Unit 2 (Contd.)

Lecture 3

3 Gray code (Reflected code)

- It is a binary coding scheme used to represent digits generated from a mechanical sensor that may be prone to error. Used in telegraphy in the late 1800s, and also known as "reflected binary code".
- In Gray code, there is **only one bit location different between two successive values**, which makes mechanical transitions from one digit to the next less error prone.
- The following chart shows normal binary representations from 0 to 15 and the corresponding Gray code.

Decimal digit	Binary code	Gray code
0	0000	0000
1	0001	0001
2	0010	0011
3	0011	0010
4	0100	0110
5	0101	0111
6	0110	0101
7	0111	0100
8	1000	1100
9	1001	1101
10	1010	1111
11	1011	1110
12	1100	1010
13	1101	1011
14	1110	1001
15	1111	1000

- The Gray code is used in applications where the normal sequence of binary numbers may produce an error or ambiguity during the transition from one number to the next.
- If binary numbers are used, a change from 0111 to 1000 may produce an intermediate erroneous number 1001 if the rightmost bit takes more time to change than the other three bits.
- The Gray code eliminates this problem since only one bit changes in value during any transition between two numbers.

4. Alphanumeric codes

- Alphanumeric character set is a set of elements that includes the 10 decimal digits, 26 letters of the alphabet and special characters such as $, %, + etc.
- It is necessary to formulate a binary code for this set to handle different data types.
- If only capital letters are included, we need a binary code of at least six bits, and if both uppercase letters and lowercase letters are included, we need a binary code of at least seven bits.

ASCII character code

The standard binary code for the alphanumeric characters is called ASCII (American Standard Code for Information Interchange). It uses seven bits to code 128 characters as shown in the table below. The seven bits of the code are designated by B_1 through B_7 with B_7 being the most significant bit.

American Standard Code for Information Interchange (ASCII)

	$B_7B_6B_5$							
$B_4B_3B_2B_1$	000	001	010	011	100	101	110	111
0000	NULL	DLE	SP	0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

NOTE:
Decimal digits in ASCII can be converted to BCD by removing the three higher order bits, 011.

EBCDIC character code

- EBCDIC (Extended Binary Coded Decimal Interchange Code) is another alphanumeric code used in IBM equipment. It uses **eight bits** for each character.
- EBCDIC has the same character symbols as ASCII, but the bit assignment for characters is different. As the name implies, the binary code for the letters and numerals is an extension of the binary-coded decimal (BCD) code.
- This means that the last four bits of the code range from 0000 though 1001 as in BCD.

Excess -3 Code

- *This is another form BCD Code, on which each Decimal Digit is coded into 4-bit Binary code.*
- *The code for each Decimal Digit obtained by adding 3 to natural BCD code of the digit.*
- *It is not-weighted code*
- *This code is self – complementing code, which means 1's complement of the coded number yields 9's complement of number itself*
- *For Example,*

Decimal Digit	Excess-3 Code
0	0 0 1 1
1	0 1 0 0
2	0 1 0 1
3	0 1 1 0
4	0 1 1 1
5	1 0 0 0
6	1 0 0 1
7	1 0 1 0
8	1 0 1 1
9	1 1 0 0

Positive & Negative Logic :

- Positive logic is defined as a high voltage level representing a logic 1 and a low voltage level representing a logic 0.
- Negative logic is the reverse, i.e., a low voltage level represents a logic 1 and a high voltage level represents a logic 0.