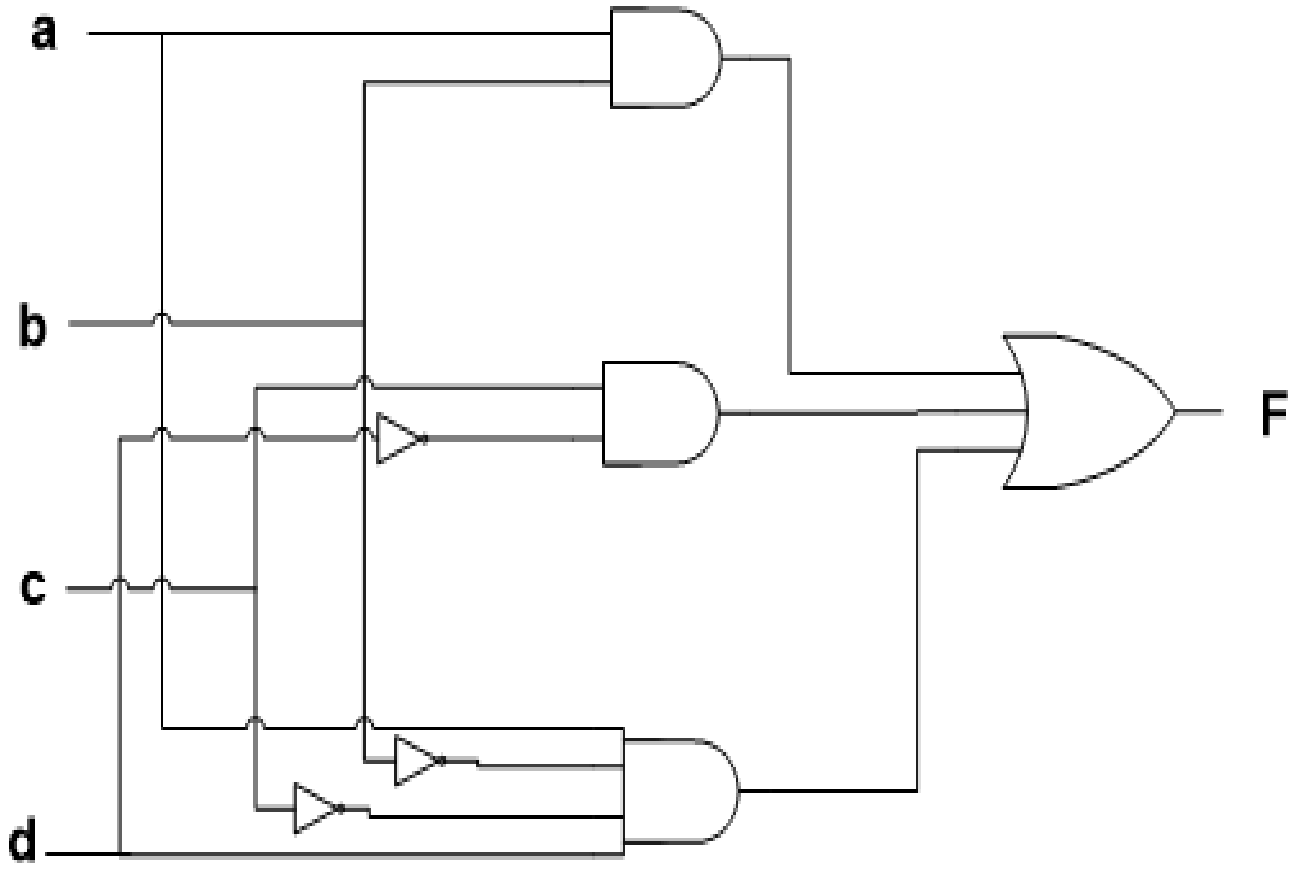
COE 272
Digital Systems

Lecture 4: Logic Implementation using resistors, Diodes and Transistors

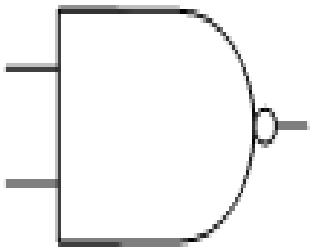
EXAMPLE OF CIRCUIT WITH AND ,OR and NOT GATES

$$F(a,b,c,d) = ab + cd' + ab'c'd$$

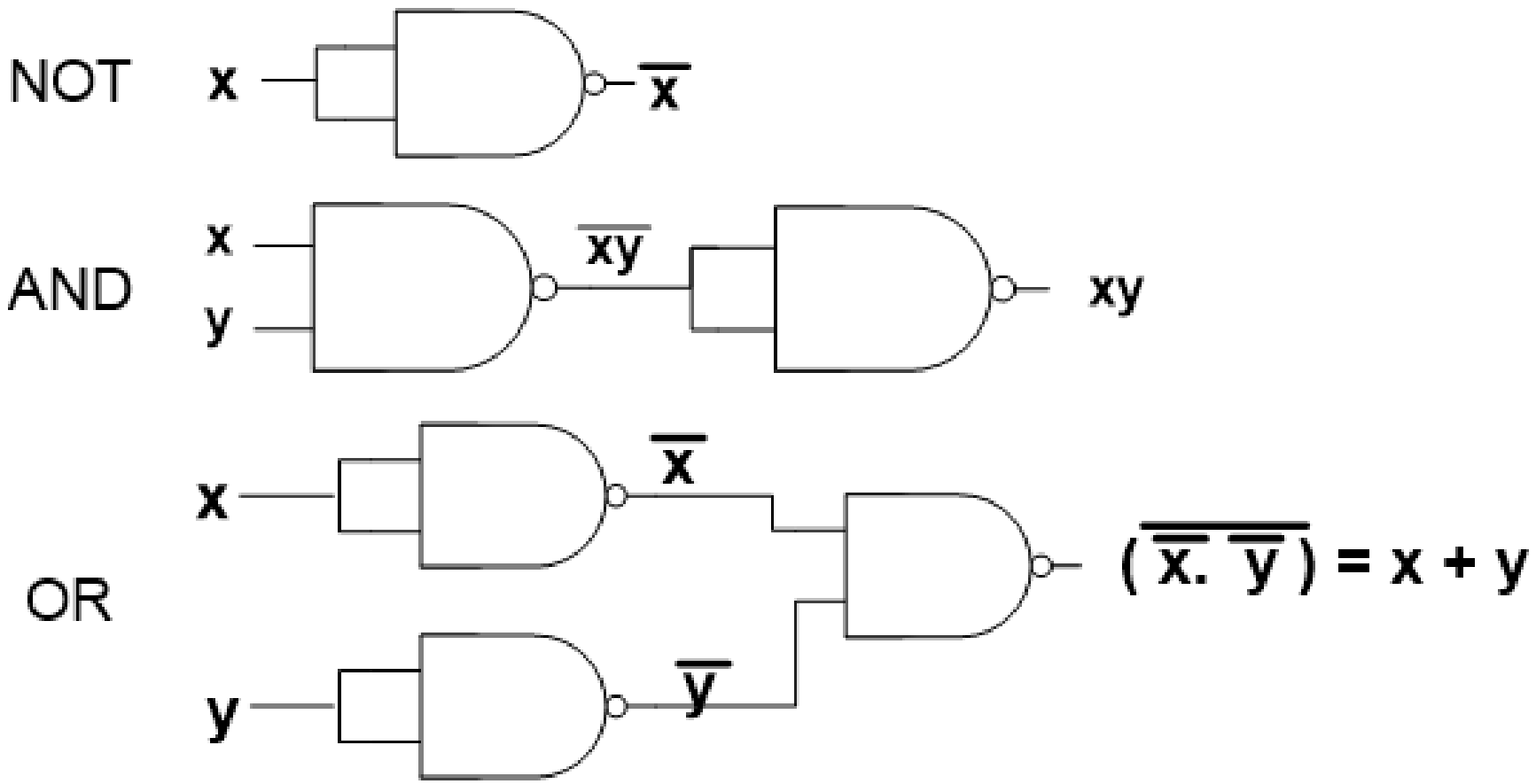


OTHER DERIVED GATES

- NAND (NOT AND)

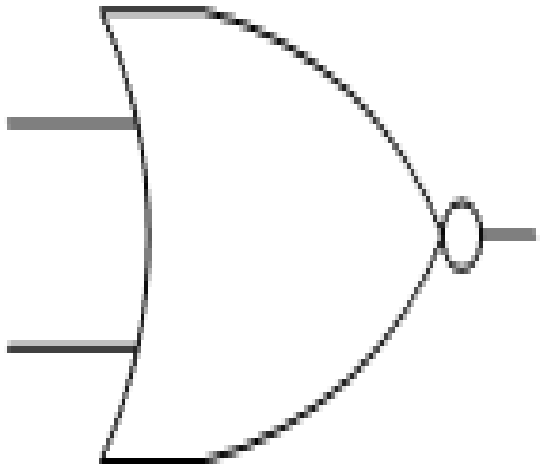
Operation	Gate Symbol	Algebraic Equation	Truth Table
NAND		$F = \overline{XY}$	

X	Y	F
0	0	1
0	1	1
1	0	1
1	1	0


NOT
x
$\overline{x}$
AND
x
y
$\overline{xy}$
xy
OR
x
$\overline{x}$
y
$\overline{y}$
$(\overline{\overline{x}.\ \overline{y}}) = x + y$

NOR OPERATION (NOT OR)

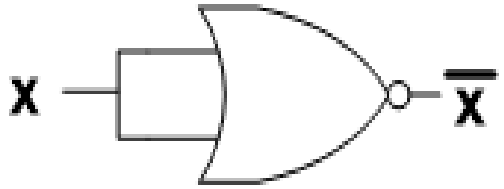
NOR



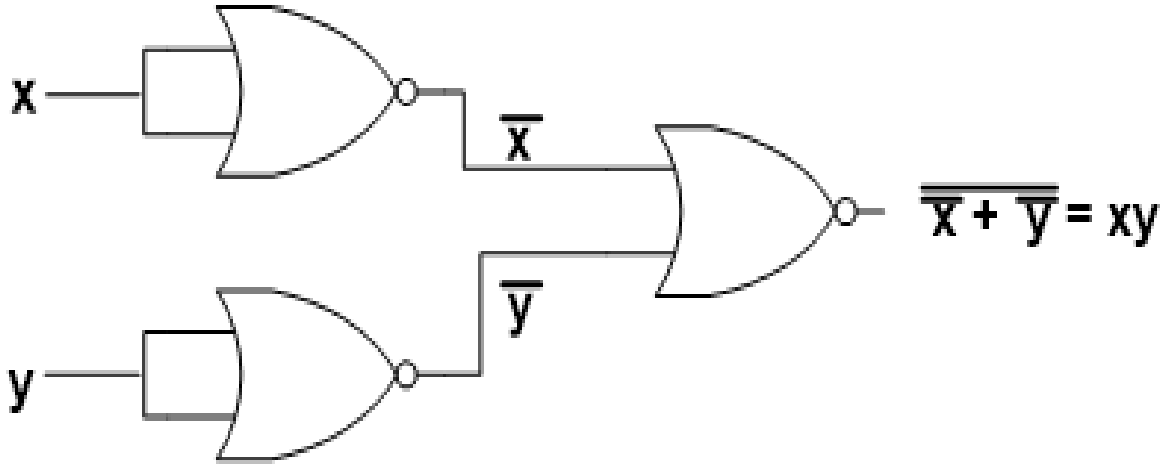
$$F = \overline{X + Y}$$

X	Y	F
0	0	1
0	1	0
1	0	0
1	1	0

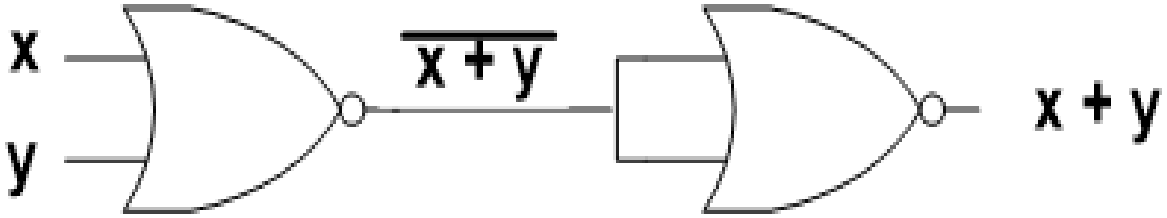
NOT


x
$\overline{x}$

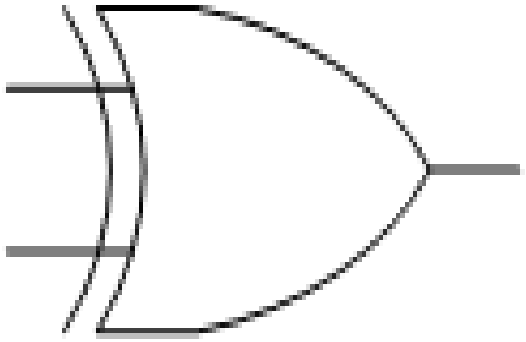
AND


x
$\overline{x}$
y
$\overline{y}$
$\overline{\overline{x} + \overline{y}} = xy$

OR


x
y
$\overline{x + y}$
x + y

EXCLUSIVE OR (XOR) OPERATION

Operation	Gate Symbol	Algebraic Equation	Truth Table
XOR		$F = X \oplus Y$	

X	Y	F
0	0	0
0	1	1
1	0	1
1	1	0

$$x \oplus y = x\bar{y} + \bar{x}y$$

XOR OPERATION

$$x \oplus 0 = x$$

$$x \oplus 1 = \bar{x}$$

$$x \oplus x = 0$$

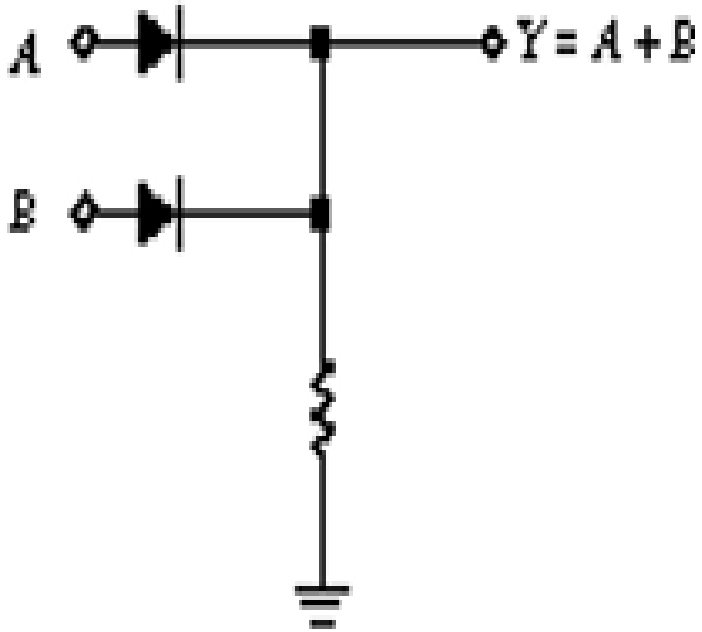
$$x \oplus \bar{x} = 1$$

$$x \oplus \bar{y} = \overline{x \oplus y}$$

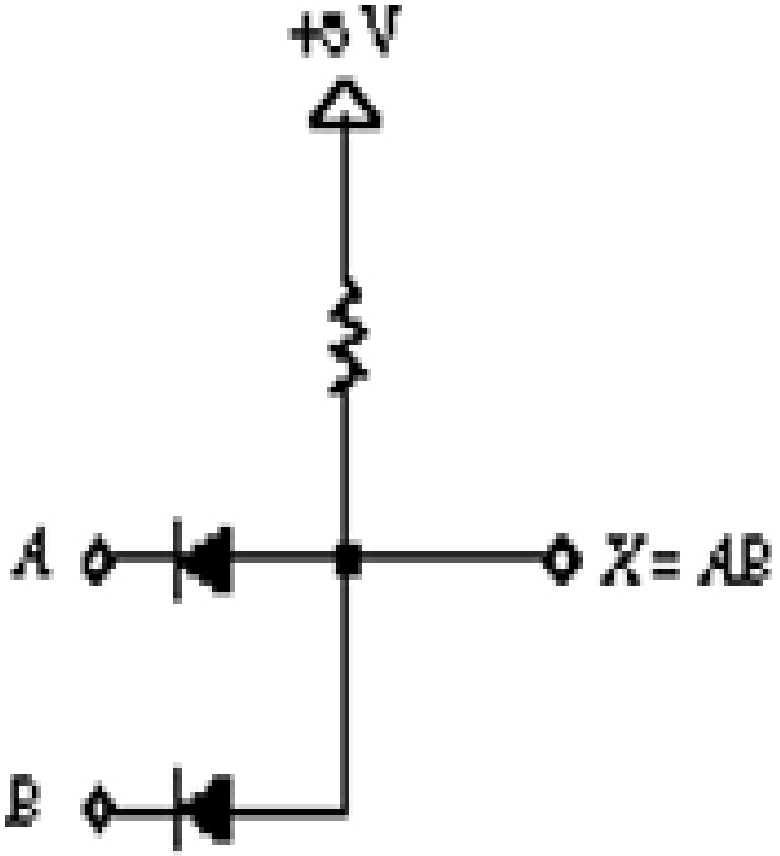
$$\bar{x} \oplus y = \overline{x \oplus y}$$

DIODE LOGIC

- We can construct simple gates with the use of diodes and resistors.
- Below is an OR gate constructed with the use of diodes and resistors.

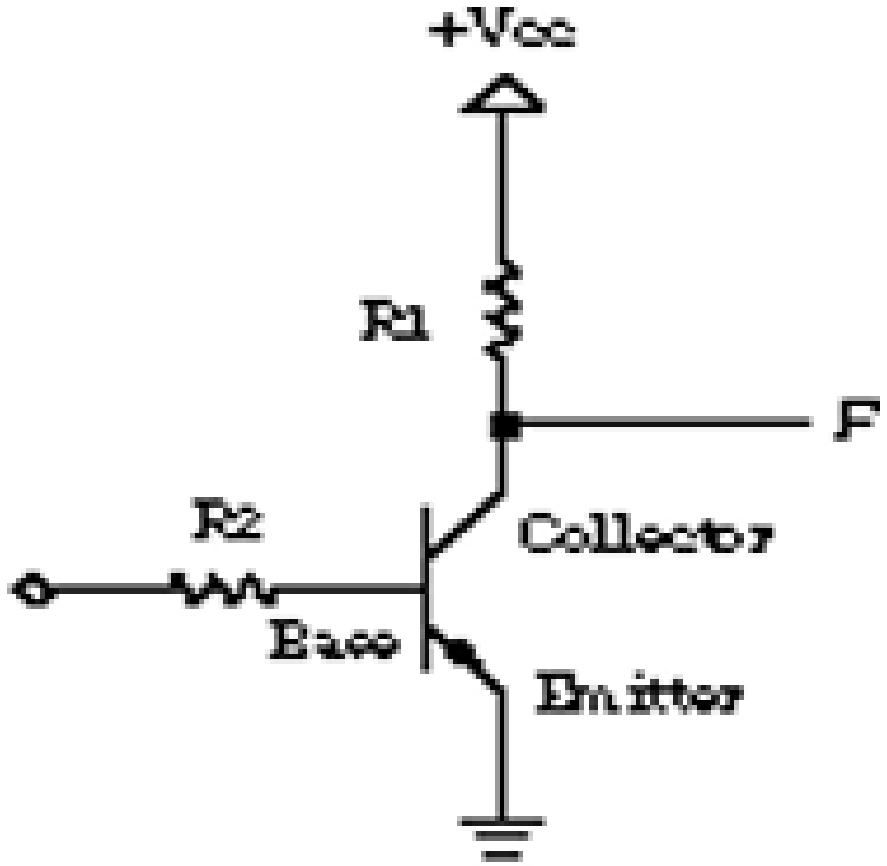


AND gate



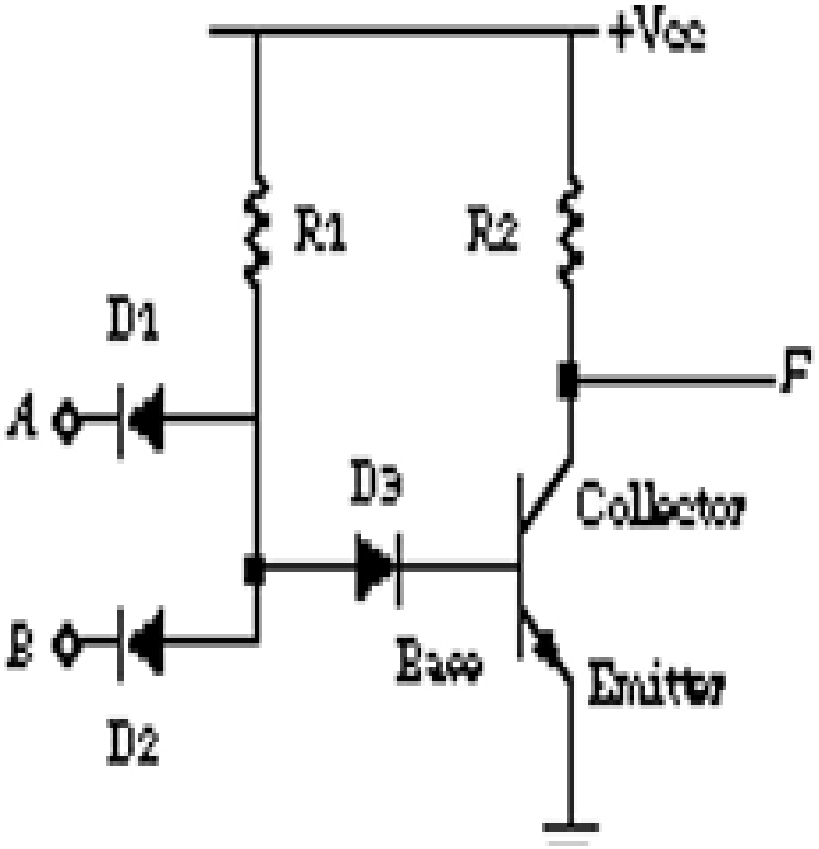
BIPOLAR TRANSISTOR LOGIC (BJT)

- BASIC INVERTER



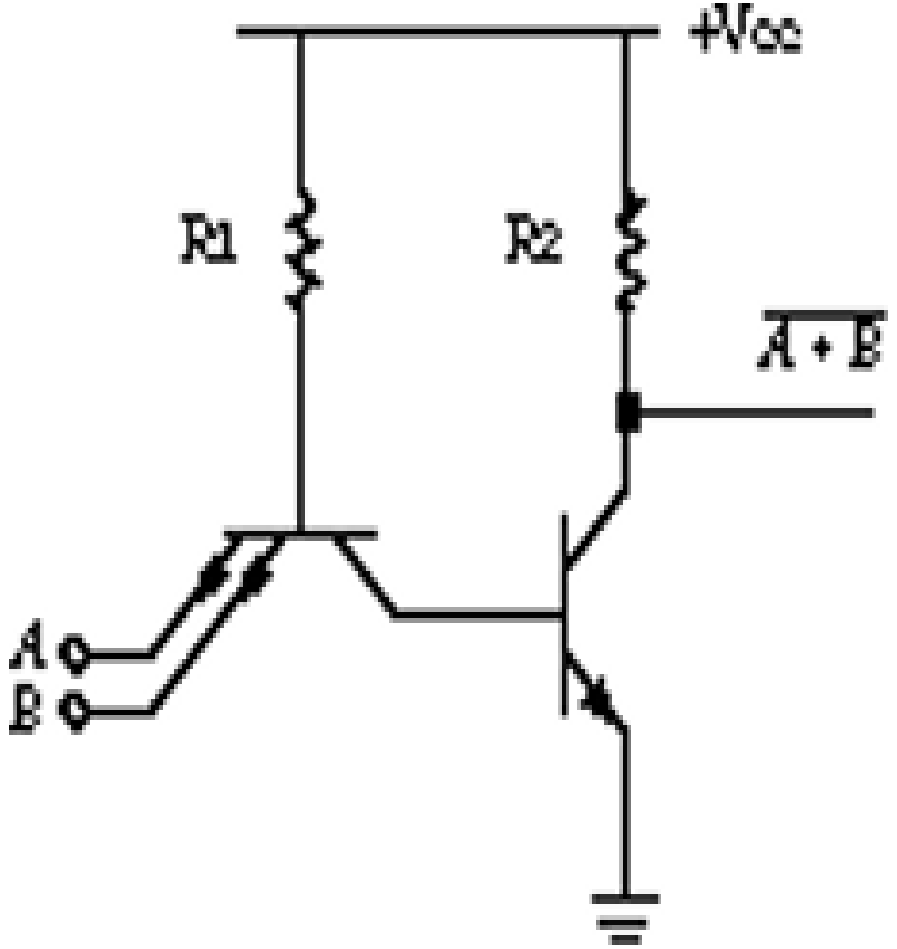
DIODE TRANSISTOR LOGIC (DTL)

- A 2 input DTL NAND gate

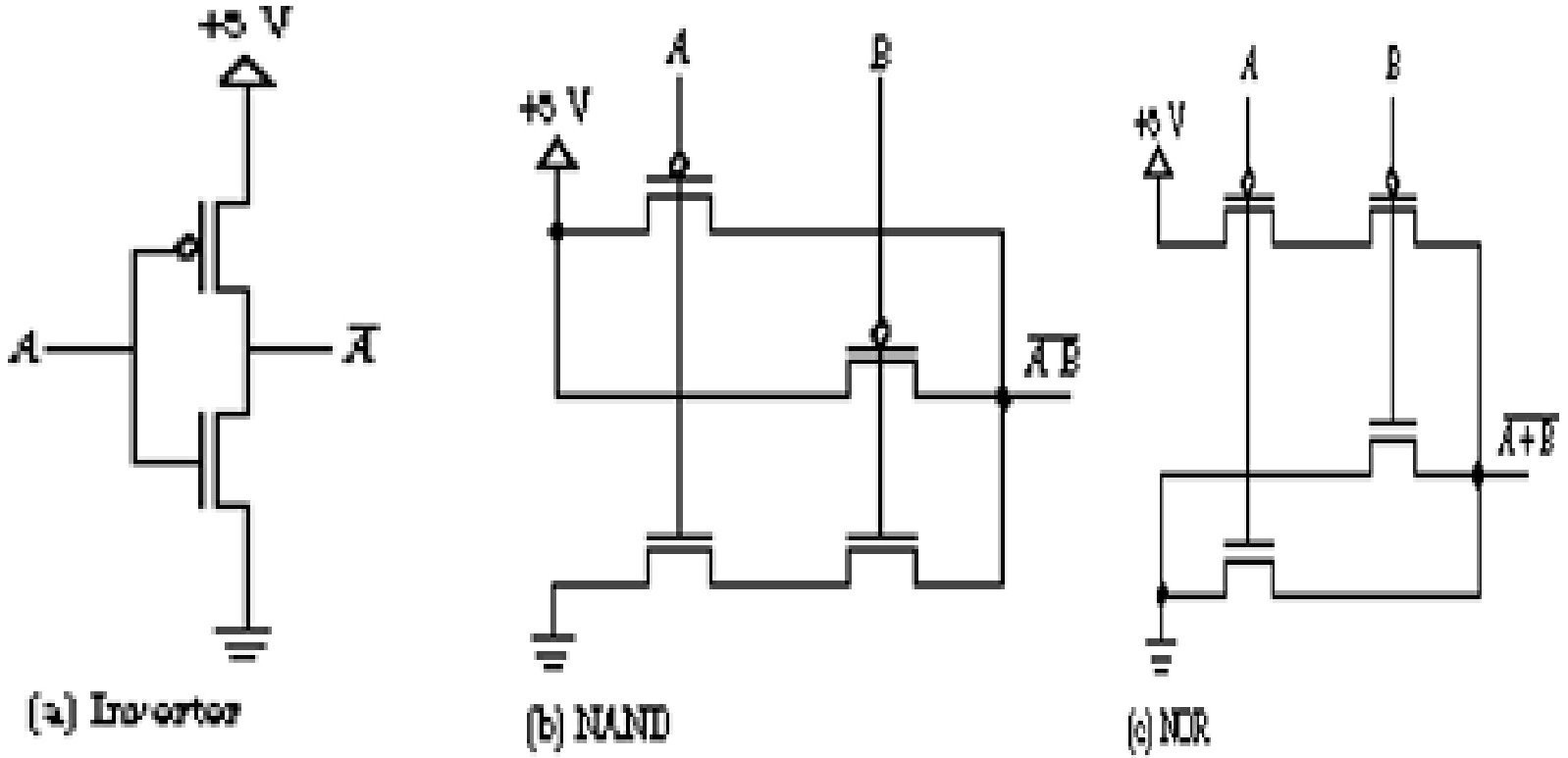


TRANSISTOR – TRANSISTOR LOGIC (TTL)

- A 2 INPUT TTL NAND GATE



LOGIC GATES FROM MOS DEVICES



THE BUFFER GATE

- This is helpful in boosting weak signals to enable them drive a resistance load if required.