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Digital Electronics

For

Second class

by

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Binary codes

A binary number of ***n*** digital may be represented by ***n*** binary circuit elements, each having an output signal equivalent to a **0** or **1**. Digital systems represent and process not only binary numbers. But also, many other "discrete elements of information". Any discrete element of information among a group of quantities can be represented by a binary code. For example, red is one distinct color of the spectrum. The letter A is one distinct letter of the alphabet. There are many numbers of binary codes such as: -

1- Decimal Codes

Numbers are represented in digital computers either in binary or in decimal through a binary code. The input decimal numbers are stored internally in the computer by means of a decimal code. There are many codes that are used to represent decimal numbers such as: -

a) Binary Coded Decimal (BCD or 8421 code)

It is the most widely used code to represents decimal numbers. The weights of the BCD are 8, 4, 2, 1. To encode any decimal number in BCD, simply replace each decimal digit with the appropriate 4-bit code and according to the weights 8421.

Example:- *Encode each of the following decimal number in BCD code*

$(3)_{10}$, $(9.2)_{10}$, $(150)_{10}$, $(65)_{10}$

$(0011)_{BCD}$ $(1001.0010)_{BCD}$ $(000101010000)_{BCD}$ $(01100101)_{BCD}$

The reverse process is called "decode" which return the coded number into its decimal equivalent is done by grouping each **4-bits** (from the **LBS** to **MSB**) and assigning the appropriate decimal digit to each group.

Example:- *Decode each of the following BCD numbers.*

$(10000110)_{BCD}$, $(100101110100)_{BCD}$

$(8 \quad 6)_{10}$ $(9 \quad 7 \quad 4)_{10}$

b) The 84–2–1 Code

It is the code that assigns negative weights to a decimal digit. Each decimal digit in any number is represented by 4-bit in the 84-2-1 code and according to its weights.

Example:- *Encode:- each of the following numbers*

$(765)_{10}$, $(3.49)_{10}$ $(9\ 1)_{10}$
$(1001\ 1010\ 1011)_{84\text{-}2\text{-}1}$ $(0101.0100\ 1111)_{84\text{-}2\text{-}1}$ $(1111\ 0111)_{84\text{-}2\text{-}1}$

Example:- *Decode each of the following*

$(1000\ 0000\ 1111)_{84\text{-}2\text{-}1}$ $(0110.0101)_{84\text{-}2\text{-}1}$
$(8\ \ 0\ \ 9)_{10}$ $(2.3)_{10}$

c) The Excess-3 Code

Encoding the decimal numbers in excess-3 code is done by adding 3 to each decimal digit then converting each one to BCD 8421as follows:

$(75)_{10}$ $(9\ .\ 8)_{10}$
3+3+ 3+ 3+
10 8 12 . 11
$(1010\ 1000)_{Excess\text{-}3}$ $(1100\ .\ 1011)_{Excess\text{-}3}$

The decoding Process is the reverse

$(1010\ 1000)_{Ecess\text{-}3}$ $(0100\ 0011)_{Ecess\text{-}3}$
10 8 4 3
3- 3- 3- 3-
$(7\ 5)_{10}$ $(10)_{10}$

d)The Gray Code (reflected code)

The Gray Code is an unweighted code; that is, there are no specific weights assigned to the bit positions. The important feature of the gray code is that it exhibits only a single bit change from one code number to the next.

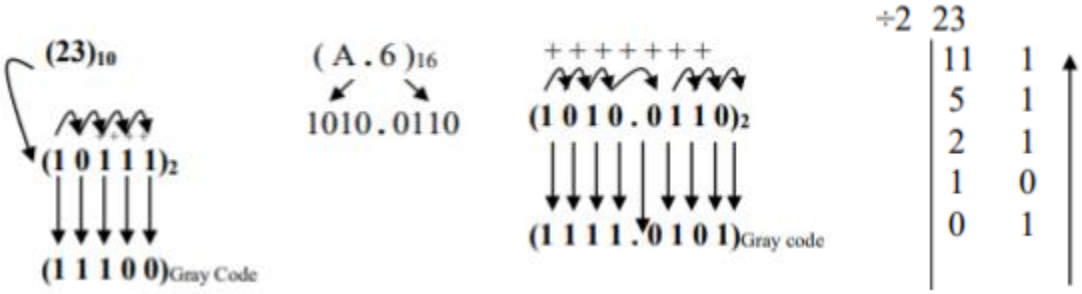
To encode any decimal number in gray code follow these steps:-

1-Convert the Decimal number into binary.

2-The MSB of the binary number is the same in the Gray code.

3-Going from MSB to LSB add each adjacent bits to get the next gray code bit (Discard Carries)

Example: - *Encode the following number in binary*



Example:- *Decode the following coded numbers*