-bit	0 0 0 1	0 0 0 1	0 0 0 1
2-bit	0 0 1 0	0 0 1 1	0 0 1 0
1-bit	0 0 1 1	0 0 1 0	0 0 1 1
3	0 1 0 0	0 1 1 0	0 1 0 0
1	0 1 0 1	0 1 1 1	0 1 0 1
2	0 1 1 0	0 1 0 1	0 1 1 0
1	0 1 1 1	0 1 0 0	0 1 1 1
4	1 0 0 0	1 1 0 0	1 0 0 0
	1 0 0 1	1 1 0 1	1 0 0 1

Number Systems

Binary coded decimal codes 8421

MCQ which one of the following code is a not a self complementary

$$\frac{0}{5} \quad \frac{1}{2} + \frac{1}{1} + \frac{1}{1}$$

Dec	A 8 4 2 1	B 2 4 2 1	C 5 2 1 1	D 8 4 -2 -1
0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1	0 0 0 1	0 0 0 1	0 0 0 1	0 1 1 1
2	0 0 1 0	0 0 1 0	0 0 1 1	0 1 1 0
3	0 0 1 1	0 0 1 1	0 1 0 1	0 1 0 1
4	0 1 0 0	0 1 0 0	0 1 0 1	0 1 0 0
5	0 1 0 1	1 0 1 1	1 0 0 0	1 0 1 1
6	0 1 1 0	1 1 0 0	1 0 1 0	1 0 1 0
7	0 1 1 1	1 1 0 1	1 1 0 0	1 0 0 1
8	1 0 0 0	1 1 1 0	1 1 1 0	1 0 0 0
9	1 0 0 1	1 1 1 1	1 1 1 1	1 1 1 1

Number Systems

Binary coded decimal codes - Addition

Ex Add $\underline{25} + \underline{43} = 68$

$$\begin{array}{r} 0010 \\ + 0100 \\ \hline 0110 \end{array} \quad \begin{array}{r} 0101 \\ + 0011 \\ \hline 1000 \end{array}$$

Carry flow from one digit to next?

Condition 1: Is any carry flow from one digit to next?

Condition 2: Check all 10 o/p codes that they are valid BCD or not?

Ex Add $26 + 27 = 53$

$$\begin{array}{r} 0010 \\ + 0010 \\ \hline 0100 \end{array} \quad \begin{array}{r} 0110 \\ + 0111 \\ \hline 1101 \end{array}$$

$$\begin{array}{r} 0110 \\ + 0101 \\ \hline 1011 \end{array} \quad \begin{array}{r} 0011 \\ + 0011 \\ \hline 0110 \end{array}$$

Invalid BCD for correction

Number Systems

Binary coded decimal codes - Addition

Ex $729 + 838$

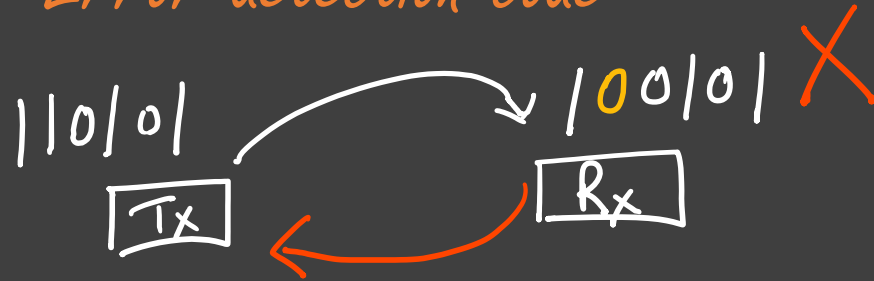
	0111	0010	1001
+	1000	0011	1000
<hr/>			
	1111	0110	0001
+	0110		0110
<hr/>			
0001	0101	0110	0111
1	5	6	7

Ex $684 + 793 = 1477$

	0110	1000	0100
	0111	1001	0011
<hr/>			
	1110	0001	0111
+	0110	0110	
<hr/>			
0001	0100	0111	0111
1	4	7	7

Number Systems

Error detection code



- Detection
- Correction.

★ Parity Codes

- ↳ Even Parity
- ↳ odd Parity.

Parity is based on numbe
of one's in a code.

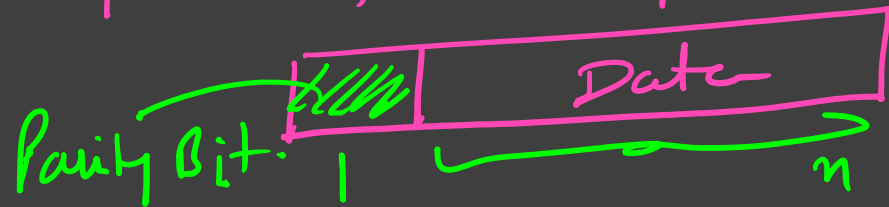
Ex The received code has been coded
using even parity
So identity ~~for~~ the code is
correct or corrected.

X 11010
3 one's, it is odd

Ex The code is coded using odd parity

✓ 11010
3 one's odd

★ Frame for Parity Code



Number Systems

Error detection code - Parity check codes

Date	<u>Even</u> Parity Code	<u>Odd</u> Parity Code
000	0 000	1 000
001	1 001	0 001
010	1 010	0 010
011	0 011	1 011
100	1 100	0 100
101	0 101	1 101
110	0 110	1 110
111	1 111	0 111

Algo C ^{odd}
if no. of ones in C are even
Append '0'
else
Append '1'
end

Number Systems

Error detection code - Parity check codes

Block Parity (Even)

0	1	0	1
1	1	0	0
1	0	1	0
0	0	1	1

P_x



0	1	0	1	✓
1	0	0	0	✗
1	0	1	0	✓
0	0	1	1	✓

R_x

Correct the detected error.
By change the bit