



# SNS COLLEGE OF TECHNOLOGY

Coimbatore-35  
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

### 23ECB201 – DIGITAL SYSTEMS DESIGN

II YEAR/ III SEMESTER

### UNIT 2 – COMBINATIONAL CIRCUITS

### TOPIC 2.5 - Code Converters (Binary to Grey and Grey to Binary)



## What is a code converter?

- A converter is needed to convert the information in to the code which we need.
- These are basically encoders and decoders which converts the data in to an encoded form.
- Coding is the process of translating the input information which can be understandable by the machine or a particular device.
- Coding can be used for security purpose to protect the information from stealing or interrupting.



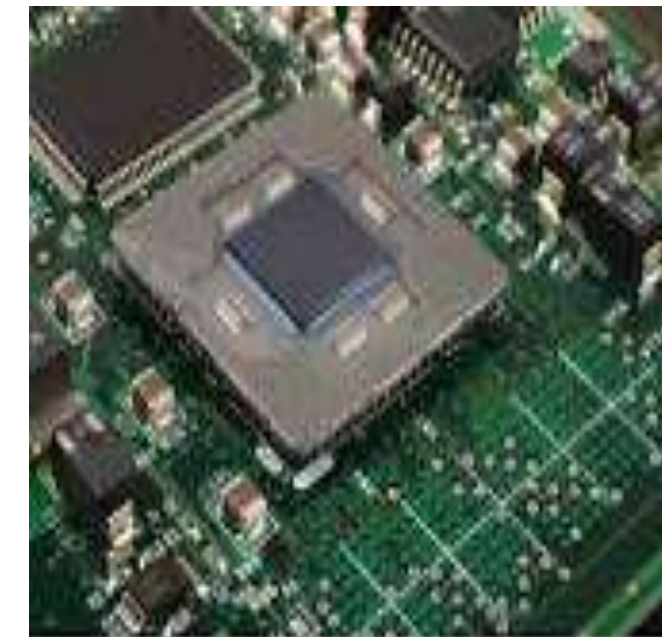
# Applications of Code Converters



## Computers

## Digital electronics

## Microprocessors



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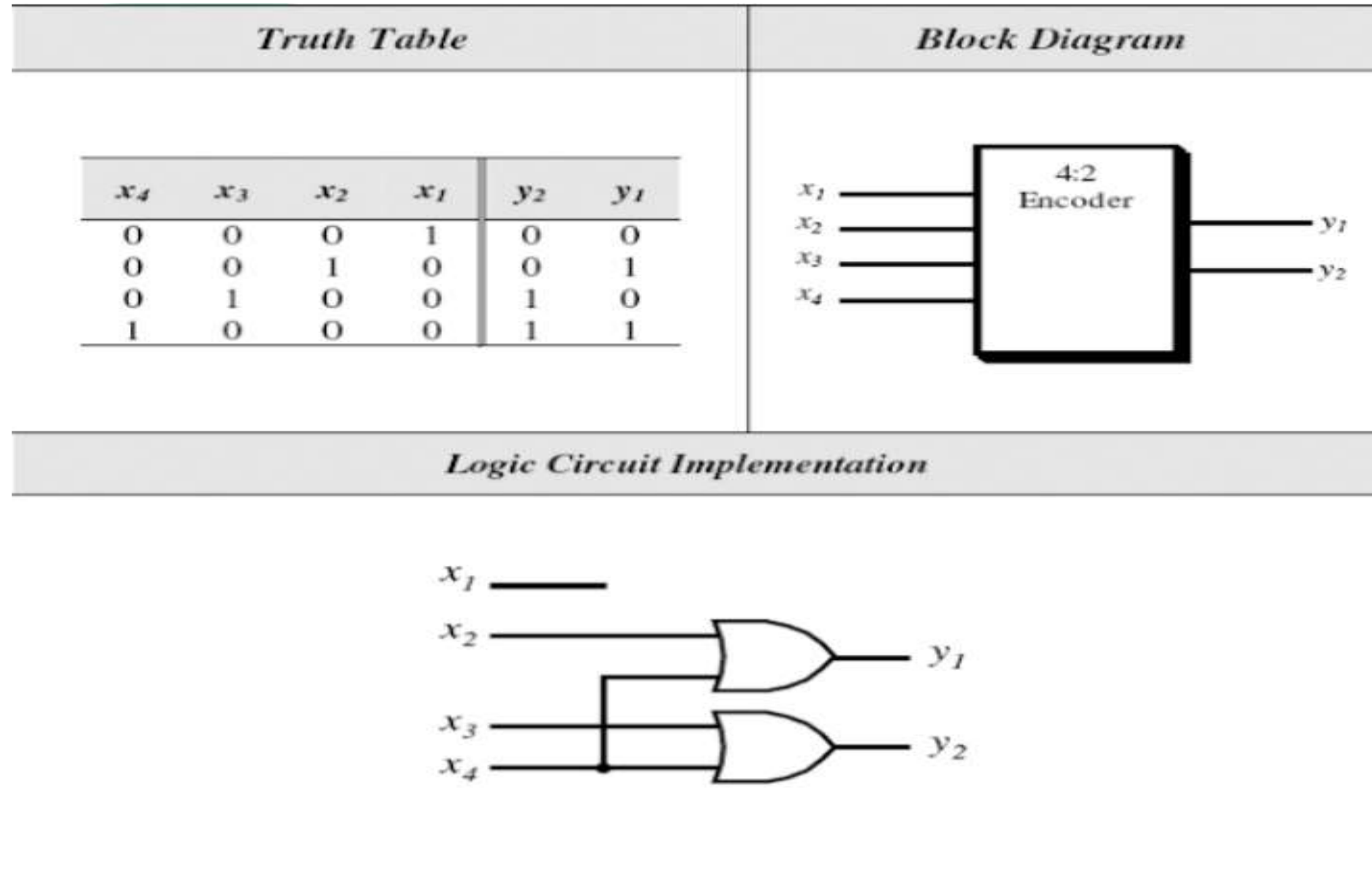
## Types of Code Converters



- There are numerous codes like
  - binary,
  - octal,
  - hexadecimal,
  - Binary Coded Decimal (BCD),
  - Excess-3,
  - Gray code,
  - Error Correcting Codes (ECCs) and
  - ASCII code



# CODE CONVERTER





# Binary to Grey Code



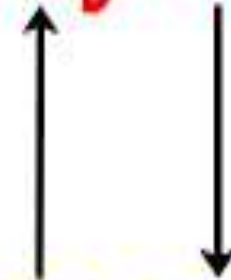
Binary

Grey



**Binary code**

**Gray code**



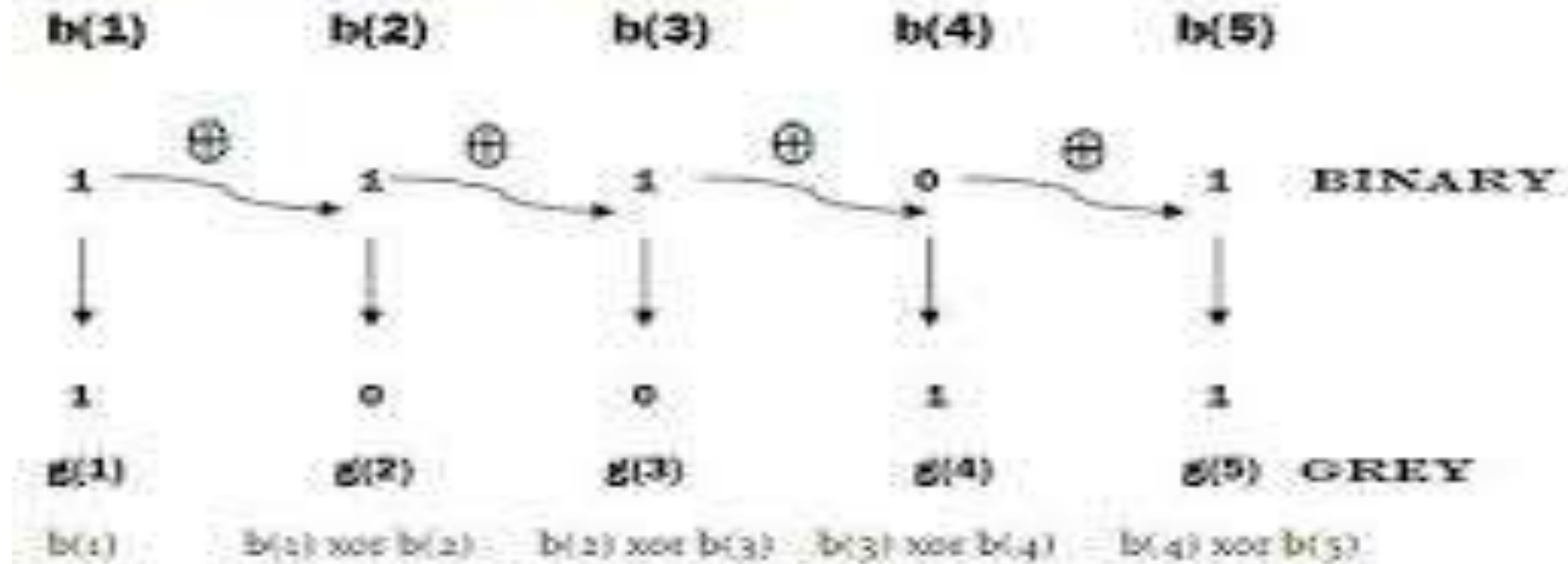


# Binary to Grey Code



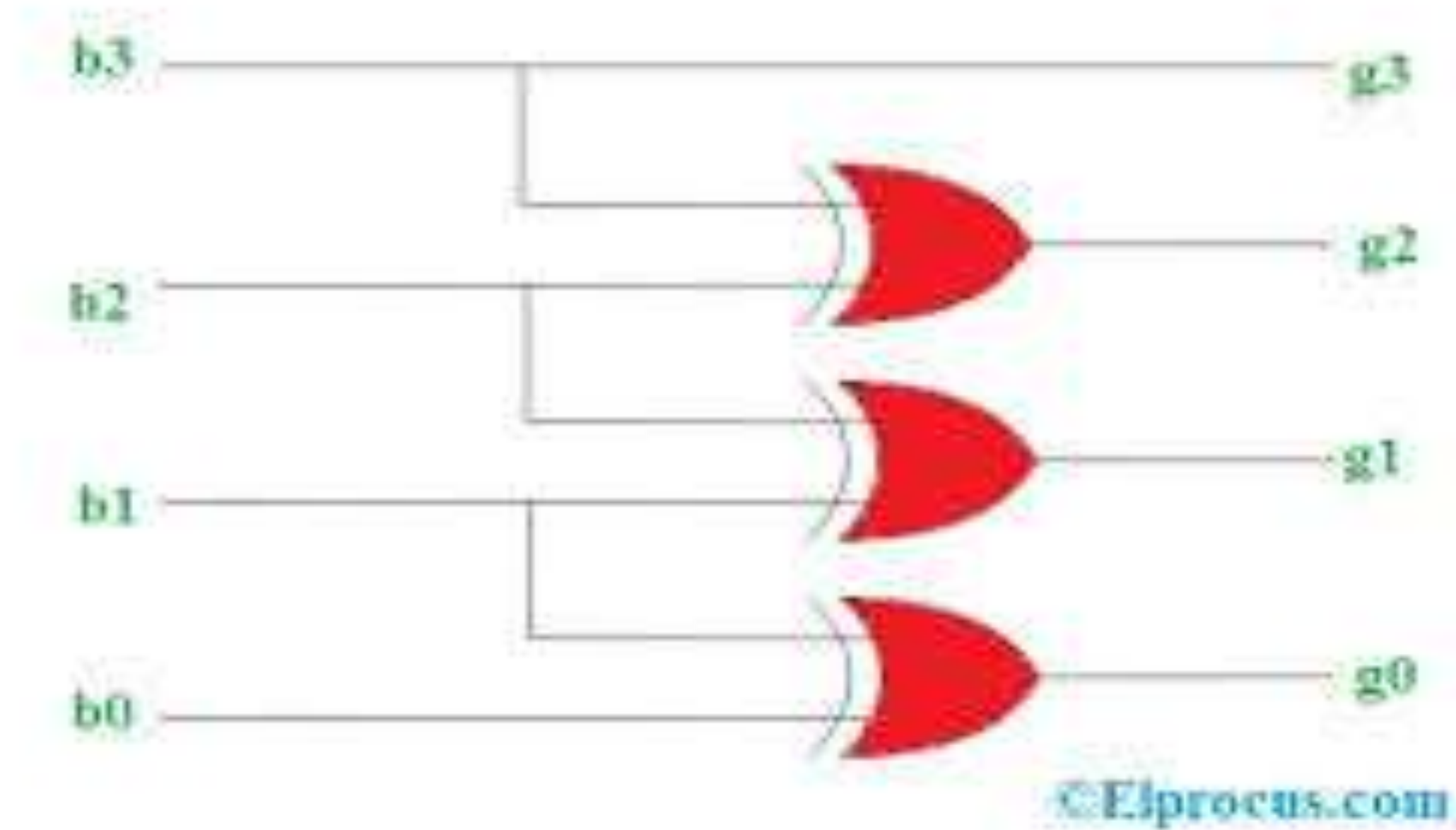
## Binary to Grey Code Conversion

Convert the binary  $11101_2$  to its equivalent Grey code





# Binary to Grey Code - Circuit







## Binary to Grey Code – K map

- Looking at grey-code (G3G2G1G0), we find that any two subsequent numbers differ in only one bit-change.
- B3 B2 B1 B0 - inputs
- G3 G2 G1 G0 - outputs

K-map for  $G_0$

$B_1 B_0$	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

$$G_0 = B_1' B_0 + B_1 B_0'$$

$$G_0 = B_0 \oplus B_1$$

K-map for  $G_1$

$B_1 B_0$	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

$$G_1 = B_1' B_2 + B_1 B_2'$$

$$G_1 = B_1 \oplus B_2$$

K-map for  $G_2$

$B_1 B_0$	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

$$G_2 = B_3' B_2 + B_3 B_2'$$

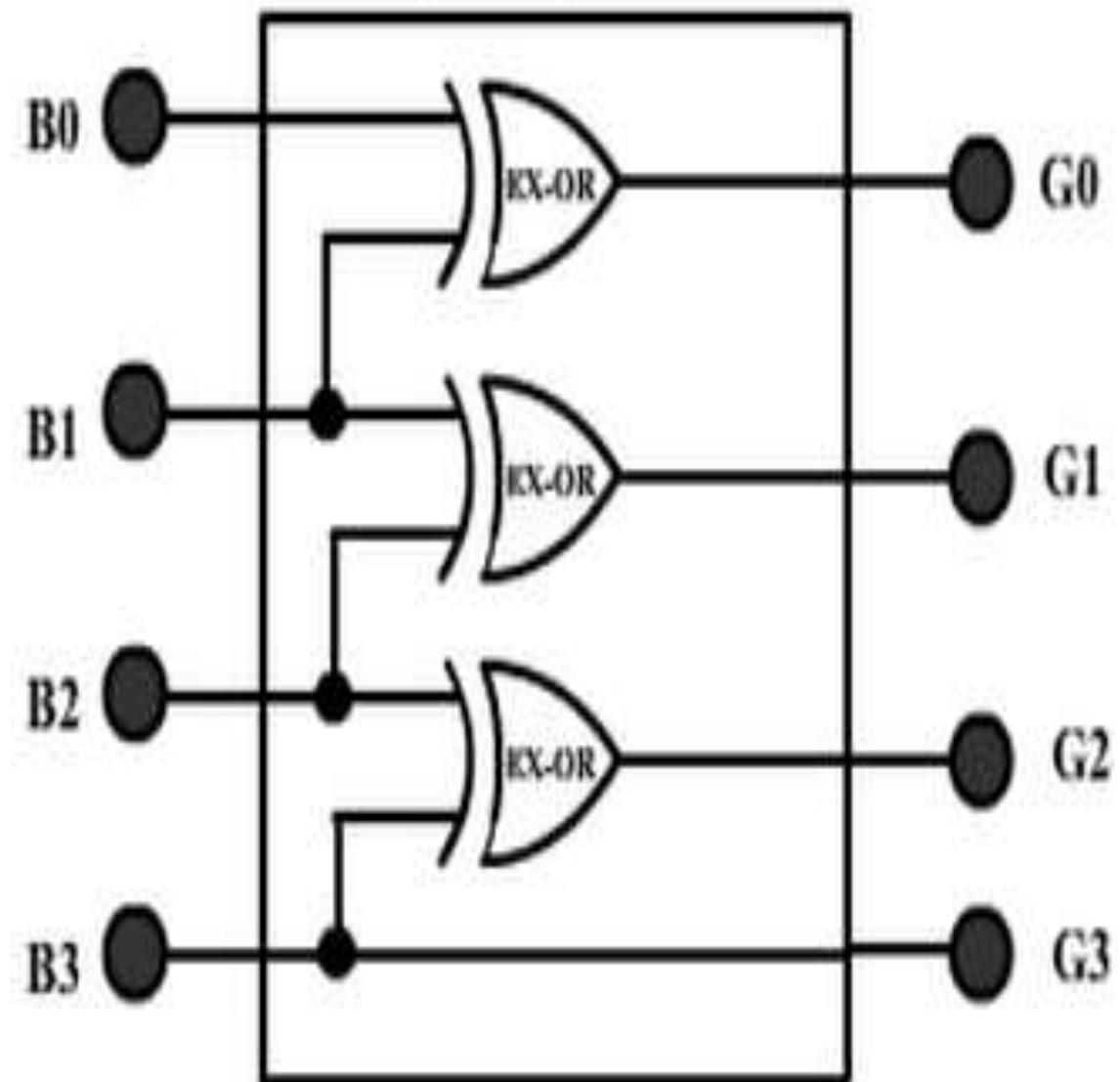
$$G_2 = B_2 \oplus B_3$$



# Binary to Grey Code – Truth Table



Binary to Gray Converter



Natural-binary code				Gray code			
B3	B2	B1	B0	G3	G2	G1	G0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0



# ACTIVITY





# Gray to Binary Code



- Once the converted code (now in Gray form) is processed, we want the processed data back in binary representation.
- Since we need a converter that would perform reverse operation to that of earlier converter called as Gray-to-Binary converter



# Gray to Binary Code – K map



K-map for  $B_0$

$G_3 G_2$	$G_1 G_0$	00	01	11	10
00	0	1	0	1	
01	1	0	1	0	
11	1	0	1	0	
10	0	1	0	1	

$$\begin{aligned}
 B_0 &= G_2 G_1' G_0' + G_2' G_1 G_0' + G_2' G_1' G_0 + G_2 G_1 G_0 \\
 &= G_0' (G_1' G_2 + G_1 G_2') + G_0 (G_1 G_2 + G_1' G_2') \\
 &= G_0' (G \oplus G_2) + G_0 (G_1 \oplus G_2)' = G_0 \oplus G_1 \oplus G_2
 \end{aligned}$$

K-map for  $B_1$

$G_3 G_2$	$G_1 G_0$	00	01	11	10
00	0	0	1	1	
01	1	1	0	0	
11	0	0	1	1	
10	1	1	0	0	

$$\begin{aligned}
 B_1 &= G_3' G_2' G_1 + G_3' G_2 G_1' + G_3 G_2 G_1 + G_3 G_2' G_1' \\
 &= G_3' (G_2 \oplus G_1) + G_3 (G_2 \oplus G_1)' \\
 &= G_1 \oplus G_2 \oplus G_3
 \end{aligned}$$

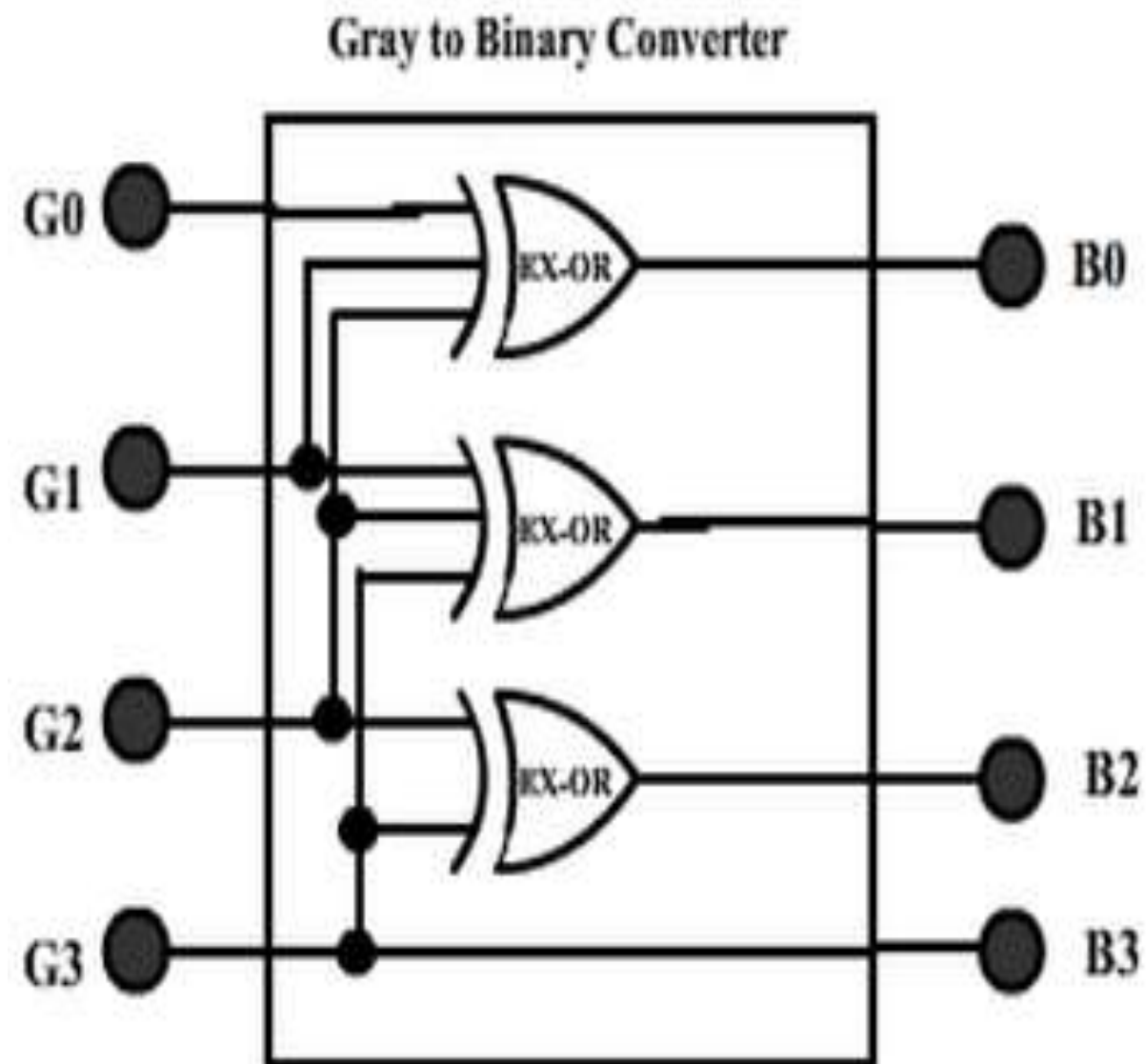
K-map for  $B_2$

$G_3 G_2$	$G_1 G_0$	00	01	11	10
00	0	0	0	0	
01	1	1	1	1	
11	0	0	0	0	
10	1	1	1	1	

$$\begin{aligned}
 B_2 &= G_3' G_2 + G_3 G_2' \\
 &= G_3 \oplus G_2
 \end{aligned}$$



# Gray to Binary Code



Gray code				Natural-binary code			
G3	G2	G1	G0	B3	B2	B1	B0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	1
1	0	0	0	1	1	1	1
1	0	0	1	1	1	1	0
1	0	1	0	1	1	0	0
1	0	1	1	1	1	0	1
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	1
1	1	1	0	1	0	1	1
1	1	1	1	1	0	1	0



# ASSESMNETS



- 1). Binary coded decimal is a combination of \_\_\_\_\_ (OUFR YARBNI SDGIITS)
- 2). When numbers, letters or words are represented by a special group of symbols, the process is called as \_\_\_\_\_(NGEIDNOC)
- 3).  $A(A+B) = ?$
- 4). The logical sum of two or more logical product terms is called \_\_\_\_\_(PSO)
- 5). An input that is known never to occur is called \_\_\_\_\_ (AREC NODT PTUNI)



**THANK YOU**