



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

19ECB231 – DIGITAL ELECTRONICS

II YEAR/ III SEMESTER

UNIT 2 – COMBINATIONAL CIRCUITS

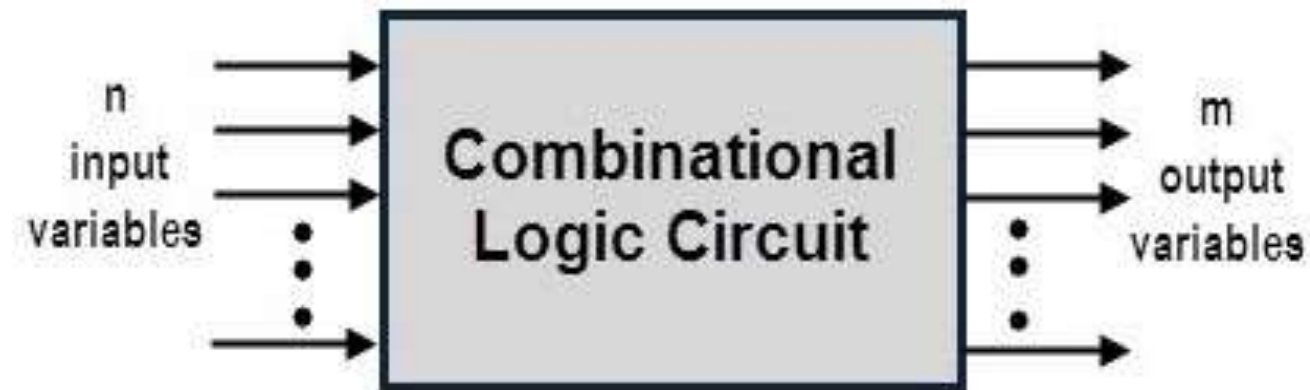
TOPIC 2 - HALF ADDER ,FULL ADDER,HALF SUBTRACTOR AND FULL SUBTRACTOR



WHAT IS COMBINATIONAL CIRCUIT?



- Output is function of input only
i.e. no feedback



Combinational Logic Circuits are memoryless digital logic circuits whose output at any instant in time depends only on the combination of its inputs.



HALF ADDER



Half Adder

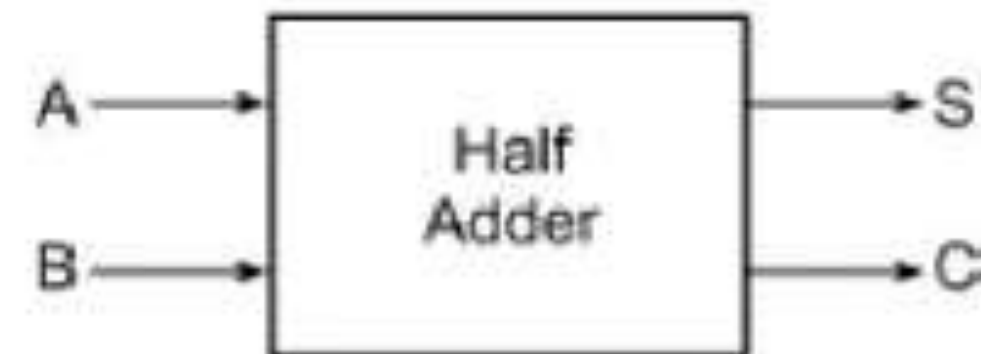
Adds **1-bit** plus **1-bit**

Produces **Sum** and **Carry**

$$\text{SUM } S = A.\bar{B} + \bar{A}.B$$

$$\text{CARRY } C = A.B$$

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1





HALF ADDER



For Carry

A \ B	0	1
0	0	0
1	0	1

$$\text{Carry} = AB$$

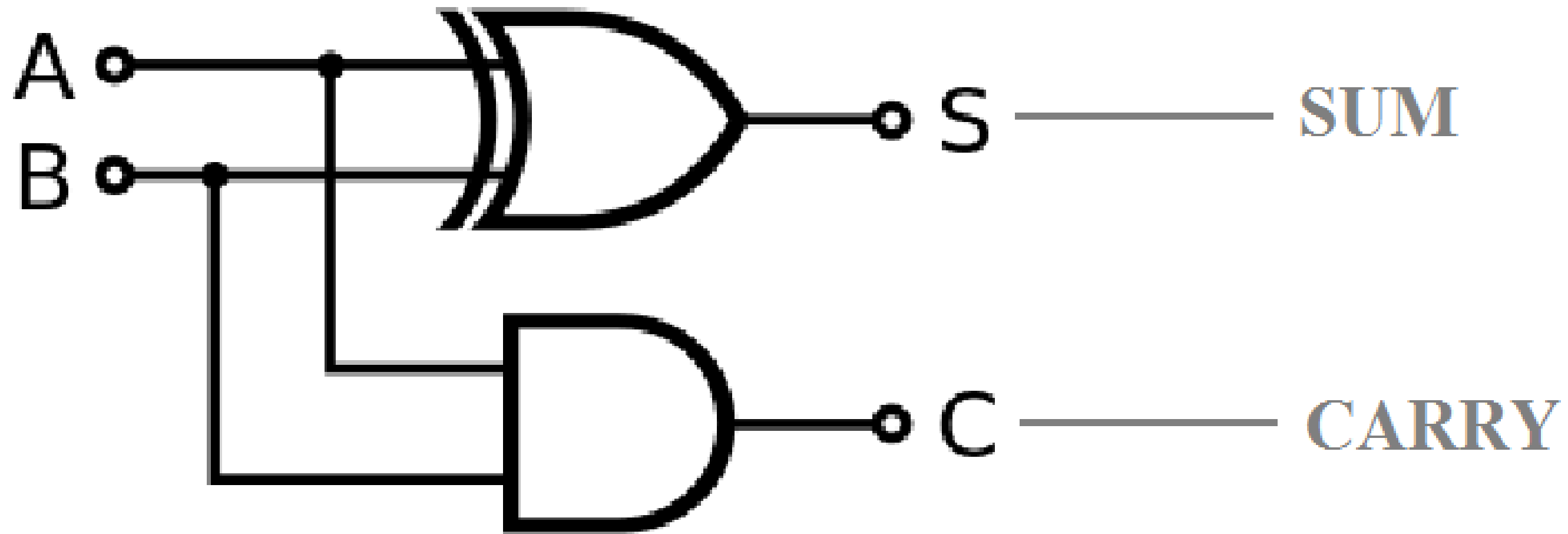
For Sum

A \ B	0	1
0	0	1
1	1	0

$$\begin{aligned}\text{Sum} &= A\bar{B} + \bar{A}B \\ &= A \oplus B\end{aligned}$$

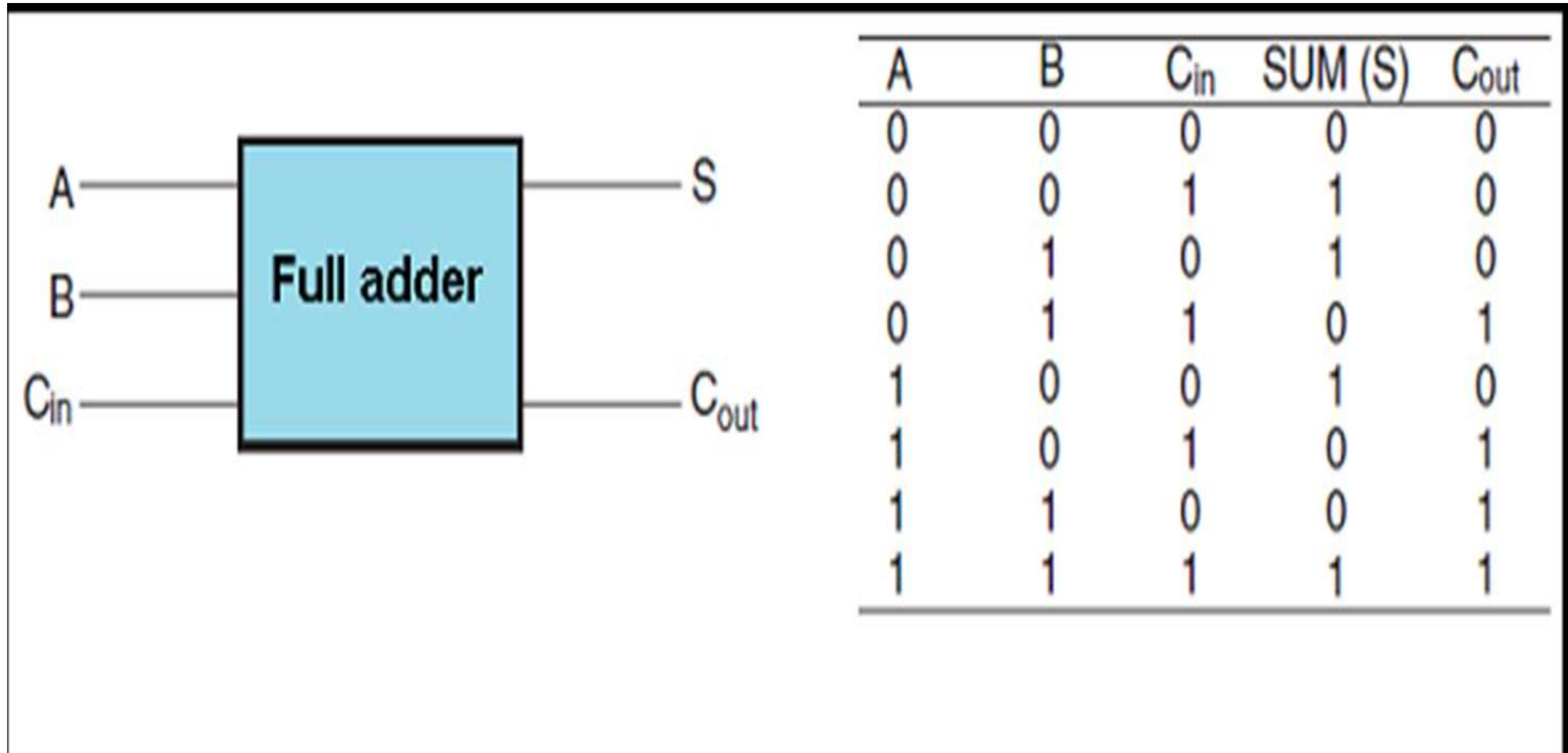


HALF ADDER





FULL ADDER





FULL ADDER

For Carry (C_{out})

$A \backslash BC_{in}$	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$$C_{out} = AB + AC_{in} + BC_{in}$$

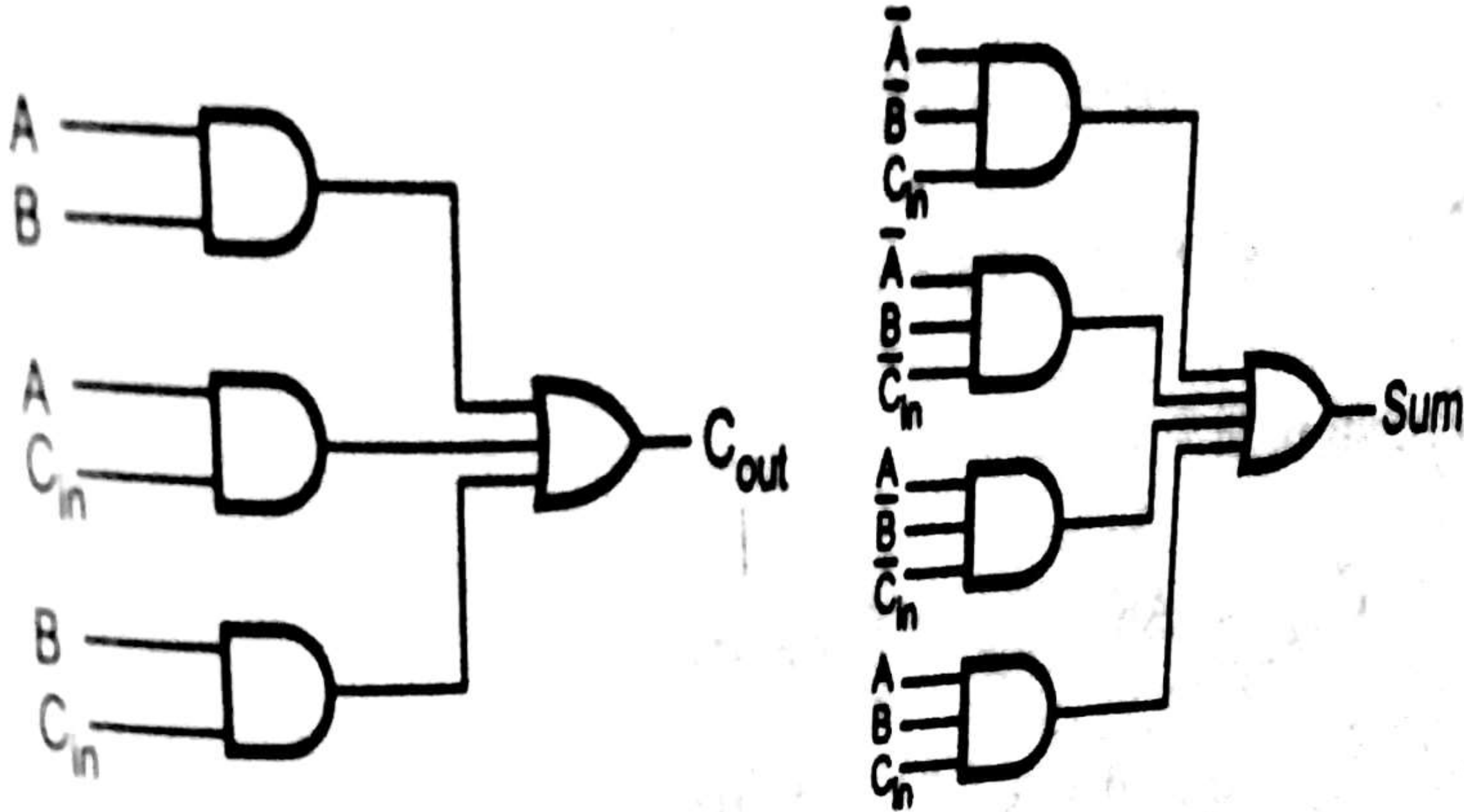
For Sum

$A \backslash BC_{in}$	00	01	11	10
0	0	1	0	1
1	1	0	1	0

$$Sum = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}$$



LOGICAL DIAGRAM





FULL ADDER

$$\text{Sum} = \bar{A} \bar{B} C_{in} + \bar{A} B \bar{C}_{in} + A \bar{B} \bar{C}_{in} + ABC_{in}$$

$$= C_{in} (\bar{A} \bar{B} + AB) + \bar{C}_{in} (\bar{A} B + A \bar{B})$$

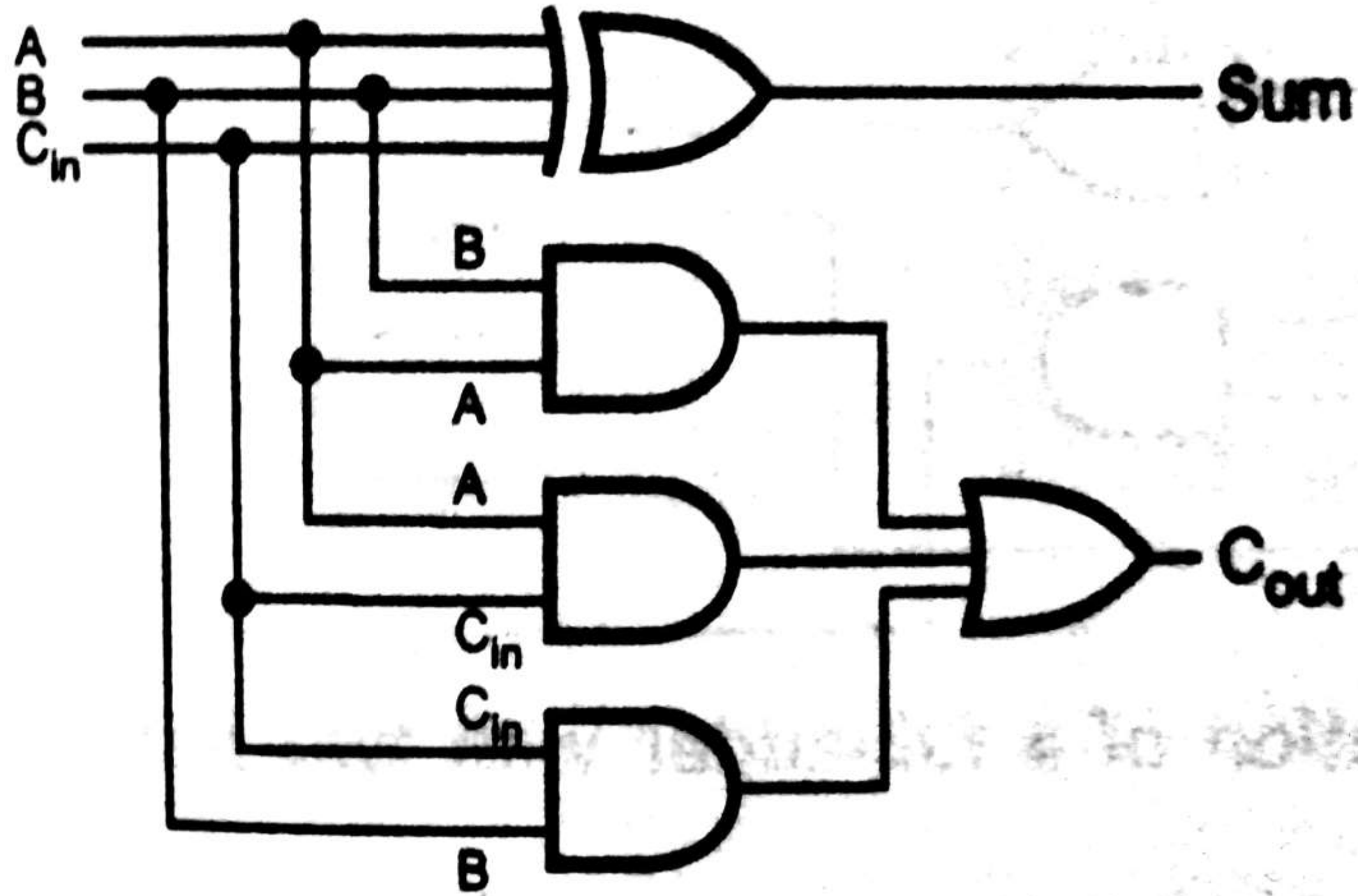
$$= C_{in} (A \cdot B) + \bar{C}_{in} (A \oplus B)$$

$$= C_{in} (\overline{A \oplus B}) + \bar{C}_{in} (A \oplus B)$$

$$= C_{in} \oplus (A \oplus B)$$

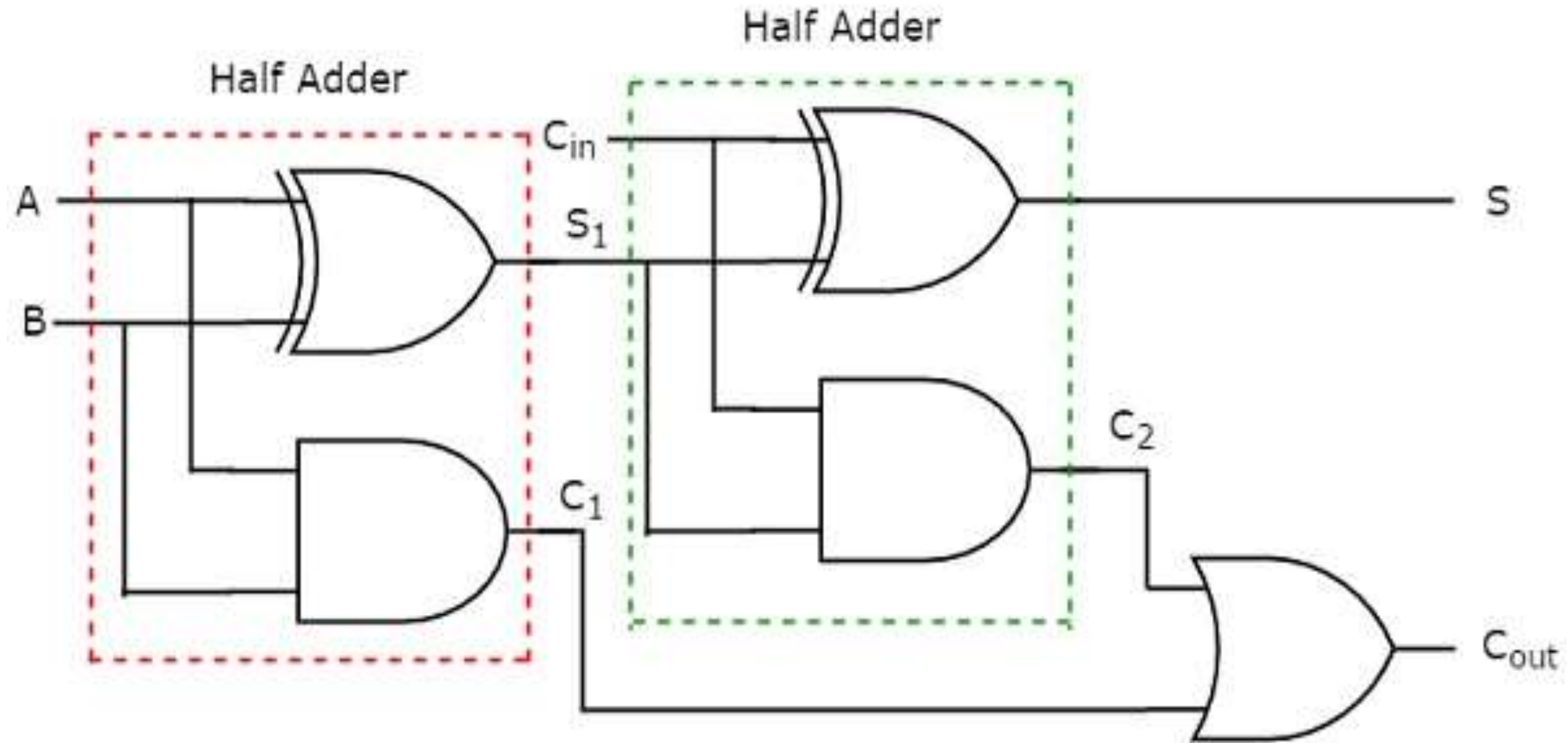


LOGICAL DIAGRAM





IMPLEMENTATION OF FULL ADDER USING TWO HALF ADDERS





HALF SUBTRACTOR

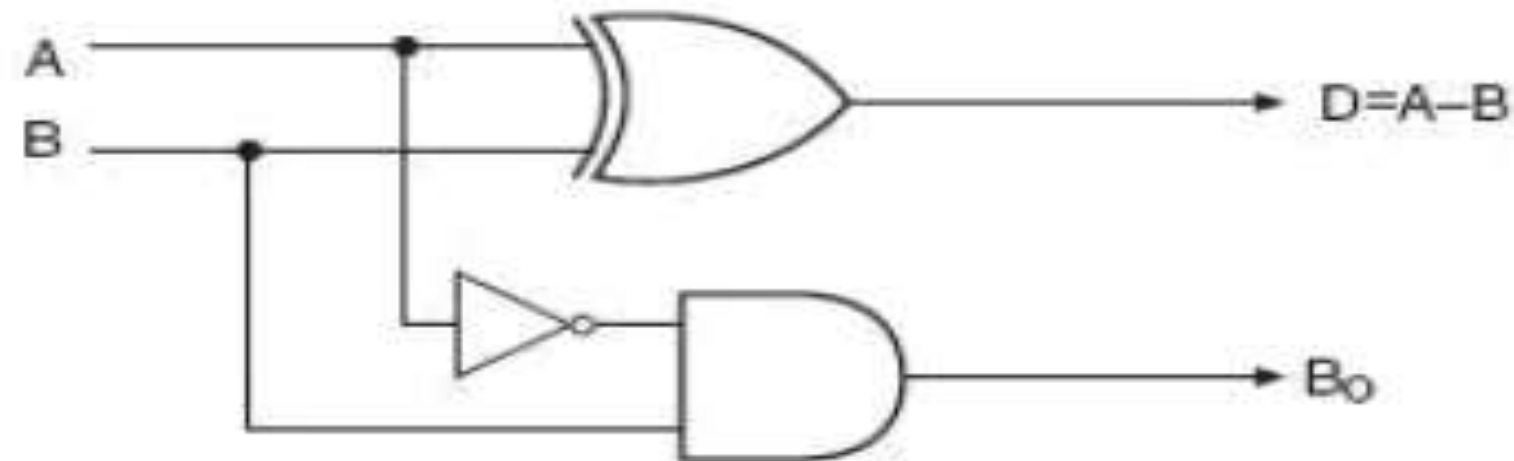
$$D = \bar{A}.B + A.\bar{B}$$

$$B_o = \bar{A}.B$$



A	B	D	B _o
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

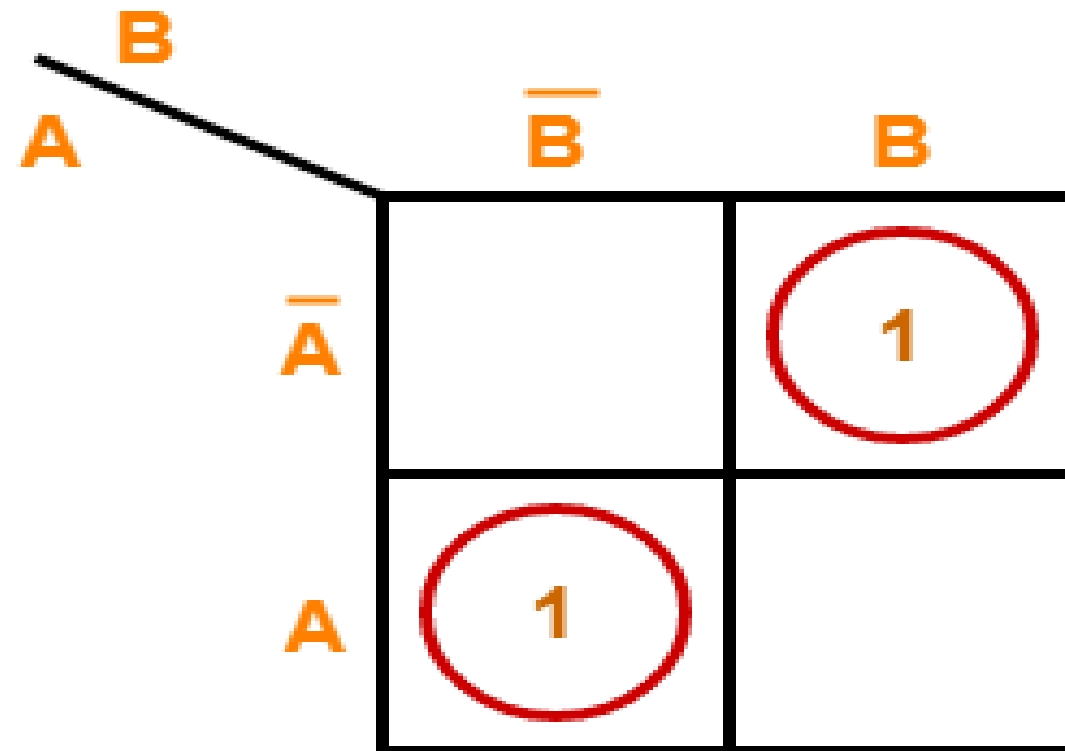
Half Subtractor





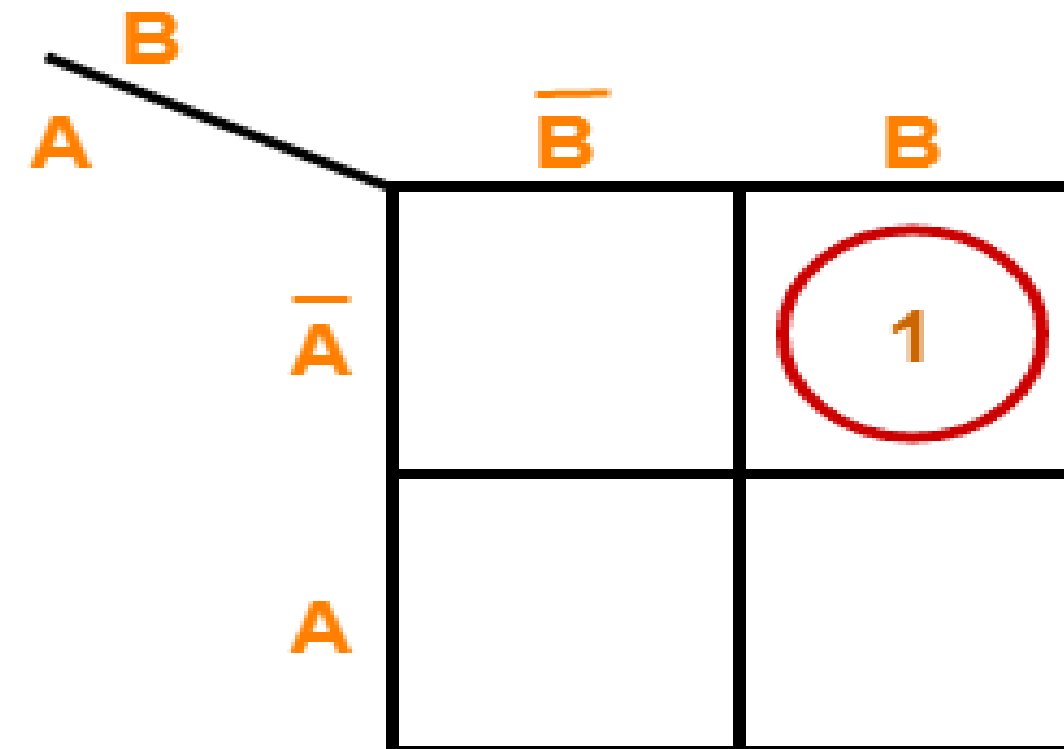
HALF SUBTRACTOR

For D:



$$D = A \oplus B$$

For b:

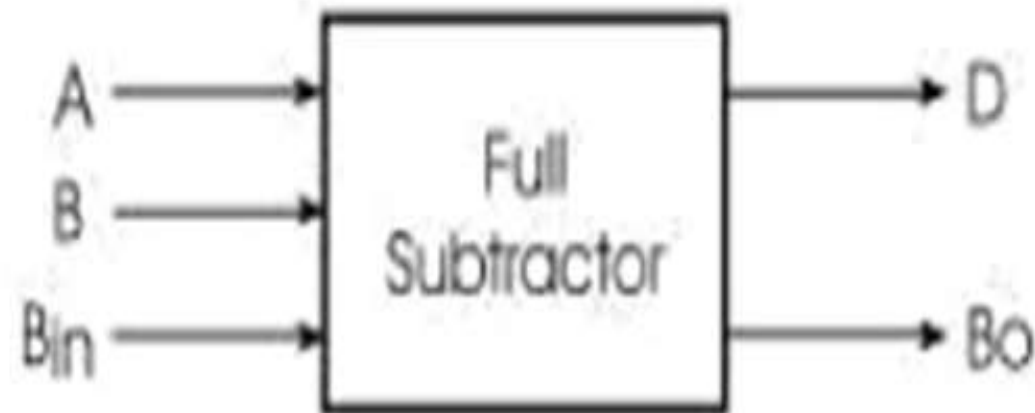


$$b = \bar{A} \cdot B$$

K Maps



FULL SUBTRACTOR



Minuend (A)	Subtrahend (B)	Borrow In (B_{in})	Difference (D)	Borrow Out (B_o)
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1



FULL SUBTRACTOR



For Difference :-

A \ B	$B B_{in}$ 00	$\bar{B} B_{in}$ 01	$B \bar{B}_{in}$ 11	$\bar{B} \bar{B}_{in}$ 10
\bar{A} 0		1		1
A 1	1		1	

$$\therefore \text{Difference} = A \oplus B \oplus B_{in}$$

$$\begin{aligned} \therefore \text{Difference} &= \bar{A} \bar{B} B_{in} + \bar{A} B \bar{B}_{in} + A \bar{B} \bar{B}_{in} + A B B_{in} \\ &= \bar{A} (\bar{B} B_{in} + B \bar{B}_{in}) + A (\bar{B} \bar{B}_{in} + B B_{in}) \\ &= \bar{A} (B \oplus B_{in}) + A (B \odot B_{in}) = \bar{A} (B \oplus B_{in}) + A (\overline{B \oplus B_{in}}) \\ &= A \oplus B \oplus B_{in} = A \oplus B \oplus B_{in}. \end{aligned}$$

For B_{out} :-

A \ B	$B B_{in}$ 00	$\bar{B} B_{in}$ 01	$B \bar{B}_{in}$ 11	$\bar{B} \bar{B}_{in}$ 10
\bar{A} 0		1	1	1
A 1			1	

$$\therefore B_{out} = \bar{A} B + \bar{A} B_{in} + B B_{in}$$

$$\therefore B_{out} = \bar{A} B + \bar{A} B_{in} + B B_{in}$$



FULL SUBTRACTOR

For D:

	BB_{in}	$\bar{B}\bar{B}_{in}$	$\bar{B}B_{in}$	BB_{in}	$B\bar{B}_{in}$
\bar{A}		1			1
A	1		1		

$$D = A \oplus B \oplus B_{in}$$

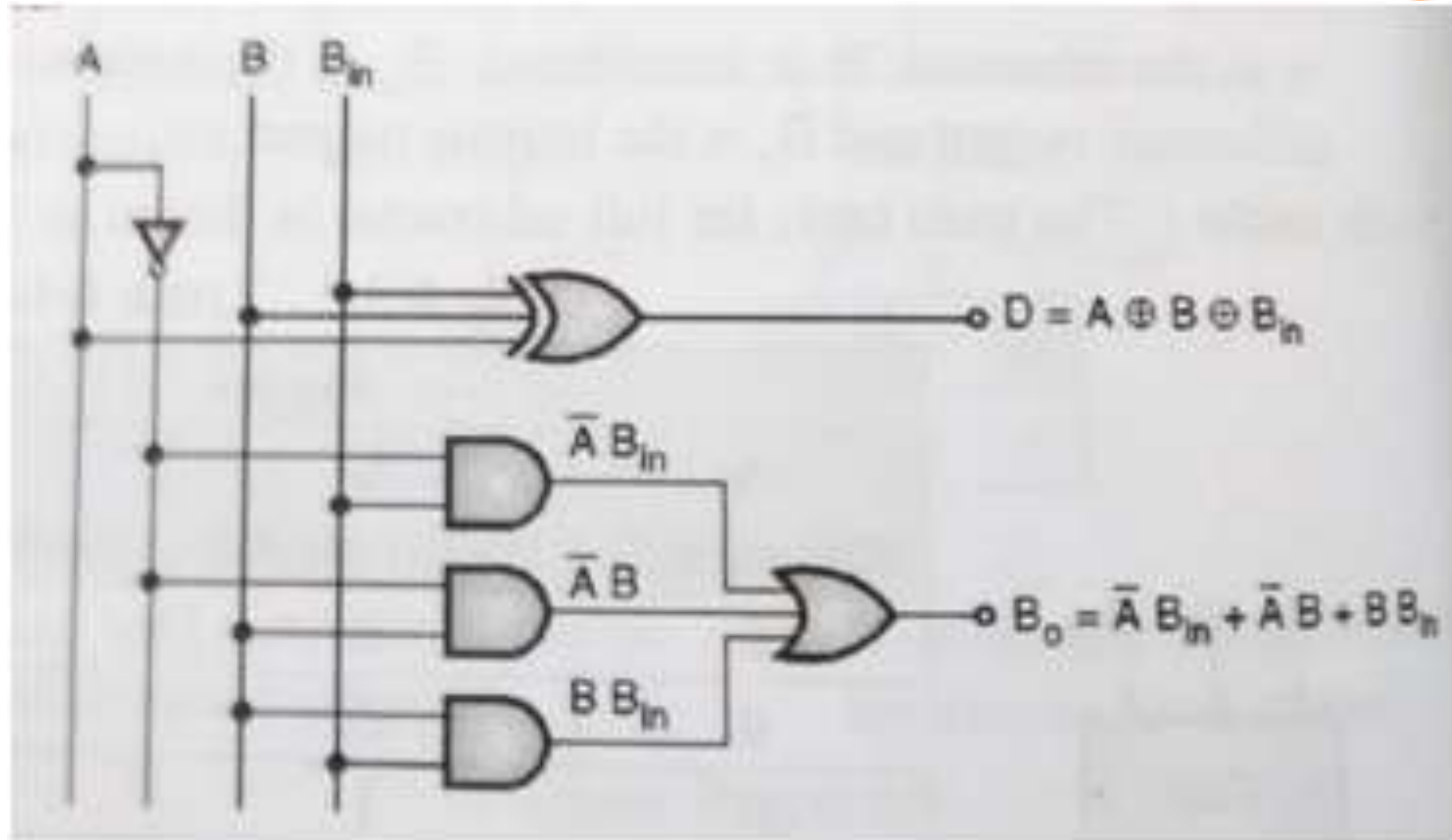
For B_{out} :

	BB_{in}	$\bar{B}\bar{B}_{in}$	$\bar{B}B_{in}$	BB_{in}	$B\bar{B}_{in}$
\bar{A}			1	1	1
A				1	

$$B_{out} = \bar{A}B + (\bar{A} + B)B_{in}$$

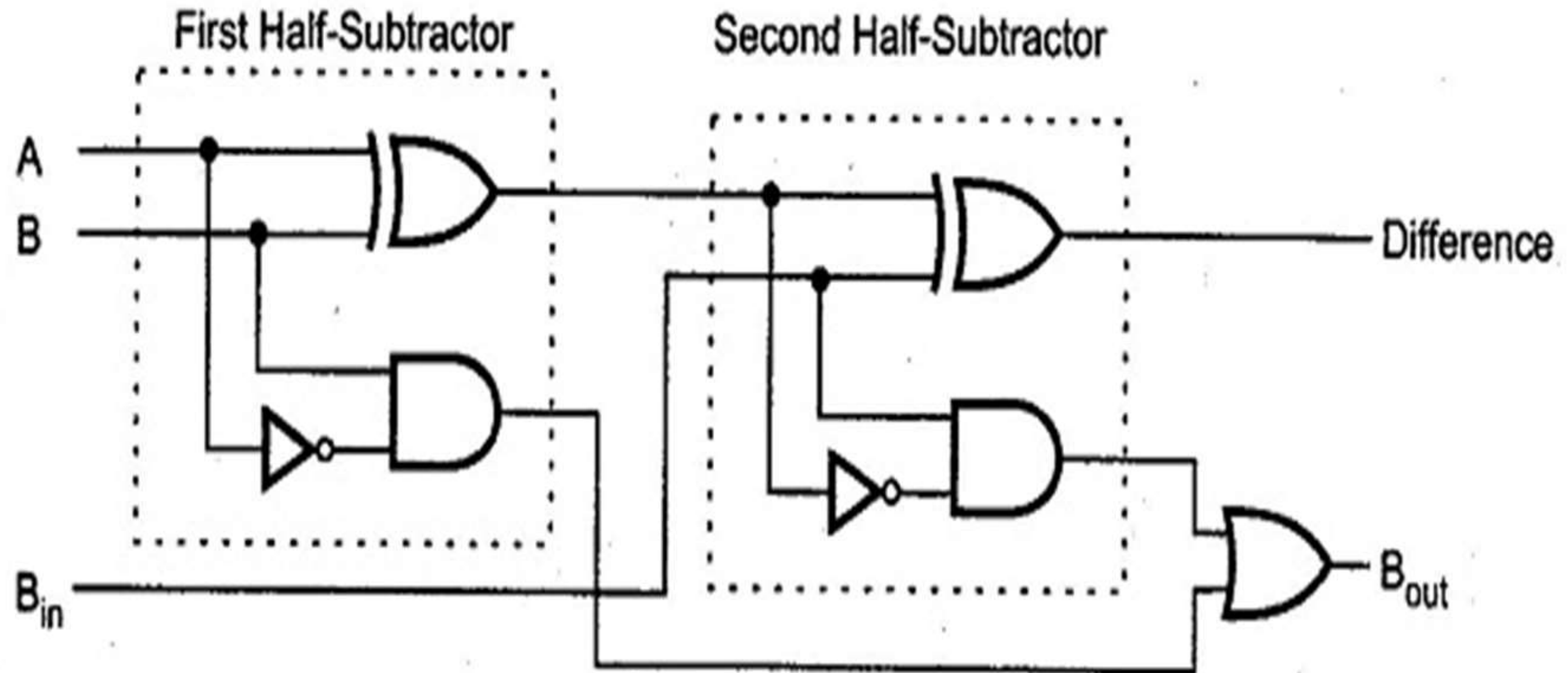


FULL SUBTRACTOR



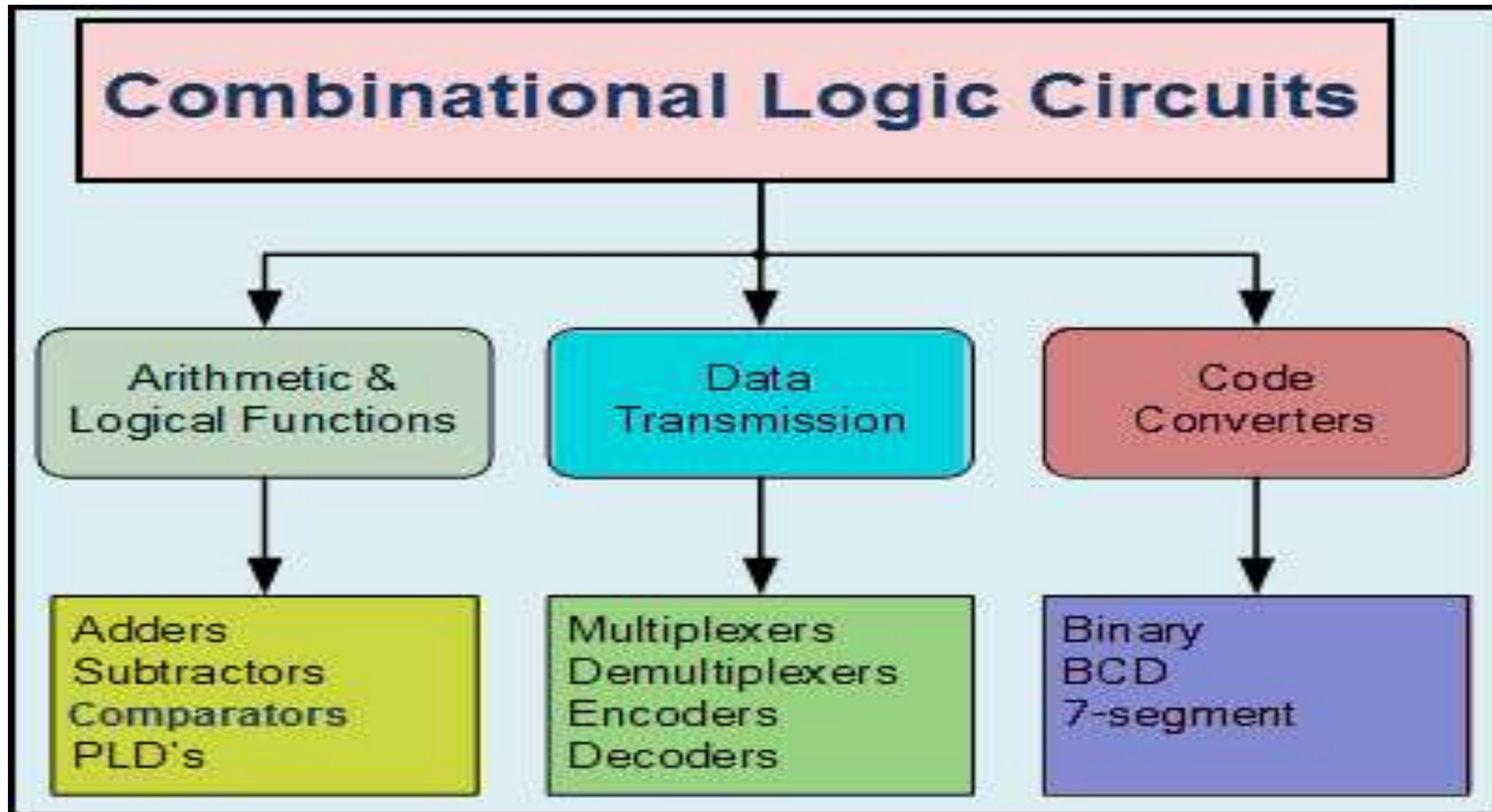


IMPLEMENTATION OF FULL SUBTRACTOR USING TWO HALF SUBTRACTORS





APPLICATIONS OF COMBINATIONAL CIRCUITS





ASSESSMENTS



1. Draw the block diagram of Half adder and Half subtractor.
2. Draw the logical diagram of Full adder.
3. What is Full subtractor?



THANK YOU