Combinational Ckts - IV

Comprehensive Course on Digital Logic Design 2023/2024

B V Reddy • Lesson 25 • Nov 23, 2022

NUMBER SYSTEMS

Any number is associated with **Base** (or) **Radix**

$$(734)_{10}$$

$(734)_{10} =$

$(472.15) =$

A number system with base ‘ ***b***’ , will have ***b*** different digits and they are from ***0 to b -1*** .

$(421)_4$

$(243)_5$

$(851)_9$

Base (b) is always a positive integer .

In general $b \geq 2$

Base	**Different digits**
2 (Binary)	
8(Octal)	
10 (Decimal)	
16 (Hexadecimal)	

Conversation of Number System

1. Decimal to Any Base

$$[N]_{10} \rightarrow [?\,]_b$$

2. Any base to Decimal

$$[N]_b \rightarrow [?\,]_{10}$$

3. one base to another base

$$[N_1]_{b_1} \rightarrow [?\,]_{b_2}$$

4. Required base = $(\,Given\ Base\,)^{integer}$

1. Decimal to Other Base

- Integer part, repeated division by the required base .

- Fractional part , repeated multiplication by the required base .

Q) $(53.75)_{10} = \quad (-----\ -)_2$

Q) $(0.15)_{10} = \quad (-----)_2$

Note :

It is possible to obtain the equivalent of integer part but may not possible for fractional part .

Q) $(53.75)_{10} = \quad (-----\ -)_4$

Q) $(39.5)_{10} = \quad (-----)_8$

Q) $(39.5)_{10} = \quad (----\ -)_{16}$

2. Any base to Decimal

$$(x_2 x_1 x_0 \,.\, x_{-1} x_{-2} x_{-3})_b = (\quad ? \quad)_{10}$$

Q) $(311.30)_4 = \quad (-----)_{10}$

Q) Find the minimum decimal equivalent of $(3AB26)_x$

Q) $(137.4)_8 = \quad (-----\,-)_{10}$

Q) $(DAD)_{16} = \quad (-----\,-)_{10}$

Q) $(ECE)_{16} = \quad (- - - - \; -)_{10}$

Q) $(EEE)_{16} = \quad (-----\ -)_{10}$

Q) Find b if $\sqrt{(41)_b} = (5)_{10}$

3.One base to another base

$$[N]_{b_1} \rightarrow [?]_{b_2}$$

1. Convert the given number to the decimal system
2. After that convert to required base

Q) $(3)_4 = (\ ?\ )_8$

Q) $(7)_8 = (\ ?\ )_9$

Q) Find the value of x if $(193)_x = (623)_8$

Q) Find b_1 *and* b_2 if $(235)_{b_1} = (565)_{10} = (1065)_{b_2}$

Q) The solution to the quadratic equation $x^2 - 11x + 22 = 0$ is x =3 and x =6 , what is the base of the system

4. Required base = $(Given\ Base)^{integer}$

Q) $(1011010110.010110010)_2 = (-----\ -\ )_8$

Q) $(10110101110.010110010)_2 = (-----\,-\,)_4$

Q) $(1011010110.010110010)_2 = (-----\ -)_{16}$

Q) $(2210121012.2011022)_3 = (-----)_9$

Q) $(3210332101.2210)_4 = (-----\,-)_{16}$

Q) Find the number of solutions of ' Y ' exists for $(123)_5 = (X8)_Y$

Q) Find the number of solutions of ‘ x ‘ exists for $(123)_X = (12X)_3$

Q) Find the base of the following system such that given operation is valid

$24+14 = 41$

Q) Find the base of the following system such that given operation is valid

$$\frac{66}{6} = 11$$

Q) Find the base of the following system such that given operation is valid

$$\sqrt{121} = 11$$

Q) Find the base of the following system such that given operation is valid

$$\sqrt{41} = 5$$

Complement Analysis

$$|N|_r$$

1. **r' s complement**

2. (r-1)'s complement

Binary (r=2)

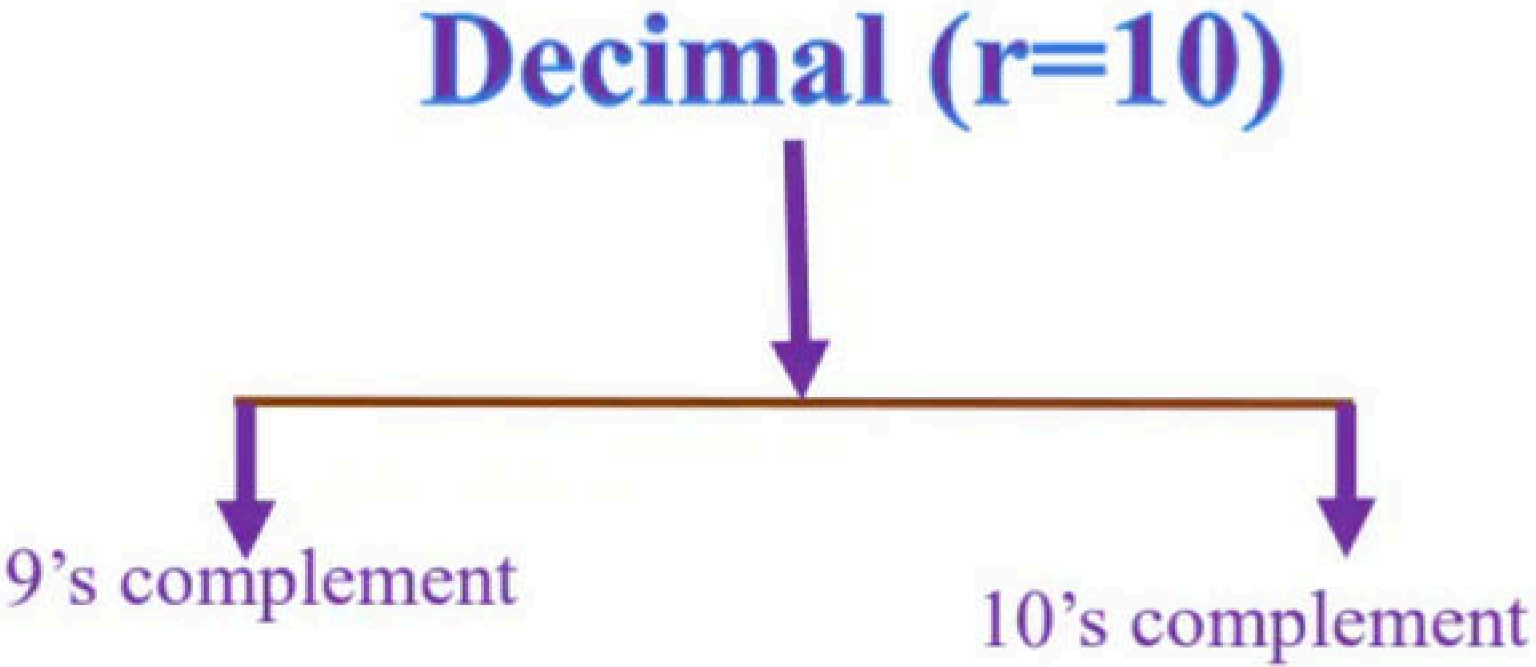
1's complement

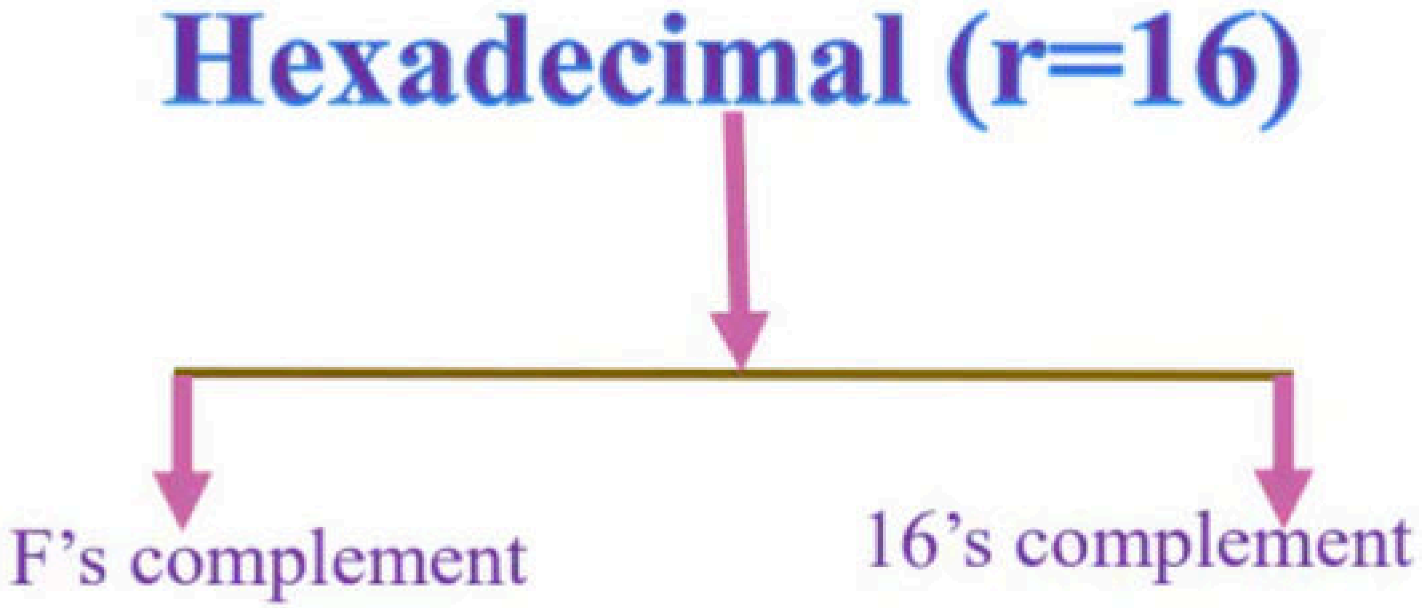
2's complement

Octal (r=8)

7's complement

8's complement


Decimal (r=10)
9's complement
10's complement


Hexadecimal (r=16)
F's complement
16's complement

r ' s complement

r' s complement of the number (N) $= r^n - N$

r --------> Radix

n -------> number of integer digits

N --------> given number

(r-1) ' s complement

(r-1) ' s complement of the number (N) $= r^n - r^{-m} - N$

r --------> Radix
n -------> number of integer digits
m -------> number of decimal digits
N --------> given number

(r-1) ’ s complement of the number (N) $= r^{n} - r^{-m} - N$

r’ s complement of the number (N) = (r-1)’s complement + r^{-m}

If m = 0

r’ s complement of the number (N) = (r-1)’s complement + 1

Q) Find the 10's complement of $(327.452)_{10}$

Q) Find the 9's complement of $(327.452)_{10}$

Q) Find the 10's complement of $(784732179)_{10}$

Q) Find the 2's complement of $(101100)_2$

Q) Find the 2's complement and 1's complement of $(0.0110)_2$

Q) Find the 9’s and 10’s complement of $(52520)_{10}$

Q) Find the 9’s and 10’s complement of $(0.3267)_{10}$

Q) Find 1's and 2's complement of $(10100100111)_2$

Q) Find 8’s and 9’s complement of $(278421)_9$

Q) Find F's and 16's complement of $(792410)_{16}$

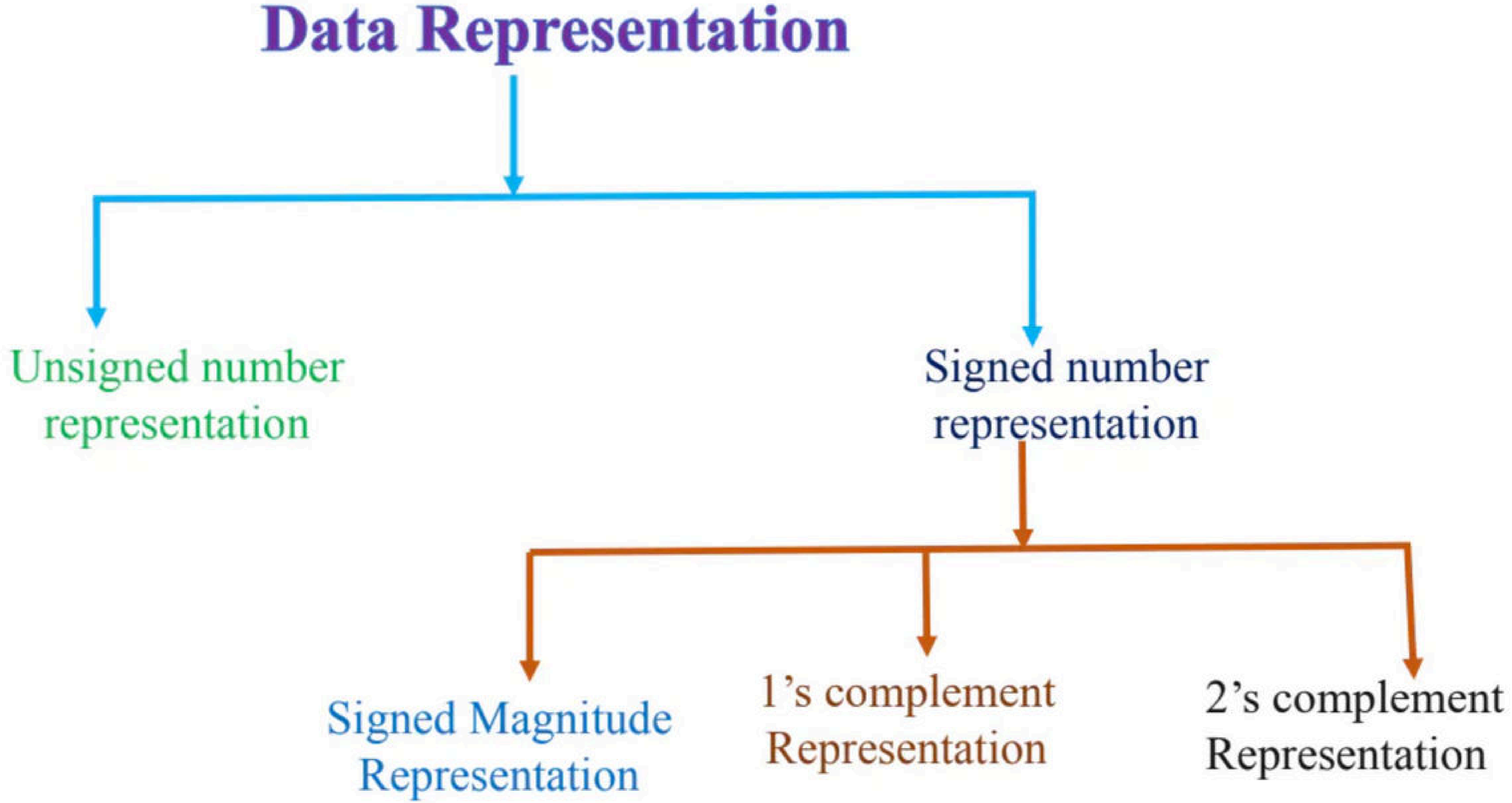
Q) Find 1's and 2's complement of $(11000100)_2$

Q) Find 1's and 2's complement of $(11010.11)_2$

Q) Find 8's complement of $(2670)_8$

Q) Find 10’s complement of $(7492)_{10}$

Q) Find 16's complement of $(9623)_{16}$


Data Representation
Unsigned number representation
Signed number representation
Signed Magnitude Representation
1's complement Representation
2's complement Representation

Unsigned Number Representation

- Strictly applicable for positive numbers
- There is no sign bit concept

+ 5 ------>

- 5 ----->

Decimal number	Unsigned number representation (4-bits)
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Range with 4 bits =

Range with 5 bits =

Range with n- bits =

Signed Number Representation

1. Signed magnitude representation
2. 1' s complement representation
3. 2's complement representation

Signed Magnitude representation

- Valid for both positive and negative numbers .
- Sign bit concept is used .

Sign bit $= 0$, for $\oplus$Ve number

$= 1$, for $\ominus$ *ve number*

+5 =

- 5 =

+5 =

- 5 =

Decimal number	Signed Magnitude Representation (4-bits)
+0	
+1	
+2	
+3	
+4	
+5	
+6	
+7	
-0	
-1	
-2	
-3	
-4	
-5	
-6	
-7	

Range with 4 bits =

Range with 5- bits =

Range with n- bits =

1's Complement Representation

➢ In this ⊕*Ve numbers* are represented as ***normal binary number with MSB '0'***

Representation of ⊖ *ve number*

1. Write the binary equivalent of magnitude
2. Take its 1's complement

+6 =

- 6 =

+6 =

- 6 =

Decimal number	1's complement Representation (4-bits)
+0	
+1	
+2	
+3	
+4	
+5	
+6	
+7	
-0	
-1	
-2	
-3	
-4	
-5	
-6	
-7	

Range with 4 bits =

Range with 5- bits =

Range with n- bits =

2's complement Representation

- In this ⊕**Ve numbe**rs are represented as ***normal binary number with MSB '0'***

Representation of ⊖ *ve number*

1. Write the binary equivalent of magnitude
2. Take its 2's complement

+6 =

- 6 =

+6 =

- 6 =

Decimal number	2's complement Representation
+0	
+1	
+2	
+3	
+4	
+5	
+6	
+7	
-0	
-1	
-2	
-3	
-4	
-5	
-6	
-7	
-8	

Range with 4 bits =

Range with 5- bits =

Range with n- bits =

Q) Find the Decimal equivalent of the **unsigned number representation** given below

a) 01101

b) 11101

Q) Find the Decimal equivalent of the **Signed magnitude representation** given below

a) 01101

b) 11101

Q) Find the Decimal equivalent of the **1’s complement representation** given below

a) 01101 b) 11101

Q) Find the Decimal equivalent of the **2's complement representation** given below

a) 01101 b) 11101

Q) **1's complement representation** of the numbers given below , find the decimal equivalents

a) 01001

b)001001

c)0001001

d)11001

e)111001

f)1111001

Q) **2's complement representation** of the numbers given below , find the decimal equivalents

a) 01001

b)001001

c)0001001

d)11001

e)111001

f)1111001

Q) Find the **2's complement representation** of the following

$-2 =$

$-4=$

$-8=$

$-16=$

$-2^n=$

Note :

The minimum number of bits required for - 2^n , using 2's complement representation = ---------

Q) A number in 4- bit 2's complement is $x_3x_2x_1x_0$,this number when stored using 8- bits will be

a) 0000 $x_3x_2x_1x_0$
b)1111 $x_3x_2x_1x_0$
c) $x_3x_3x_3x_3x_3x_2x_1x_0$
d) $\overline{x_3}\ \ \overline{x_2}\ \ \overline{x_1}\ \ \overline{x_0}\ x_3x_2x_1x_0$

Q. How many one's are present in the binary representation of $(8 \times 4096) + (4 \times 256) + (9 \times 16) + 5$

(a) 6 (b) 5 (c) 3 (d) 4

Binary Subtraction using 1's complement

1. Represent the given numbers in the 1's complement form.
2. Add the two numbers.
3. If carry is generated ,then the result is positive and in the true form , add carry to the LSB to get the final answer .
4. If carry is not generated , then the result is negative , and in the 1's complement form . To get final answer take 1's complement of the result.

Q)Perform the following operation for the given numbers using 1's complement form .

a) 8 - 4

b)4 - 8

Binary Subtraction using 2's complement

1. Represent the given numbers in the 2's complement form
2. Add the two numbers
3. If carry is generated ,ignore it .
4. If MSB is 0, then the result is positive and in the true form .
5. If MSB is 1, then the result is negative and is in 2's complement form .
   (whether there is a carry (or) no carry does not matter)

Q. Perform the following operation for the given numbers using 2's complement form .

46 - 14

Q. Perform the following operation for the given numbers using 2's complement form .

$$-75+26$$

Q) Simplify the following using 2's complement form

$9 + 4$

$$
\begin{array}{r}
9 = 01001 \\
4 = 00100 \\
\hline
01101 \\
\hline
\end{array}
$$

$C_{out} = 0$

$C_{in} = 0$

$\underline{Ans = +13}$

$x = 0$

$y = 0$

$z = 0$.

$\bar{x}\,\bar{y}\,\bar{z}$

No overflow

$C_{in} \oplus C_{out} = 0$

Q) Simplify the following using 2's complement form

9- 4

$$
\begin{array}{rl}
9 = & 01001 \\
-4 = & 11100 \\
\hline
 & 00101 \\
\hline
\end{array}
$$

Cout = 1

Cin = 1

Ans = +5 ✓

x = 0

y = 1

z = 0

$\bar{x} y \bar{z}$

Cin ⊕ Cout = 0

No over flow

Q) Simplify the following using 2's complement form

-9 + 4

$$-9 = 10111$$

$$4 = 00100$$

$$11011$$

$C_{out} = 0$

$C_{in} = 0$

Ans = $-[00101] = -5$

$x = 1$

$y = 0$

$z = 1.$

$x\bar{y}z$

$C_{in} \oplus C_{out} = 0$

No overflow

Q) Simplify the following using 2's complement form

-9 - 4

$$
\begin{array}{rr}
-9 = & 10111 \\
-4 = & 11100 \\
\hline
 & 1.00111 \\
\hline
\end{array}
$$

Cout = 1

Cin = 1

$x = 1$

$y = 1$

$z = 1.$

$x\,y\,z$

$C_{in} \oplus C_{out} = 0$

No overflow

$$Ans = -[01101] = \underline{\underline{-13}}$$

Q) Simplify the following using 2's complement form

9 + 8

$$9 = 0\,1001$$

$$8 = 0\,1000$$

$$\overline{\;1\,0001\;}$$

$x = 0$

$y = 0$

$z = 1$

$\bar{x}\bar{y}z$

$C_{in} \oplus C_{out} = 1$

overflow

$C_{out} = 0$

$C_{in} = 1$

Ans $= -[0111] = -15$

Q) Simplify the following using 2's complement form

-9 - 8

$$-9 = 10111$$

$$-8 = 11000$$

$$\begin{array}{r} 1 \\ \hline 01111 \\ \hline \end{array}$$

Cout = 1

Cin = 0.

Ans = + 15

x = 1

y = 1

z = 0.

$x y \bar{z}$

Cin $\oplus$ Cout = 1

overflow

$a - b$

$a > b$

$a - b < a$

$a + b$

$\underline{a > b}$

$a + b > a$

Overflow

Over flow occurs in signed arithmetic operations if two same sign numbers are added and result exceeds with given number of bits.

Over flow can be detected by using 2- methods

1. by using carry bits

2. by using sign bit

1. By using carry bits

C_{in} ---------------→ *carry into MSB*

C_{out} ----------→ *carry out from MSB*

if $C_{in} \oplus C_{out} = 0 \longrightarrow$ No overflow

$C_{in} \oplus C_{out} = 1 \longrightarrow$ overflow occurs.

2. By using sign bit

X ----------> Sign bit of 1st number

Y -----------> Sign bit of 2nd number

Z-----------> Sign bit of Resultant

Over flow = $\bar{x}\bar{y}z + xy\bar{z}$

NOTE :

to avoid the overflow , increase the number of bits .

$$
\begin{array}{rl}
9 = & 001001 \\
8 = & 001000 \\
\hline
 & 010001 \\
\hline
\end{array}
$$

Ans = + [010001]

= +17

Q) Let x be the sign bit of N_1, y be the sign bit of N_2, and z be the sign bit of $N_1 + N_2$, then the condition for overflow .

a) $x \neq y \neq z$ b) $x \neq y = z$

c) $x = y \neq z$ d) $x = y = z$

$x=0$	$x=1$
$y=0$	$y=1$
$z=1$	$z=0$.

$x = y \neq z$.

over flow occurs.

Q. Let R1 and R2 be two 4-bit registers that store number in 2's complement form , for operation R1 + R2 , which of the following values of R1 and R2 gives overflow.

a) R1= 1100 , R2 = 1010
b) R1= 1001 , R2 = 1111
c) R1= 1011 , R2 = 1110
d) R1= 0011 , R2 = 0100

Method-1

$n = 4$

$-(2^{n-1})$ to $+(2^{n-1}-1)$

-2^3 to $+2^3-1$

-8 to $+7$.

a) $R_1 = 1100$

$R_1 = -[0100] = -4$

$R_2 = 1010$

$R_2 = -[0110] = -6$.

$R_1 + R_2 = -10$

Method-2

$R_1 = 1100$

$R_2 = {}_1 1010$

0110

$C_{in} = 0$

$C_{out} = 1$

$C_{in} \oplus C_{out} = 1$

over flow

Method-3

$$\boxed{\begin{array}{l} x = 1 \\ y = 1 \\ z = 0 \end{array}} \rightarrow \text{over flow}$$

Q) Two numbers represented in signed 2's complement form as P = 11101101 , Q = 11100110 , if Q is subtracted from P , then the value obtained in signed 2's complement from is

a) 100000111 b) 00000111 c) 11111001 d) 111111001

BINARY CODES

Numeric Codes

1. BCD Code
2. Excess-3 Code
3. Gray Code
4. Self-complementing code

1. BCD (Binary Coded Decimal) Code :

In this code each decimal number is represented by a separate group of 4- bits.

$(2\,3\,4\,5)_{10} = (0010\ 0011\ 0100\ 0101) \longrightarrow$ BCD

1 1 1 1 → 15

- It uses only 0 to 9
- 0 to 9 are valid BCD Code
- 10, 11, 12,13,14,15 are invalid BCD Code
- Coding method is very simple but it requires more number of bits .

10
11
12
13
14
15

$$(27)_{10} = (0010\ 0111) \rightarrow \text{BCD}$$

$$\begin{array}{r|l}
2 & 27 \\ \hline
2 & 13 - 1 \\ \hline
2 & 6 - 1 \\ \hline
2 & 3 - 0 \\ \hline
 & 1 - 1.
\end{array}$$

$$(27)_{10} = (11011)_2 \longrightarrow \text{Binary.}$$

$$(13)_{10} = (0001\ 0011) \longrightarrow \text{BCD}$$

$$(13)_{10} = (1101) \longrightarrow \text{Binary.}$$

11 → 1011 → Binary

1 0110

0001 0001

0 to 9 → Valid BCD

11 → 0001 0001 → BCD

Eg. of BCD Codes

8 4 2 1
2 4 2 1
3 3 2 1
4 2 2 1
5 2 1 1
5 3 1 1
5 4 2 1
6 3 1 1
7 4 2 1
$7\,4\,\bar{2}\,\bar{1}$
$8\,4\,\bar{2}\,\bar{1}$

Natural BCD.

8.

2 4 2 1.
1 1 1 0

$8\ 4\ \bar{2}\ \bar{1}$

9 = 1 0 1 0

3 = 0 0 0 0

6 = 0 1 0 1

$7\ 4\ \bar{2}\ \bar{1}$

9 = 1 0 0 1

3 = 0 0 0 0

5 = 0 1 1 0

0
1
2
3
4
5
6
7
8
9.

_ _ _ _

2 4 2 1

6 = 1 1 0 0

6 = 0 1 1 0

BCD Addition

1. Express the given numbers in BCD form

2. Add the corresponding digits of the decimal numbers of each group .

3. If there is no carry and the sum term is valid code , no correction is needed

4. If there is a carry out of one group to next group , (or) if the sum term is an invalid BCD code , then add 6_{10} (0110) to the sum term of that group and the resulting carry is added to the next group .

Q) Perform the following using BCD addition

25+13

$$
\begin{array}{rcll}
25 & = & 0010 & 0101 \\
13 & = & 0001 & 0011 \\
\hline
 & & 0011 & 1000 \\
\hline
\end{array}
$$

Q) Perform the following using BCD addition

679.6+536.8

679.6 = 0110 0111 1001 . 0110

536.8 = 0101 0011 0110 . 1000

1011 1010 1111 . 1110

0110 0110 0110 . 0110

0001 0010 0001 0110 . 0100

1 2 1 6 . 4

Q. When two BCD numbers are added, under what conditions a correction factor of 6 is added to a 4-bit nibble

(MSQ)

a) When the nibble value is one of 1010, 1011, 1100, 1101, 1110, or 1111

b) When there is a carry out of the nibble to the next higher significant nibble

c) When a final carry is generated

d) When the nibble value is one of 0001, 0010, 0100, 1000, ×

A, B, C

4-bit → nibble

8-bits → Byte.

BCD Subtraction

1. Express the given numbers in BCD form

2. Subtract the corresponding digits of the decimal numbers of each group .

3. If there is no barrow no correction is needed.

4. If there is a barrow from the next group ,or if the difference term is an invalid BCD code then 6_{10} (0110) is subtracted from the difference term of that group .

Q) Perform the following using BCD subtraction

38-15

Q) Perform the following using BCD subtraction

206.7-147.8

EXCESS-3 CODE

The EX-3 code can be derived from the natural BCD code by adding 3 to each coded number.

3

Ex-3 code = BCD + 3

Ex-3 code of (4) = 4 + 3 = 7.

= 0111

Ex-3code of $(15) = 15+3 = 18$

$= (0001\ 1000)$

Ex-3 code of $(27) = 27+3 = 30$.

$= 0011\ 0000$.

Valid EX -3 : 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

Invalid EX-3 : 0, 1, 2, 13, 14, 15.

Gray Code

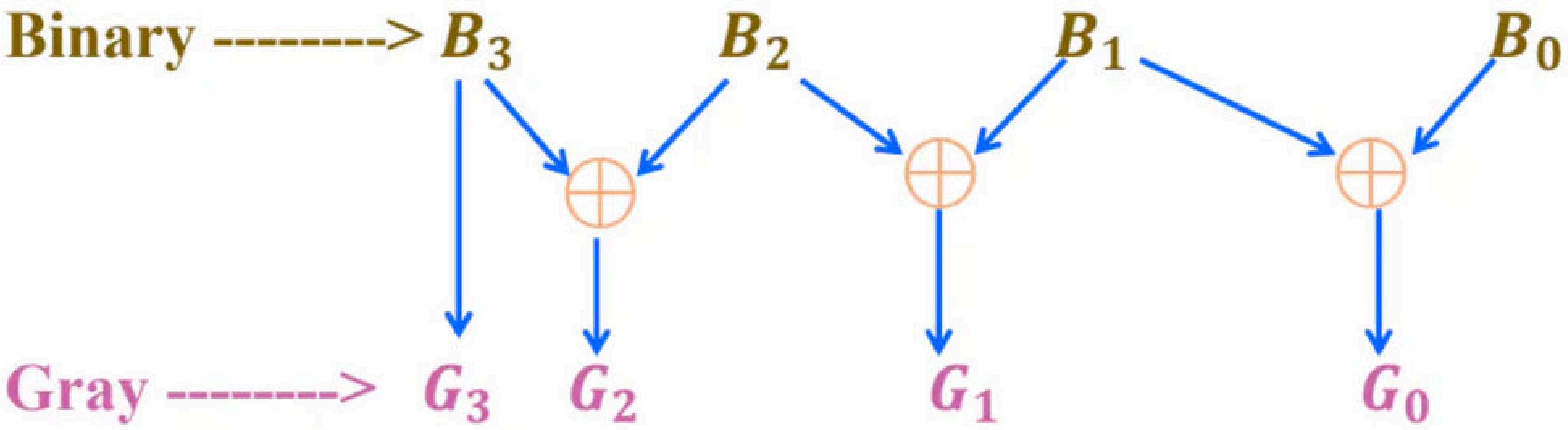
Gray code is a non-weighted code, successive decimal numbers are differ by only one bit .

- Non- weighted code
- Unit distance code
- Cyclic code
- Reflective code
- Minimum distance code

Decimal	1- bit Gray code	2- bit Gray code	3- bit Gray code
0	0	0 0	0 0 0
1	1	0 1	0 0 1
2		1 1	0 1 1
3		1 0	0 1 0
4			1 1 0
5			1 1 1
6			1 0 1
7			1 0 0

Binary to Gray Code

Side by Side



Q) Find the Gray code of the following

1 1 0 0 1 0

Binary = 1 1 0 0 1 0

Gray = 1 0 1 0 1 1

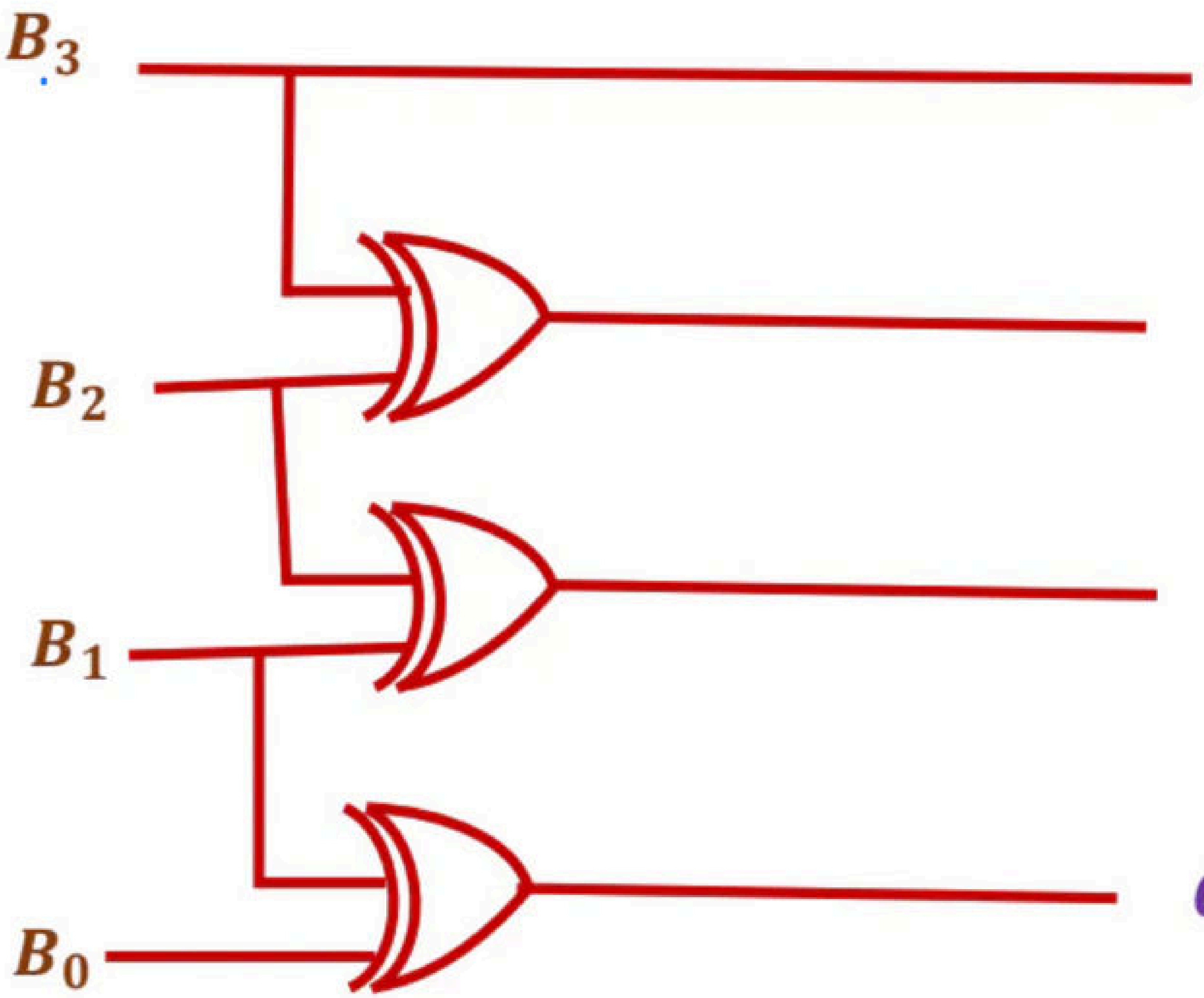
Q) Find the Gray code of the following

1 1 1 0 0 1 1 0

Binary = 1 1 1 0 0 1 1 0

Gray = 1 0 0 1 0 1 0 1

Logic gate



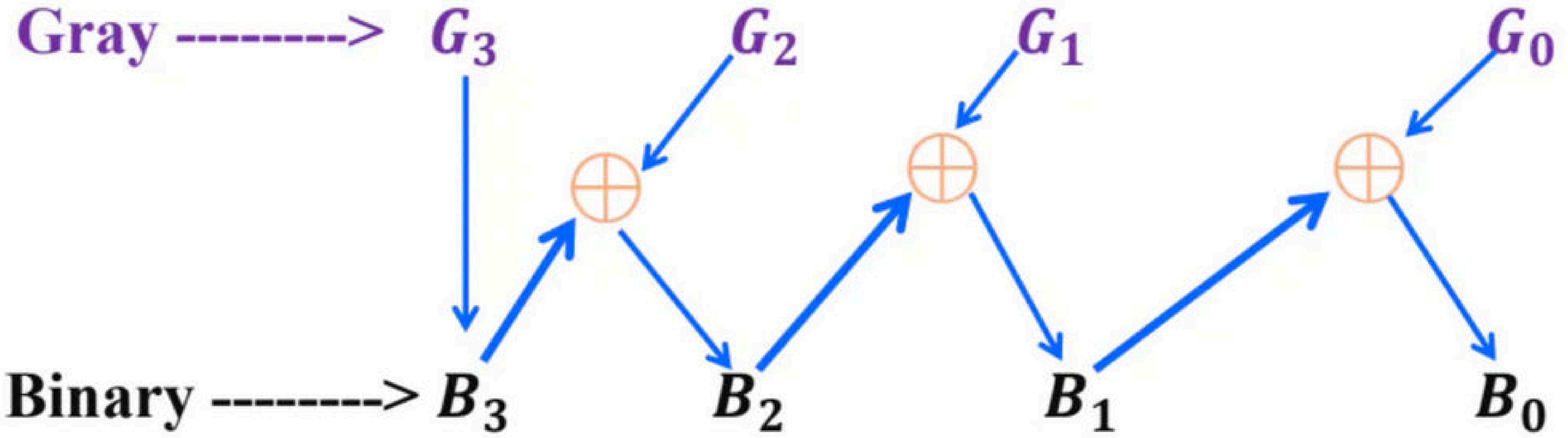
$G_3 = B_3.$

$G_2 = B_3 \oplus B_2$

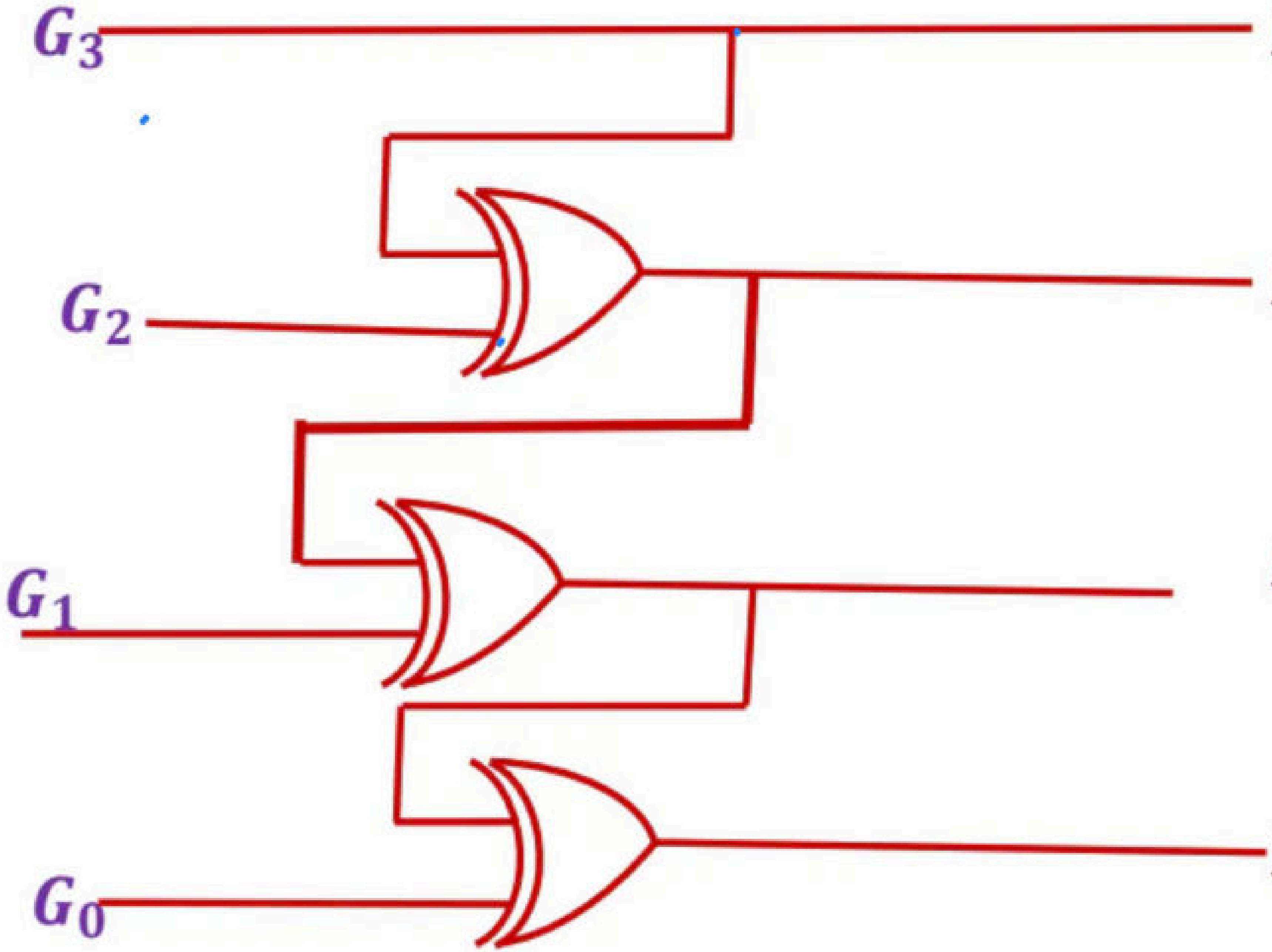
$G_1 = B_2 \oplus B_1$

$G_0 = B_1 \oplus B_0.$

Gray to Binary Code



Gray Code to Binary Code



$B_3 = G_3$

$B_2 = B_3 \oplus G_2$

$B_1 = B_2 \oplus G_1$

$B_0 = B_1 \oplus G_0$.

Q) Find the binary code of the following

1 0 1 0 1 1

Gray = 1 0 1 0 1 1

Binary = 1 1 0 0 1 0

Q) Find the binary code of the following

1 1 1 0 0 1 1 0

Gray = 1 1 1 0 0 1 1 0

Binary = 1 0 1 1 1 0 1 1 .

Self Complementing Codes

- A code is said to be self complementing, if the 1' complement of a number N is equal to the 9's complement of the number
- For a code to be self complementing, the sum of all its weights must be 9 .

Eg. of Self Complementing Codes

2 4 2 1
5 2 1 1
4 3 1 1
3 3 2 1
XS-3

2421

N = 8

1110

0001

9's comp $(8)_{10}$ = 1

0001

XS-3 code

N = 5

XS-3 of (5) = 5+3 = 8

(1000)

(0111)

9's comp (5) = 4

3 + 4 = 7

(7) = (0111)

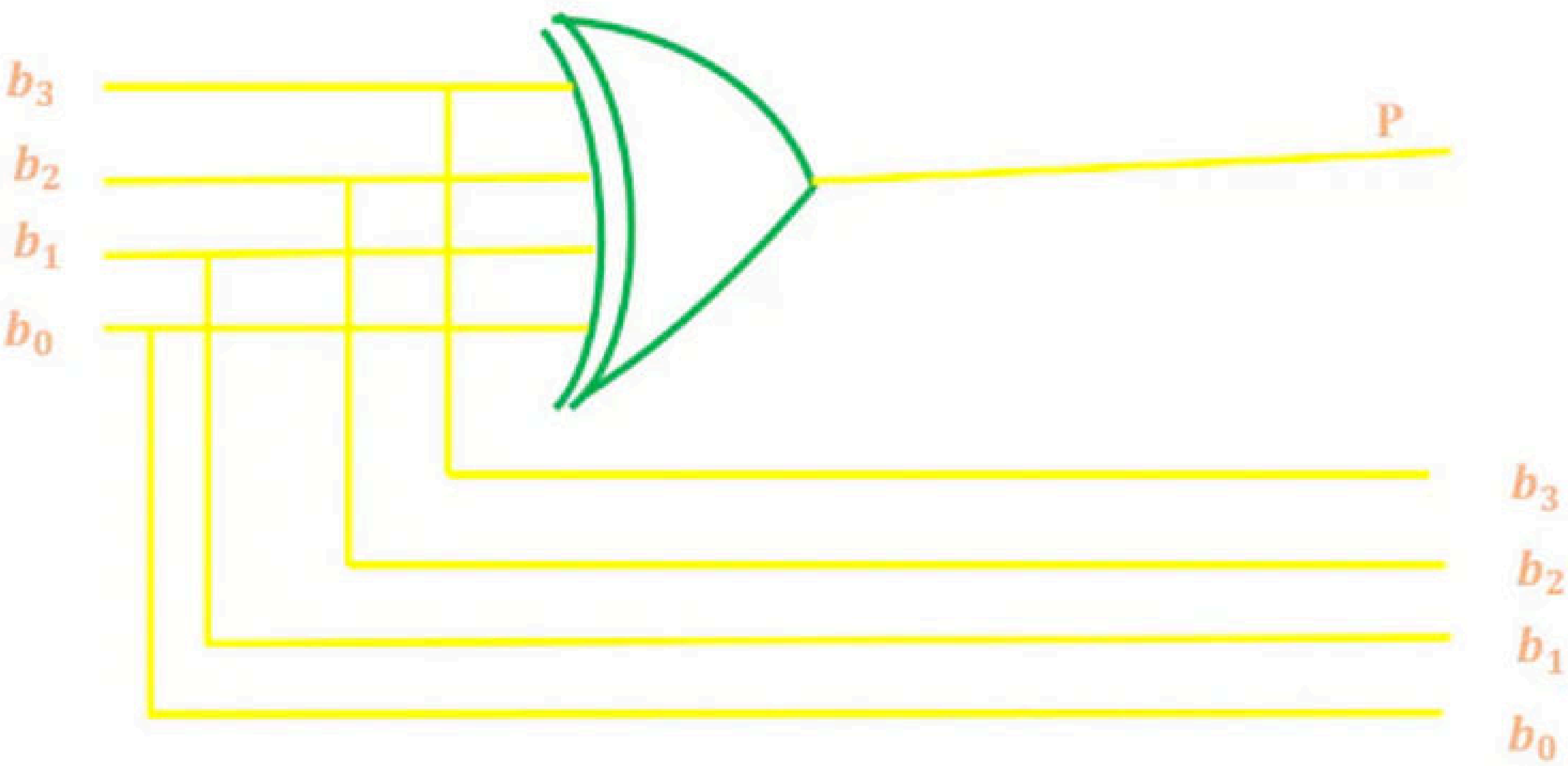
PARITY BIT

A parity bit is used for the purpose of detecting errors during transmission of binary information . A parity bit is an extra bit included with a binary message to make the number of 1's either odd or even. The message including the parity bit is transmitted and then checked at the receiving end for errors. The circuit that generates the parity bit in the transmitter is called a parity generator and the circuit that checks the parity in the receiver in called a parity checker .

Even parity

In case of even parity , the added parity bit will make the total number of 1's is an even number .

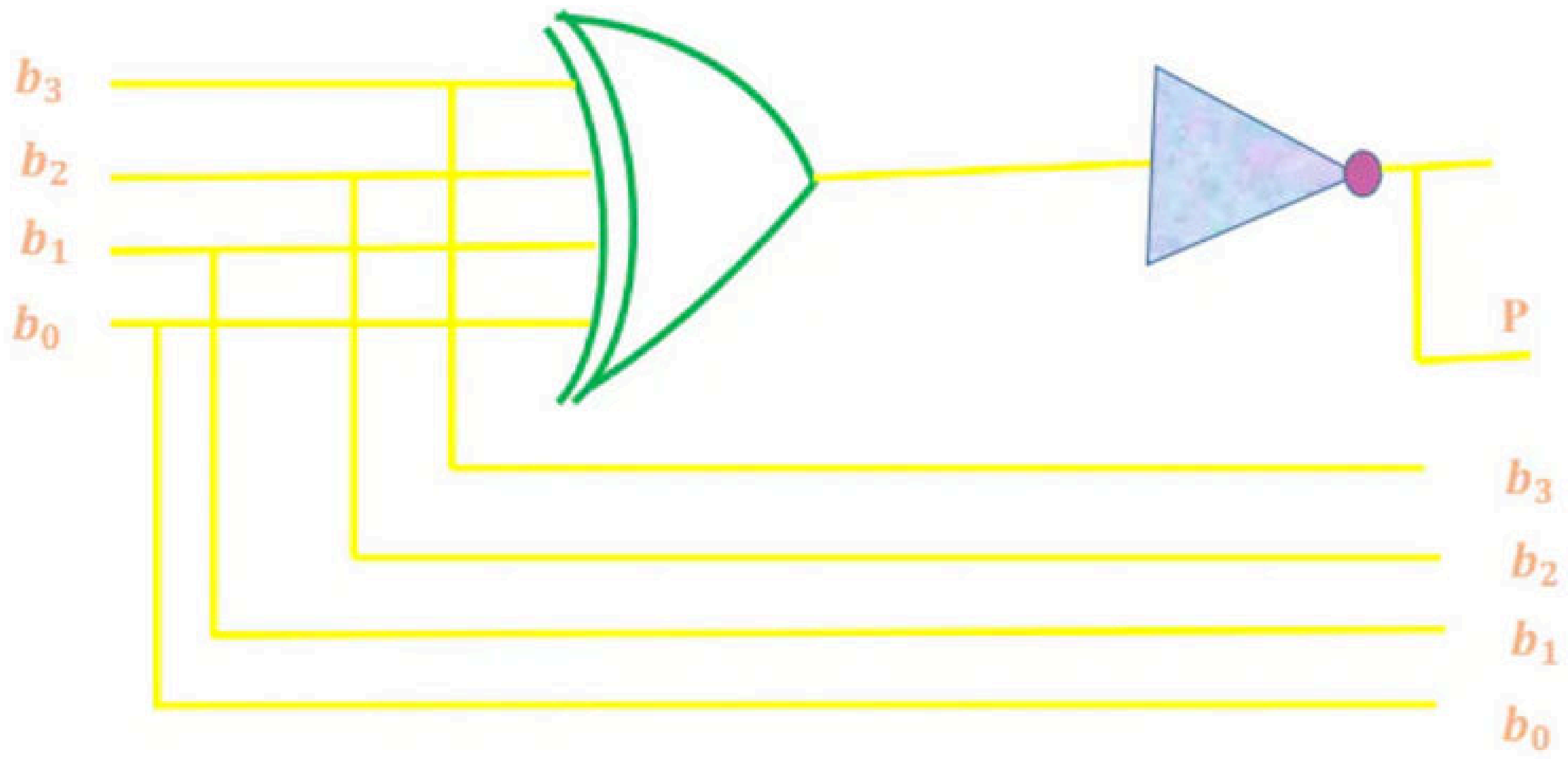
3- bit message	Message with even parity	
	message	Parity


b_3
b_2
b_1
b_0
P
b_3
b_2
b_1
b_0

Odd parity

In case of odd parity , the added parity bit will make the total number of 1's is an odd number .

3- bit message	Message with odd parity	
	message	Parity


b_3
b_2
b_1
b_0
P
b_3
b_2
b_1
b_0

Hamming Code

For the detection and correction of 1-bit errors

Selection of Parity bits

The hamming code uses the number of redundant bits (parity bits) depending on the number of information bits in the message .

Location of Parity bits

Assigning the values to Parity bits

- Each parity bit check the corresponding bit locations and assign the bit values as 1 or 0 so as to make the number of 1 s as even for even parity and odd for odd parity .

Bit location	7	6	5	4	3	2	1
Bit designation							
Binary representation							
Data bits							
Parity bits							

Q. **Encode a binary word 11001 into the even parity hamming code.**

Bit location									
Bit designation									
Binary representation									
Data bits									
Parity bits									

Q. Let us assume the even parity hamming code , if the received code is 1101100 , verify whether the received data is correct or not , if not correct find the correct data .

Q. P, Q and R are the decimal integers corresponding to the 4- bit binary number 1100 considering in signed magnitude, 1's complement and 2's complement representations, respectively . The 6- bit 2's complement representation of (P+Q+R) is……..

a) 111101
b) 110101
c) 110010
d) 111001

Q. Two numbers are chosen independently (with replacement) and uniformly at random from the set {1,2,3,…….13 } . The probability that their 4-bit unsigned binary representations have the same most significant bit --------------

Q. Which of the following represents '$E3_{16}$'?

(a) $(CE)_{16} + (A2)_{16}$

(b) $(1BC)_{16} - (DE)_{1}$

(c) $(2BC)_{16} - (1DE)_{16}$

(d) $(200)_{16} - (11D)_{16}$

Q. A new Binary Coded Pentary (BCP) number systems is proposed in which every digit of a base -5 number is represented by its corresponding 3-bit binary code. For example, the base-5 number 24 will be represented by its BCP code 010100 . In this numbering system, the BCP code 100010011001 corresponds to the following number in base -5 system

a)423
b)1324
c)2201
d)4231

Q. Consider the addition of numbers with different bases

$$(X)_7 + (Y)_8 + (W)_{10} + (Z)_5 = (K)_9$$

If X=36 , Y = 67 ,W=98 and K =241 then Z is …..

a)34
b)15
c)68
d)25

Q. Let x_1 be the maximum value that can be represented in signed 2's complement form using 6 -bits.

Let x_2 be the minimum value that can be represented in signed 1's complement form using 5 bits.

Let x_3 be the minimum value that can be represented in signed 2's complement form using 7 bits.

Then find the value of $x_1 + \frac{x_2}{2} + 2x_3$

(a) -180.5 (b) -104.5

(c) 108.5 (d) 130.5

Q. The 4-bit binary number 1110 represents

(a) $(-1)_{10}$ in signed magnitude system and $(-2)_{10}$ in signed 2's complement system
(b) $(-1)_{10}$ in signed 1's complement system and $(-2)_{10}$ in signed 2's complement system
(c) $(-2)_{10}$ in signed magnitude system and $(-1)_{10}$ in signed 2's complement system
(d) $(-6)_{10}$ in signed magnitude system and $(-1)_{10}$ in signed 2's complement system

Q. A number N of base r is represented as $(N)_r$ let $(10_{16})^3 = (X)_{10}{}^2$

a)64

b)15

c)22

d)19